The Philosophy of Biology

An Episodic History

Is life different from the non-living? If so, how? And how, in that case, does biology, as the study of living things, differ from other sciences? These questions lie at the heart of *The Philosophy of Biology*, and are traced through an exploration of episodes in the history of biology and philosophy. The book begins with Aristotle, then moves on to Descartes, comparing his position with that of Harvey. From the eighteenth century, the authors consider Buffon and Kant. From the nineteenth century, the authors examine the Cuvier–Geoffroy debate, pre-Darwinian geology and natural theology, Darwin, and the transition from Darwin to the revival of Mendelism. Two chapters on the twentieth century deal with the Modern Evolutionary Synthesis and such questions as the species problem, the reducibility or otherwise of biology to physics and chemistry, and the problem of biological explanation in terms of function and teleology. The final chapters reflect on the question of human nature and the implications of the philosophy of biology for the philosophy of science in general.

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An Episodic History

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Notes on Citations and References

- For most authors of a single work or a small body of work, we have used the standard citation form in the text and in the references: for example – Adams 1980.

- For certain authors of a substantial, well-edited body of work, we have used a standard reference system or abbreviations, as noted here, to cite the editions in which these authors' writings can be found.

Aristotle
References to the Greek text of the various treatises of Aristotle – *History of Animals, On the Soul, Politics*, and so on – are to the page numbers of I. Bekker's text. Most of these now standard texts can be found in editions published by Oxford University Press. Unless otherwise specified, English translations of Aristotle's works are from Barnes 1984.

Buffon
Buffon's works are referenced first to the original French publication date and place, and then, in most cases, to page numbers in Buffon's *Oeuvres philosophiques* (edited by Jean Piveteau, 1954), which we have abbreviated as OP. English translations are our own, except those taken, as noted, from Lyon and Sloan 1981.

Darwin
Darwin's works are generally cited in their first editions. The first edition of the *Origin of Species* is abbreviated *Origin*. Publications of Darwin's notebooks, letters, marginalia, and so on will be found under

Darwin, not under the names of their editors. Unpublished manuscripts found in the Darwin Research Archive at Cambridge are abbreviated as DAR.

Descartes
The abbreviation AT refers to the French text of Descartes's *Oeuvres* edited by C. Adams and P. Tannery. CSMK refers to English translations found in *The Philosophical Writings of Descartes*, edited by J. Cottingham et al.

Kant
The abbreviation Ak refers to the so-called Akademie edition of Kant's works published by the Deutsche Akademie der Wissenschaften, 1908–1913. Kant's various works are cited in the text first by title and date, then by paragraph (where the original text is so divided), then by volume and page number in Ak).

Titles are cited in English in the text and in both English and German in the references – for example, Kant (1781), *Critique of Judgment (Kritik des Urteilskraft)*. Translations of the *Critique of Pure Reason* are by Norman Kemp Smith (Kant 1929) unless otherwise noted. Translations of the *Critique of Judgment* are by W. Pluhar (Kant 1987).

Acknowledgments

In this book, we deal with the relationships between philosophy and biology at various times and places in our tradition. As befits a contribution to a series on the evolution of modern philosophy, it is a history of the philosophy of biology rather than a philosophy of biology in the usual sense. Although we deal with recent and even contemporary issues in the last four chapters, our approach is primarily historical rather than "systematic." Philosophical issues are raised in close connection with actual biological discoveries and theorizing.

It will be clear from our text that we are much indebted to others who have worked in this area in a similar spirit, at once philosophical, historical, and biologically alert – particularly Jean Gayon, Jon Hodge, and Phillip Sloan – as well as to Richard Burian, who has read and criticized some of our chapters. Regrettably, the manuscript had been nearly completed before the untimely death of Stephen Jay Gould and the appearance of his last and massive work; we were able to take account only partially of his arguments on aspects of our subject.

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Preface

There would never be, Immanuel Kant assured his readers, a "Newton of a blade of grass." Living things, he believed, are examples of "natural purposes," entities organized so purposefully that we cannot explain them altogether through the blind causality we apply to inanimate nature. At the same time, Kant argues that if living beings are organized purposely, or on purpose, rather than just purposefully, we cannot know it. There seems to be something special about things that are alive that exempts them from Newtonian mastery.

Something like this, although not quite in Kantian terms, has been the view of many natural historians, physicians, and comparative anatomists, as well as philosophers, in our tradition. Others, notably Descartes and his followers, as well as more recent "reductionist" thinkers, have denied that any such difference exists.

Yet even among those who stress the uniqueness of life, a number have appeared, at least implicitly, to welcome the accolade of "Newton of a blade of grass," whether for themselves or others. Georges Cuvier seems to have been happy to assume that title, though it was animals, not plants, that he studied. But he would also have been willing to claim the crown for Master Aristotle. Some thought Cuvier's rival, Etienne Geoffroy Saint-Hilaire, more worthy of that honor. And of course many have since found that it was Charles Darwin who gave the study of life such a new and scientifically satisfying solution that he truly deserved the title "Newton of a blade of grass." Still, all of these claimants would at least have agreed with Kant that the subject matter of biology has something about it that is not quite the same as physics.

Is life different from the non-living? If so, how? And how, in that case, does biology, as the study of living things, differ from other sciences? Or does it after all? That is the basic cluster of questions we have focused

on in what follows. The result is a study of figures and of episodes in the history of biology, as well as of philosophy, that seem to us to illuminate these basic problems in one way or another. Thus, while we are dealing with *some* interactions between biology and philosophy, we are far from attempting a survey of such events. That would be both tedious and beyond our competence. For example, we touch only incidentally on the preformation/epigenesis debate; we come close to ignoring the coming of the cell theory; we overlook Pasteur and the question of spontaneous generation, as well as Claude Bernard and the analysis of experimental method. Indeed, our treatment of the nineteenth century focuses, as we admit, on Darwin and some of the events that precede and follow the development of his theory. Linnaeus appears, parenthetically, in our chapter on Buffon, and Lamarck receives equally short shrift in the context of the Paris Museum of Natural History in the early nineteenth century and the Cuvier–Geoffroy debate. Nor, it should be added, despite the appearance of Harvey, whom we treat as a physiologist rather than a physician, have we dealt even episodically with the very complex, and different, subject of the history of medicine. Yet our hope is that by this highly selective, if not idiosyncratic, procedure we can illuminate some facets of the prehistory of the philosophy of biology as it has recently developed.

We begin in antiquity, in particular with Aristotle, whose views we explore in Chapter I for at least three reasons. First, Descartes's would-be reform of the foundations of biology is intelligible only in the context of the Scholastic, at least remotely Aristotelian, tradition in which he was educated. Indeed, the Scholastic tradition itself reaches through to Cesalpino and into the beginnings of modern taxonomy. Second, Descartes's position is especially clear, as he himself stresses, in his arguments against Harvey's view of the motion of the heart, which we review. And Harvey, for his part, was a profoundly Aristotelian thinker, not in following the Scholastic model, but as an investigator with a deeply rooted interest in the functional particularities of living beings. Finally, in the nineteenth century, we find Cuvier attributing to Aristotle the foundation of comparative anatomy, insisting that in his own far-reaching study of the animal kingdom he was only carrying on the work for which Aristotle had laid down the foundation and the method. Geoffroy, of course, disagreed; we needed a new beginning, he believed. But even if he was right, we would want to know what it was he wanted to displace or transcend. Quite apart from those historical reasons, moreover, Aristotle, as the one great philosopher in our

tradition who was also a great biologist, deserves to stand at the head of our study. So we begin by looking at his biology and, briefly, at some of the changes in biological philosophy that followed in the Hellenistic period.

From Aristotle and his successors we move abruptly to the origin of modern mechanism in the person of Descartes, comparing his position on the motion of the heart with that of Harvey. Setting the Cartesian enterprise within its Scholastic context, we see it reducing to local motion the four Aristotelian kinds of change: substantial, quantitative, qualitative, and local. Apart from God and mind, there is just spread-outness, and those things that look in some ways a little like us are only bits of matter ingeniously engineered by their creator. In effect, the notorious doctrine of the beast-machine does away with life. At the same time, Descartes, accepting the new doctrine of the circulation of the blood credited to Harvey, boasts that his own very different account of cardiac motion is superior to that of the English physician, precisely because it is more mechanical. The heart is a furnace in which the entering blood is rarefied, so that it pushes its way out into the aorta. Harvey's account is less perspicuous, and, what is worse, it reverses the traditional order of diastole and systole in a manner difficult for well-trained physicians to accept. In fact, Descartes's doctrine was commonly accepted for some time to come.

In the eighteenth century, we focus, first, on the work of the Comte de Buffon, the great natural historian whose work spans most of the century. Here we have clearly left the Scholastic tradition for a period in which it is the Newtonian heritage that has come to dominate – in Buffon's case in the guise of the seeming inductivism of Newton's method. We find the inverse-square law prevailing everywhere, but do not ask why. We simply face reality and accept it. What we call "causes" are in fact only carefully generalized effects. Buffon sharply contrasts the abstractions of mathematics with what he calls "physical truth," which provides us with the best certainty we can attain. True, we must sometimes hypothesize, but then only carefully, in close touch, Buffon hopes, with concrete reality. Given this methodology, we look at Buffon's work in several areas: his radical skepticism about taxonomy, in contrast to the widely accepted Linnaean system; his concept of the species as a historical – though permanent – entity; his view of generation, which is opposed to the popular notion of "emboitement," or preformed encasement, but involves so-called organic molecules and internal molds, as well as special forces that maintain each species; and, finally, Buffon's

sense of the uniqueness of the living, which puts him into some relation to the emergence of a vitalist philosophy.

Toward the close of the (eighteenth) century we have, further, Kant's "Critique of Teleological Judgment," an account, as we have seen, of organisms as "natural purposes," in which all parts are harmoniously both ends and means (Kant 1793). In this work, Kant was both influenced by, and in his turn, an influence on work in the unified, or unifying, set of inquiries that was beginning to be called "biology," especially at the University of Göttingen. In Kant, the conflict between mechanistic physics and the purposiveness of life forms is at its most acute – so acute, he held, that we will never resolve it.

The early nineteenth century is marked by the preeminence of the Museum of Natural History in Paris. It was a time of explosive development in comparative anatomy. In particular, we consider the famous controversy between two leading figures there, Georges Cuvier and Etienne Geoffroy Saint-Hilaire. For Cuvier, it was the details of comparative anatomy that mattered. Geoffroy, in contrast, was always in search of constancies, of one overarching plan that would explain the morphological relations (though not primarily genealogical relations!) between animals of seemingly different types. By the time Darwin was formulating his theory, both of these perspectives had come to be accepted alongside one another, although in the *Origin of Species*, Cuvier's "conditions of existence" were ranked as more fundamental than Geoffroy's "unity of type." We explore the Cuvier–Geoffroy controversy in Chapter 5.

Two interconnected lines of thought in Britain remain to be considered as background to Darwin's theorizing. On the one hand, there is the development of geology, which revealed extinctions – and plenty of them. The development of geology gave rise to the important debate between uniformitarians and catastrophists about the proper reading of the earth's history. Their divergence reflected a wider disagreement in the philosophy of science between John Herschel's conception of the identification of "true causes" as the heart of the inductive process, and William Whewell's perhaps more conservative notion of the "consilience of inductions." At the same time, a traditional belief in the fixity of species was shaken, in some quarters by the work of Lamarck, but (in Britain at any rate) more shockingly and at a more popular level by the publication of the notorious *Vestiges of Creation* in 1844. All these developments, finally, were closely related to challenges posed to, and defenses attempted for, a deeply rooted British trust in the tradition

of natural theology, as exemplified most conspicuously in the work of William Paley.

When it comes to Darwin himself, we first consider the road to his theory, which is somewhat more circuitous than used to be thought. We then single out some of the epistemic presuppositions of the method he followed when he finally gave an "abstract" of his theory to the public in 1859, and we notice the implications for taxonomy of the understanding of species that follows from that theory. It may look as if the author of the *Origin of Species* has done away with species; in fact, he has given them a new genealogical reality. Finally, there is the question of man's place in nature, with which Darwin dealt privately in his *Notebooks*, but made public in 1871 in *The Descent of Man*, as well as in his book of 1872 on the emotions.

If Darwin changed the tenor of biology, he did not in fact convert his contemporaries and successors wholesale to the acceptance of his theory of natural selection. In looking at the period from Darwin to the rise of genetics, we note, first, some workers who accepted selection as central to evolution. But then we also consider the work of Haeckel and his "biogenetic law," which made the search for phylogenies the primary focus of evolutionary speculation (Haeckel 1866). The work of Francis Galton developed partly out of his disappointment in selectionist explanation, but contributed to the advance of evolutionary theory through his introduction of statistical methods. These were carried on, under a phenomenalist banner, by the biometricians Weldon and Pearson. Contrasted with their stress on continuity in the natural world was the insistence on discontinuity put forward by Bateson and the first "geneticists," who, like De Vries with his mutation theory, found Mendel's work, "rediscovered" in 1900, opposing the notion of small gradual variations leading slowly and smoothly to new varieties or species.

It was the founding of the "evolutionary synthesis" in the 1920s and 1930s, whose history we consider in Chapter 9, that dissolved this seeming opposition, although, more broadly, the synthesis has been taken to mean the coalescence, not just of two fields – genetics and Darwinism – but of a number of fields: systematics, paleontology, and botany, as well as genetics and the theory of selection. We examine the synthesis in a number of its architects, such as Dobzhansky, Mayr, and Wright, and then note some of the recent challenges to it: from some paleontologists, for example, who have objected to the reduction of macro-evolution (evolution at and above the species level) to subspecific micro-evolution;

and from developmental biologists, especially in recent attempts to read some features of development into evolutionary theory.

Although the analysis of evolutionary theory is certainly central to the philosophy of biology as it developed in the second half of the twentieth century, there have also been other conspicuous areas of debate. The species problem is still hotly debated. After Darwin, can we call species real? And if so, what are they? An authoritative view has been that of Ernst Mayr's "biological species concept," according to which species are potentially interbreeding populations. But there has also been opposition to this notion. One question vigorously debated concerns the ontological status of species, again in the wake of evolutionary theory: Are they classes (which, some argue, cannot be altered) or individuals? Further, whatever species are, there is the problem of classifying them. Numerical taxonomists wanted a purely conventional basis for their science. Various sorts of "cladists" want a method based somehow on Willi Hennig's "phylogenetic systematics." Still other, evolutionary, taxonomists claim that classification by splitting alone will not do; evolutionary distance, change in life style, and so on, should be taken into account.

A second group of problems concerns the reduction, or otherwise, of biology to physics and chemistry. Early in the century, there were still vitalists opposing programmatic mechanists. Although confrontation in those terms seems to be over, biologists and biologically concerned philosophers still take diverse stands on the question, permitting, or opposing, various degrees of reduction – theoretical, ontological, or methodological.

Finally, there is the problem of biological explanation. If it is somehow *sui generis*, is it, as many used to think, teleological in character? There is still lively discussion about this question, especially in relation to the concept of function and its connection, if any, with teleology of some sort. Here we consider the two major contenders, "etiological" or "selected effect" functions, and "causal role" functions, as well as some variants on them.

As the title of our book indicates, the topics we are concerned with have chiefly to do with matters in biology in general – reflections on understanding life – rather than with human concerns, with questions having to do with our life in particular. However, in Chapter 11, we do look, if sketchily, at questions connected with human nature. First, there is the question of human origins, especially with respect to the unity of the species. Second, there is the old worry of nature versus

nurture. Third, we ask about some of the characteristics we alone seem to possess, such as language and mind. Finally, we discuss briefly some of the implications of the Human Genome Project and of the recent development of technology that permits direct manipulation of our genetic material.

In conclusion, in Chapter 12, we reflect briefly on some implications of the philosophy of biology for the philosophy of science in general.