THE PHILOSOPHY OF BIOLOGICAL SCIENCES

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Keywords: Philosophy, logic, semiotic, taxa, realism, nominalism, population, bioethics

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Summary

We begin by noting that the biological sciences may possess special features that require them to work within a philosophical framework significantly different from that typical of experimental sciences. The chief candidate for such a feature is the historical dimension that the biological sciences have been acknowledged to possess ever since the acceptance of the theory of evolution. This historical dimension distinguishes the biological sciences from all other sciences, with the exceptions only of geology and cosmology.

Various aspects of theoretical biology are discussed, including the bearing that such ancient debates as that between nominalism and realism continue to have on the subject. Finally, we touch briefly on some problems central to the field of bioethics.

1. Introduction

To speak of a philosophy of the biological sciences would require us first to assess whether biological sciences have such features as to suggest the need for a philosophical framework significantly different from the philosophy underlying other sciences, and, before that, whether there is any justification for a philosophy of science as a distinct discipline.

To deal with such problems exhaustively would require at least a book-length treatment. However, as biology has features, some of which it shares with cosmology and geology, that separate it from other sciences both in matters of principles and of methods, and has unique ethical implications, we shall assume that the philosophical background needed for biology is to some extent both peculiar and unique.

2. Basic Issues in the Philosophy of Biology: Is Biology an Experimental or a Historical Discipline?

The aspects of the philosophy of biology that must be considered are (a) the subject's methods and logic, (b) its ethical implications. Issue (a) may be further split into two critical questions: (i) does biology rank among experimental sciences, or does it use experimental methods to test theories that in fact belong in the realm of the historical disciplines? (ii) given that biology, like any other science, has to be expressed through an appropriate vocabulary, how does this vocabulary relate to reality? Issue (b) raises a vast array of problems with such a host of practical implications that in this brief contribution they may be indicated by a few examples only.

Let us consider first the problem of whether biology may be considered as an orthodox experimental science. Had we considered the problem prior to the general acceptance of evolution (not necessarily of any given theory of evolution), the answer could have been yes, as any problem concerning morphology, physiology, reproduction, etc. may, at least in principle, be broken down into a set of hypotheses, each one being, in principle if not yet in practice, testable by appropriate experiments. The spectacular developments of all branches of biology bear witness of the truth of this statement.

However, when we assume the descent of present organisms from past ones more or less different from the present ones, or when we investigate the very origin of life, we automatically step into the domain of the historical disciplines.

Progress in the study of the pre-biotic conditions of the Earth has shown that reasonable hypotheses may be advanced as to the origin of living beings. These, so far, leave us uncertain as to whether we should assume that the origin of the first living being was such an improbable event that it may well have happened only once, or, alternatively, some have argued that, given certain conditions, the assemblage of a living being was almost necessary. In the latter case, we might assume that life originated repeatedly, as favorable conditions were widespread. In both cases, again, the tracing of the origin of life is a historical investigation.

There is, indeed, no doubt that each development in the history of living beings happened just once, even if parallel or convergent developments may have been far from rare. To make an obvious comparison: we daily sit at table for lunch or supper and we may well eat the same foods for days on end, yet each meal is by itself a unique event. Even assuming that as many features as you like have been exactly repeated, at least the time factor will have changed here. Classical experimental research is atemporal in the sense that, even when it involves a long sequence of events, they are assumed to occur independently of historical time.

Evolutionary studies, by contrast, always subsume the time factor. As such, whether we study a fossil bone in the light of comparative anatomy or an ancient parchment, considering it in the light of paleography, the type of investigation is very much the same. The late Sir Karl Popper was keenly aware of the problem and long hesitated before including evolutionary theories within the realm of scientific ones. In the end he did include them, though by a very debatable argument.

It is undeniable that the reconstruction of phylogenetic relationships, by whatever technique, logically belongs to the same kind of studies as the reconstruction of family genealogies.

3. Methodological Debates

A number of attempts have been made to bypass this difficulty and to bring evolutionary studies within the typical patterns of standard science, but all these have, so far proved to be more or less complete failures.

The more recent debates have centered on the following issues. Some schools have endeavored to reach, or, at least, to approach objectivity' by developing techniques aimed to simply measure the differences between individual specimens, between populations etc., this being the purely "phenetic" approach. Others, while aiming at the same result, have developed principles and techniques whose rigorous implementation is assumed to be appropriate for the determination either of phyletic affinities (orthodox cladistics) or at least to provide a more objective, and therefore a more scientific, assessment of basic degrees of similarity, and, as a bonus, to unveil some phylogenies (transformed cladistics).

Other schools have refined the more traditional approach, which considers the risk of bias to be unavoidable and that all available features should be considered and "weighted" in the light of pooled experiences. As a more adequate treatment of these principles and methods is to be found elsewhere in this Encyclopedia, we shall consider here only some philosophical implications of the debate.

To the phenetic approach it may be objected that it explicitly allows for the grouping of organisms unrelated from the evolutionary standpoint and thus, on the altar of objectivity, sacrifices a basic scientific goal: the understanding of phyletic relationships. However, phonetic techniques have proved useful for the separation of closely similar taxa and are thus quite useful, especially in research on biodiversity.

To cladistics, in its different varieties, it may be objected that they presume the implementation of binary logics and do not take into account a number of modern and not so modern developments of logics, such as Bayesian logics, "fuzzy" logics, and others, which, as it will become apparent in the next paragraph, are, apparently, more suitable for dealing with such objects as biological taxa. Indeed cladistics subsumes a deterministic world and a deterministic logic, and it is quite questionable whether these really generally apply in evolutionary biology.

A complementary aspect of the debate, which is relevant from the logical and philosophical standpoint is that, as the implementation of the algorithms currently employed in cladistic analysis usually results in a large number of alternative dendrograms, the choice among them is made through the implementation of algorithms based on the "principle of parsimony" or "Ockam's razor." This principle, although strongly advocated by great logicians such as Leibniz, according to several authors is unsuitable for this type of analysis on both mathematical and logical grounds. Besides,

there is the trivial fact that there is no single "principle of parsimony" and that when different principles are implemented, the results change.

A big problem closely related to this issue is that phylogenetic analyses of biomolecular evidence have, up to now, always been done by implementing algorithms based on binary logics, and on the basis of some principle of parsimony.

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Bibliography

Note: The interested reader in advised to consult all the volumes of the two major journals in the field: *Biology and philosophy* and *Acta Biotheoretica.*

Breck A. D. and Yourgrau W., eds (1974). *Biology History, and Natural Philosophy*. New York: Plenum. [A collection of essays by most of the significant scholars of the time; certainly not obsolete.]

Mayr E. (1988) *Towards a New Philosophy of Biology: Observations of an Evolutionist*. Cambridge, MA: Harvard University Press. [An important collection of essays on a wide range of topics.]

Pinna G. and Ghiselin M., eds (1996). Biology as History. Papers from International Conferences sponsored by the California Academy of Sciences in San Francisco and the Museo Civico di Storia Naturale in Milan. N.1 *Systematic Biology as an Historical Science*, Milano 24–26 June 1996. In Memorie della Società Italiana di Scienze Naturali e del Museo Civico di Storia naturale in Milan, **27**:1–133.

Biographical Sketch

Alberto M. Simonetta (b. 1930) is Professor of Zoology at the University of Florence (Italy). He has studied in Florence, where he had his first academic appointments, and was appointed as full professor of Comparative Anatomy at the University of Camerino in 1969. His major research interests are the comparative anatomy and evolution of Vertebrates and of Arthropods, including fossils, theoretic aspects of evolutionary taxonomy, and the history of biology.