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### **Philosophy of Microbiology**

MAUREEN A. O'MALLEY

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In her book, *Philosophy of Microbiology*, Maureen A. O'Malley takes us on a journey into a fascinating and philosophically so far relatively unexplored world: the world of the smallest living beings, the microbial world. The aim of this journey is nothing less than a transformation of philosophy of biology and, at least in part, of philosophy of science in general. O'Malley's message is that philosophers should abandon their limited perspective of reflecting on humans and larger organisms such as cats and sunflowers only, and acknowledge the tremendous significance of microbes to the biological world by starting their philosophical analyses of (biological) science with reflections about microbes and microbiology. O'Malley shows in an intriguing manner how such a 'microbes-first perspective' (160) gives rise not only to a 'more inclusive' (200) perspective and 'fuller understanding' (198) of biological phenomena, but also results in a rethinking of standard philosophical views and concepts and in a discussion of novel philosophical questions. In a nutshell, her central claim is that a microbe-centred perspective transforms and enhances philosophical reflection.

O'Malley begins her book with an explanation of why microbes are of special biological significance (3–10). We learn that microbes are extremely important to the biological world because they are so many and so diverse (biodiversity), because other life forms would not have evolved without microbes (evolutionary history), and also because nowadays other life forms could not exist without microbes since their metabolism affects planetary processes that sustain all life forms (biogeochemistry) and since microbes collaboratively interact with many other life forms (symbiotic collaboration). O'Malley presents the enormous biological significance of microbes as an uncontroversial fact, on the basis of which she then constructs her actual argument, namely that microbes and microbiology are not only biologically significant but also and in particular philosophically significant. Despite the many microbiological details O'Malley introduces, this book is thus primarily a philosophical book—a book that is supposed to make the microbial world and the science that studies it accessible to philosophers and to philosophically interested scientists.

The strategy of *Philosophy of Microbiology* is twofold: on the one hand, O'Malley gives reasons why it is in general valuable to examine microbiology philosophically and explicates how taking a microbial perspective transforms and enriches current philosophy of biology and philosophy of science. These general claims are, on the other hand, illustrated and specified by several examples of how a microbes-first perspective contributes to or changes existing philosophical debates about biological classification (chapter 2), about the species concept (chapter 3), about general accounts of evolution (chapter 4), about the concept of biological individuality, about development, multicellularity, and reproduction (chapters 4 and 5), about model organisms and their roles in scientific practice (chapter 6), and about general theories of life (conclusion). O'Malley's decision to connect the microbiological perspective with standard, familiar philosophical debates and questions is a merely strategic decision: in her view, such a 'cautious route' is 'likely to persuade more philosophers that microbes matter' (217). This, however, should not mislead one into thinking that the philosophical views O'Malley develops are also cautious or standard. The overall tone of her book and the answers she gives to traditional philosophical questions are rather revisionary in spirit. O'Malley argues that if we as philosophers abandon our 'zoocentric' perspective (i.e. our focus on animals) and take a microbiological perspective instead, this will provide us not merely with additional information broadening the scope of our philosophical claims, e.g. by adding further case studies that support these claims. Rather, the peculiarities of the microbial world and of microbiology will require of us to develop new conceptual frameworks, to rethink existing concepts (e.g. the concept of species, biological individual, reproduction, multicellularity, development, biological organization), to transform traditional philosophical questions and to pose new questions (e.g. If not species but multilineage communities are regarded as fundamental biological units, how can this enhance biological classification?), and to fundamentally revise general philosophical accounts (e.g. of evolution, of life).

The revisionary spirit of O'Malley's book becomes apparent in particular in the way she addresses specific philosophical problems, for instance the problem of biological individuality. Her central claim is that if our favourite animals continue to be the focus of our metaphysical inquiries we will be stuck with a 'limited', 'biased', and 'uninteresting' (37–38) concept of biological individuality. By contrast, an analysis that starts with microbes will, so O'Malley says, yield a 'more inclusive' (213) and 'more realistic' (160) understanding of what biological individuals and organisms are because it will highlight the vast significance of collaborative interactions among living beings. According to O'Malley, a microbiological perspective reveals that the paradigmatic life form is not the isolated, autonomous organism, as we typically think about humans

and other animals, but rather the community of multiple, interacting lineages that share genetic resources. Multilineage communities might appear to us as strange, anomalous biological individuals (or ‘superorganisms’, 106) but O’Malley argues that this scepticism is due only to our limited zoo- and anthropocentric perspective, from which we should try to detach ourselves.

In my view, O’Malley has written a book that not only opens up a new biological world to (most) philosophers but that also draws refreshing and innovative philosophical conclusions from this new perspective. However, some of the philosophical theses O’Malley presents seem—in particular given their revisionary character—to be too hastily developed and to rely on implicit assumptions that are far from uncontroversial. For example, though, personally, I am sympathetic to pluralistic, pragmatist interpretations of scientific practice, it should not be predetermined that an analysis of microbiology must yield, for instance, a pragmatic conception of natural kinds that focuses on their epistemic roles (92–93), a pluralistic account of biological individuality (116), or a pragmatic understanding of biological organization, according to which a nested-hierarchy view is as useful as a flatter, metabolism-focused view (93, 212). Even if one shared O’Malley’s “‘bottom-up” approach’ (217) and even if it were true that scientists are ‘methodological pluralists’ (215), this would still not render it impossible to develop monistic, non-pragmatic theories about microbes and microbiology that are adequate. When reading *Philosophy of Microbiology*, philosophers should thus keep in mind that O’Malley’s pluralistic and pragmatist beliefs function as background assumptions that influence the presented views but that are rarely satisfactorily substantiated.

Given her pluralistic stance, one of the major claims O’Malley makes is astonishing and difficult to accord with the rest of her views: it is the “‘unity of life” thesis’ (194) or “‘continuity of life” perspective’, which she presents as ‘unobjectionable’ (201). According to the ontological part of the unity-of-life thesis, microbes and macrobes are not two fundamentally different kinds of organisms, but rather unified, e.g. on a molecular level. O’Malley puts this in another way by claiming that there exists a continuity among all living beings because they share many ‘common capacities’ (201). This continuity serves as the ground on which she argues that some apparently clear-cut boundaries and differences (e.g. between unicellular and multicellular life), in fact, do not exist, are ‘vague’ (156), or must be ‘softened’ (42, 91). In parallel with this emphasis on unity and continuity, we also find an emphasis on diversity and plurality in O’Malley’s argumentation: she is explicitly claiming that ‘microbiology discloses an overwhelming variety of living things’ (215), she acknowledges that there exist also differences between microbes and macrobes, and she even invokes the diversity of living beings as another fact that requires the

‘softening of many traditional classificatory boundaries’ (91). It seems as if O’Malley wants to have it both ways: life is diverse but still unified and continuous. But how exactly these two opposites can be brought together remains, unfortunately, an open question.

A second, less substantial tension in O’Malley’s work concerns her claim that ‘microbes are [philosophically] superior to macrobes’ (197) and the pragmatist stance that shows up at different points of her argumentation. It seems as if, at the level of philosophy of (micro)biology, O’Malley holds that microbes are only one model system among many and that each of them allows scientists to pursue a different purpose (they all are parts of an ‘integrative strategy’, 188). On the level of metaphilosophy, however, O’Malley endorses the much stronger claim that philosophers *must* make their ‘biology-based models with microbes first’ (218)—regardless of what might be best for the purposes they pursue. This assumption seems to be unnecessarily strong and is not perfectly in line with O’Malley’s other claims.

Finally, I would like to raise a concern about the general message of *Philosophy of Microbiology*. A central thesis of this book is that the living world is more complex and fuzzy than philosophers with a zoocentric perspective think it is. As soon as you dive into the microbial world, so the message goes, you will start to recognize that apparently real boundaries and differences vanish (or, at least, become vague or soft), continuity and unity appear all over, and living beings turn out to be entangled in deep webs of dynamic interactions. This complexity of life might be an important fact that is best emphasized from a microbiological perspective and that philosophers should pay attention to. But this message also runs the risk of tearing down familiar boundaries, discarding well-known concepts and views, and leaving the reader in conceptual confusion and with the (unsatisfactory) knowledge that everything is continuous and entangled with one another.

To be clear: I do not think that O’Malley’s book is a mere destructive project that questions traditional philosophical concepts and views. Major parts of her book are concerned with the positive project, in which she uses the microbiological perspective to construct alternative views and to rethink traditional concepts. My point is rather that the reader often needs a great deal of open-mindedness and effort to overcome the confusion and to get herself into O’Malley’s project of rethinking philosophy of biology.

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