

# PHILOSOPHICAL FOUNDATIONS OF NEUROSCIENCE

SECOND EDITION

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**M.R. Bennett**  
and  
**P.M.S. Hacker**

WILEY Blackwell

Reviews of *Philosophical Foundations of Neuroscience*:

‘This remarkable book, the product of a collaboration between a philosopher and neuroscientist, shows that the claims made on behalf of cognitive science are ill-founded. The real significance of impressive recent developments in the study of the brain, they allege, has been clouded by philosophical confusion in the way in which these results have been presented. The authors document their complaint in a clear and patient manner. . . . They disentangle the confusions by setting out clearly the contrasting but complementary roles of philosophy and neuroscience in this area. The book will certainly arouse opposition. . . . But if it causes controversy, it is controversy that is long overdue. It is to be hoped that it will be widely read among those in many different disciplines who are interested in the brain and the mind.’ *Sir Anthony Kenny, President of the British Academy (1989-1993)*

‘Overall the book provides the most thorough critical survey of the ruling theories of mental phenomena as they figure in contemporary science. The attention to detail is meticulous, and the philosophical analysis outstandingly lucid. Contemporary scientists and philosophers may not like Bennett and Hacker’s conclusions, but they will hardly be able to ignore them. The work is a formidable achievement.’ *John Cottingham, Professor of Philosophy, University of Reading*

‘Contemporary neuroscience is an exciting, ebullient field and its practitioners are not much given to self-doubt. This dissection of the field by Bennett and Hacker ought to provoke some misgivings. Arguing for a sharp distinction between conceptual analysis of our everyday psychological concepts on the one hand and empirical, neuroscientific investigation on the other, Bennett and Hacker conclude

that many neuroscientists – and some of their philosopher friends – have ignored or muddled that distinction at their peril. In particular, they argue that the misuse of psychological concepts in the interpretation of neural processes does not lead to testable or even false claims, but to nonsense. Neuroscientists, psychologists and philosophers will be challenged – and educated – by this sustained and well-informed critique.’ *Paul L. Harris, Professor, Human Development and Psychology, Harvard University*

‘[It] will certainly, for a long time to come, be the most important contribution to the mind-body problem there is.’ *G. H. von Wright (1916–2003), Research Professor, Academy of Finland and Professor of Philosophy at Cambridge, Cornell and Helsinki*

‘Sweeping, argumentative, and brilliant, this book will provoke widespread discussion among philosophers and neuroscientists alike.’ *Dennis Patterson, Notre Dame Philosophical Review*

‘Devastating critiques of psychologists and neuroscientists. . . . Whether this book leads to a reconfiguring of contemporary neuroscience and the philosophy associated with it will tell us much about the dynamics of contemporary intellectual life.’ *Anthony O’Hear, Philosophy*

‘This book is a joy to read. . . . A model of clarity and directedness . . . [Bennett and Hacker] have produced that rarity of scholarship, a genuinely interdisciplinary work that succeeds. . . . This is a wonderful book that will illuminate, provoke and delight professional scientists, philosophers, and general readers alike.’ *Damian Grace, Australian Book Review*

‘Clinical precision and . . . relentless good sense . . . [a] thoughtful and useful treatise.’ *Daniel N. Robinson,*

## *Philosophy*

'Mandatory reading for anybody interested in neuroscience and consciousness research. The vast spectrum of material in philosophy and neuroscience that Bennett and Hacker consider is impressive and their discussion is thorough and illuminating.' *Axel Kohler, Human Nature Review*

'A delicious cake of a book in which Bennett and Hacker guide the reader through a conceptual minefield of confusions repeatedly made by neuroscientists and philosophers alike.' *Constantine Sandis, Metapsychology*

'Anyone who has ever framed a theory or explained one should read this book - at the risk of forever falling silent.'  
*The Rector, University of Sydney, Obiter Dicta*

'Impressively lucid . . . Bennett and Hacker unquestionably succeed in challenging our own concepts, examine them for dross, and strive to home in on fundamentals.' *Neil Spurway, Journal of the European Society for Study of Science and Theology*

'The fruit of a unique co-operation between a neuroscientist and a philosopher. . . . An excellent book that should be read by all philosophers of cognition and all researchers in the cognitive neurosciences.' *Herman Philipse, ABG #2, De Academische Bockengids*

'This book is an intellectual delight to read, whatever one's opinions on the subjects discussed, and it is impossible not to learn from it. Whether cognitive neuroscience is an appropriate method for a scientific psychopathology is an important question for psychiatry in the twenty-first century and this book raises critical issues in indirectly addressing this question and as such is important reading for psychiatrists, cognitive neuroscientists, psychologists and philosophers.' *Matthew Broome, International Review of Psychiatry*

‘[T]here are, I think, grounds for hope that this book will do an enormous amount of good, both in correcting philosophical confusion within neuroscience and in promoting a new style of dialogue between neuroscience and philosophy.’ *David Cockburn, Philosophical Investigations*

‘Filled with pedagogical and constructive advice, this substantially new edition is the catalogue raisonné that many practising neuroscientists and neurologists had been calling for. By expounding them solely on their own merits, it makes clear why many of the propitious discoveries and theories about brain and mind that we live by shine imperial and how they – just as often – reveal themselves disquietingly unclothed.’ *Juan M. Pascual, Professor in Neurology, Physiology and Pediatrics, University of Texas Southwestern Medical Center*

‘No single work of neuroscience has a greater bearing on all others, or higher warrant to be read ahead of them. A peerlessly incisive analysis, ranging far across the domain, it lays bare the conceptual bedrock on which scientific enquiry rests and the claims of neuroscience ultimately stand or fall. It exposes a litany of errors that render empirical questions unanswerable by robbing them of the sense both truth and falsehood presuppose. It shows that though conceptual these errors have material, real-world consequences irremediable by empirical effort alone.’ *Parashkev Nachev, Professor of Neurology, Institute of Neurology, UCL*

‘The first edition of *Philosophical Foundations of Neuroscience* was essential reading for cognitive clinical neurologists, and two decades later a second edition, which surveys and criticizes the conceptual forms of developments since the turn of the century, is most

welcome.' *Martin Rosser, Professor of Neurology, Institute of Neurology, UCL*

# **PHILOSOPHICAL FOUNDATIONS OF NEUROSCIENCE**

M. R. Bennett and P. M. S. Hacker

Second Edition

**WILEY** Blackwell

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*For Gillian and Jocelyn*

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## ***Foreword to the Second Edition***

*Denis Noble CBE FRS hon FRCP*

The publication of the second edition of this book nearly two decades after its first publication is a suitable occasion to review what it achieves and why that is important.

It has certainly succeeded in bringing a high degree of rigour to the interaction between science and philosophy in the field of neuroscience. Many of the questions raised by scientific discovery are conceptual and cannot be answered by further empirical discovery alone. Nor can conceptual analysis be dissociated completely from empirical discovery. As just one example, the deep questions about the nature of our universe raised by the discoveries of quantum mechanics and relativity would not have seemed relevant if nineteenth-century certainties about a purely deterministic universe working in a purely Cartesian space had been confirmed. That is one of the reasons why collaboration between active scientists and active philosophers is necessary.

It is also one of the reasons the authors refer in their introduction to 'the fact that the potentiality for conceptual confusion is buried deep in our language. Such confusions can be eliminated for a few decades by painstaking conceptual analysis. But they will rise again, as younger generations fall into the same traps. Sense data died under critical onslaught in the 1950s and 1960s, but by the end of the century internal representations arose phoenixlike from their ashes.'

It seems to me to be obvious that language needs constant re-analysis as the meanings of words change, new metaphors arise and new potential confusions occur. Yet, by

and large, twentieth-century science was not ready to accept that philosophy had anything of any importance to contribute. That view was based on the idea that science and philosophy as they were understood in the seventeenth century had confused the two, even to the extent of naming the first scientific journal *Philosophical Transactions of the Royal Society*. Originally published in 1665, its first editor, Henry Oldenburg, was as much at home discussing (in long correspondences in Latin) with the philosopher Benedict Spinoza as he was with the scientist Isaac Newton. One of Spinoza's great philosophical works was nearly published in the journal.

In later centuries the idea grew that, once issues that had initially been raised as philosophical issues had become the subject of practical empirical enquiry, there was no longer any need for further philosophical analysis. That depended of course on the conviction that the initial conceptual distinctions had been set in stone and were no longer open to question.

I see the signs that the twenty-first century is proving to be more aware of the pitfalls this creates. To take just one example that has been the subject of my own research recently, the discoveries that led to the so-called central dogma of molecular biology, formulated by Crick in 1958 after the earlier empirical discovery of the double helix, were presented in the last century as an unquestioned empirical fact. Yet the reason they were viewed in that way was itself based on a deep misunderstanding of the nature of the DNA molecules. Following in the footsteps of the quantum-mechanics pioneer Erwin Schrödinger, the genetic material was assumed to reproduce itself like a crystal. You will find that assumption hidden away in the textbooks, and sometimes openly acknowledged in the popularizations, such as Richard Dawkins's *The Selfish*

*Gene*, where he explicitly says, of DNA replication, that ‘This is how crystals are formed.’

We now know that DNA does not function like a crystal in living cells, nor does it reproduce itself accurately. In fact, the copying process is so inaccurate that there would be hundreds of thousands of copy errors if the cell did not come in to ensure faithful transmission to the next generation by systematically proof-correcting the inaccurate copies.

With that fact alone, many other foundations in evolutionary biology turn out to be conceptual errors. I have detailed those errors elsewhere.<sup>1</sup> They are fundamental to our view of ourselves as humans and our place in the universe, and raise many philosophical questions that had been considered closed, such as whether we and other organisms are purposeful.

Neuroscience, like any other field of science, cannot be immune from such problems raised by assumptions that creep into our views of the world and then become treated as accepted facts. The problems raised by metaphysical assumptions masquerading as empirical facts are just one example where collaboration between science and philosophy is necessary.

Finally, I wish to draw attention to the fact that this edition is not simply the original book updated. As the authors explain in their introduction, the book has been substantially rearranged to separate out conceptual problems that individually require more extensive treatment. Moreover, a vast literature, particularly on new technical methods, is out there to be taken into account.

I particularly appreciate the fact that there is now a separate chapter (3) concerned with the conceptual problems arising from ascribing to the brain properties that



can only sensibly be ascribed to the organism as a whole. I see this point as a natural ally to my own arguments for multilevel interpretations of organisms (the principle of biological relativity), since those arguments lead to demonstrations that it does not make sense to ascribe functions, purposes and goals to levels of organization that could not possibly integrate those functions. As an example from my own field of physiology, it does not make sense to ascribe to the molecules of the heart the function of pumping blood around the body. Functions and purposes can only be ascribed to levels where they make sense (in this case to the complete circulatory system), and some of those (psychological attributes) are necessarily applied sensibly only to the whole living being. As the authors emphasize throughout their book, if a property cannot sensibly be ascribed to something, then it is not an empirical question whether it is or is not the case. Both answers would be meaningless.

Separating [chapter 3](#) from its related conceptual problems, such as introspection, enables those problems to be more thoroughly analysed in [chapter 4](#). While reading that chapter I tried to imagine what it would be like for me to be in the privileged position of being an observer in some future neuroscience laboratory. My privilege would be to observe, through some yet-to-be-invented high-resolution process (vastly higher resolution than current scanning methods), the detailed molecular and electrical neural and other body processes that had been discovered to be those associated with me thinking about, for example, the square root of minus 1. And I realized of course that, were that to be possible, I would be just like those neuroscientists. I would have no idea how to interpret all the electrical and molecular events as somehow 'being' my idea of the square root of minus 1. I would be just as ignorant as I would be if gazing at the series of 0s and 1s in a computer readout of

its binary-number activity when calculating a problem involving complex numbers.

That inability in understanding my own brain processes would have nothing to do with the problem I already had as a student when first grappling with and learning the concept of imaginary numbers (I use this example only because it readily shows just how absurd it would be to claim that one could 'see' imaginary numbers in my brain!). For I would also be none the wiser if the question I had been imagining while my brain was being examined was a much less problematic one, perhaps what I wished to eat for breakfast. The only way for those processes to be understood, by me or by the neuroscientists, would be for it to *be* me thinking those thoughts and telling the world what I was thinking. But the neuroscientists could learn that directly from me without recording from my brain.

I think this is a general problem in the multilevel understanding of organisms, not limited to the brain and nervous system. As I have already indicated in this foreword, all science requires conceptual analysis as an ongoing process.

## Notes

- 1 D. Noble, 'The illusions of the modern synthesis', *Biosemiotics* (2021), <https://doi.org/10.1007/s12304-021-09405-3>.

*Denis Noble CBE FRS hon FRCP  
31 May 2021*

# ***Foreword to the First Edition***

*Denis Noble CBE FRS hon FRCP*

This book was simply waiting to be written. The reductionist agenda in biological science has generated so many conceptual difficulties that someone, sometime, had to analyse these problems in depth from outside the reductionist viewpoint. That a neurophysiologist and a philosopher should combine to do so is also a sign of the times. As biology moves on to address the complexity and extraordinary subtlety of life, now that it has broken it down into its smallest pieces, we will find this kind of combination of skills and ways of thinking even more necessary. As the authors make clear, philosophy (at least in the analytical form practised here) and empirical science are not in opposition. Rather they deal with different kinds of question. Yet, since a conceptual scheme is necessary to any fruitful experimentation, we cannot avoid asking both kinds. Keeping a clear head while we do so is not as easy as it may seem!

I must issue a warning: this book is *highly* controversial. Some of my scientific colleagues will strongly challenge, and will surely be deeply provoked by, the claim that neuroscience has frequently and systematically confused conceptual and empirical questions. To them I would say, first, that the authors clearly recognize the brilliance and phenomenal achievements of the scientists whose conceptual work they analyse. This is emphatically not a book debunking experimental science, any more than the fact that most physiologists now dismiss the dualist philosophy of Sherrington or Eccles detracts in any way from recognizing the immense significance of their scientific achievements. We find it perfectly possible to

admire the experimental and associated analytical skills while wincing when we see how completely trapped they were in their outdated and indefensible philosophical position.

Second, I would appeal for some patience and humility. Patience, because as a physiologist who has interacted with (and published with) professional philosophers of various persuasions for over 40 years,<sup>1</sup> I have to say that I find scientists unthinkingly debunking philosophy more often than the other way round. Humility, because the issues are of the utmost social importance. Some of the claims of reductionist science are not only conceptually incorrect or even unintelligible, they have major social implications. The words we use, the concepts by which we analyse and present biological discovery, deeply affect the way in which we see ourselves as human beings. For that reason, if for no other, a critical debate is necessary. The authors of this book have thrown down a major challenge in that debate.

The controversial nature of this book arises because the particular reductionist philosophical position it criticizes is very widely held today within the scientific community (and also by some well-known philosophers). Moreover, for most of them, this position is a *methodological* necessity, perceived to be the only paradigm for science to successfully explain things. The first reaction to the counter-argument, as presented here, will be to protest that somehow science is being (unnecessarily? ) circumscribed; that some problems are, as it were, being taken from its grasp. I would argue the other way. The first step to scientific progress is to ask the right questions. If we are conceptually confused, we will ask the wrong questions. The authors illustrate this in detail with many examples.

It is hard to escape the confines and confusions of the culture in which one finds oneself. The history of philosophy shows that, just as much as the history of science. The central appeal of this book is to throw off the remaining legacy of the Cartesian confusions, first expressed as a duality of mind and body, but latterly expressed as a duality of brain and body. The authors show that, although the first required belief in a non-material substance, while the latter is wholly materialistic, many of the conceptual problems (essentially those of the 'ghost in the machine') are the same. For our dualist predecessors the ghost was an actual immaterial substance, for us it is 'the "I"' (or 'inner eye' or whatever) that 'sees' the qualia that 'form our experience'. This is what may lead us to ask which group of cells, or even which neurone(!), is doing the 'seeing'. The point here is that simply replacing 'I' or 'inner eye' by the brain or a part of the brain doesn't avoid the problem.

The key to understanding the confusions here lies in an analysis of the logical conditions for ascribing mental and psychological properties. This is not easy. It involves one of the most difficult of twentieth-century philosophical ideas, that of the 'private language argument': what it is to say things like 'I feel pain' or 'I see red'. I struggled through the ramifications of this argument many years ago before writing my own contributions to the philosophy of biology. I wish I had had the benefit of the relatively easy path that Bennett and Hacker have provided. Even those who fundamentally disagree with their arguments ( and I look forward to seeing them engage in debate) must surely acknowledge that this is a sustained and valuable exposition of an important and influential philosophical position.

Although I would describe that position as philosophically radical (in the correct sense of that word: going back to

basic roots and eradicating those that shouldn't be there), it is often dismissed by scientists as conservative because it may appear to restrict using language in new ways. Yet, they would argue, science cannot advance without doing that. And what better way to achieve it than to start with metaphor or *façons de parler*, consolidate with dead metaphor (metaphors that become part of everyday language - constructivists argue that that is the way language evolved) and finally end up with a change in our conceptual scheme? Indeed, why not, if that is what will enlighten us, lead us into new conceptual territory, formulate new theories. But there is a simple test for whether that could work in any particular case. For each such metaphorical (or similar) change in use or meaning, or novel piece of terminology (such as 'qualia' or 'memes'), imagine stating its opposite, and then ask whether any conceivable experiment could test empirically between the two. The deep problem for many 'novel' concepts and language uses in reductionist approaches is that this test totally fails. The novel use of language is then not so much a scientific as a political or social tool. If you doubt this, try imagining an experiment to test between the existence or non-existence of qualia. Or for whether or not the brain makes representative maps (which are *not* homunculi incidentally). Or for brain states that 'explain' rational thought (rather than being a necessary physical basis for its existence). Surely we should only introduce new terminology where, as with quarks and black holes, we provide the empirical criteria for determining their existence?

Perhaps the problem for many scientists is to imagine what would happen if we abandoned the universality of the reductionist approach. For sure, the nature of science would change. But so it should! We would have to recognize that causation and explanation do not always run