In Praise of Natural Philosophy
A Revolution for Thought and Life

Nicholas Maxwell

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Abstract

Modern science began as natural philosophy. In the time of Newton, what we call science and philosophy today – the disparate endeavours – formed one mutually interacting, integrated endeavour of natural philosophy: to improve our knowledge and understanding of the universe, and to improve our understanding of ourselves as a part of it. Profound, indeed unprecedented discoveries were made. But then natural philosophy died. It split into science on the one hand, and philosophy on the other. This happened during the 18th and 19th centuries, and the split is now built into our intellectual landscape. But the two fragments, science and philosophy, are defective shadows of the glorious unified endeavour of natural philosophy. Rigour, sheer intellectual good sense and decisive argument demand that we put the two together again, and rediscover the immense merits of the integrated enterprise of natural philosophy. This requires an intellectual revolution, with dramatic implications for how we understand our world, how we understand and do science, and how we understand and do philosophy. There are dramatic implications, too, for education, and for the entire academic endeavour, and its capacity to help us discover how to tackle more successfully our immense global problems.

1. Natural Philosophy and Its Death

Modern science began as natural philosophy – or "experimental philosophy" as it was sometimes called. In the time of Isaac Newton, in the 17th century, science was not only called "natural philosophy". It was conceived of, and pursued, as a development of philosophy. It brought together physics, chemistry and other branches of natural science as we know it today, with diverse branches of philosophy: metaphysics, epistemology, methodology, philosophy of science – even theology. Science and philosophy, which we see today as distinct, in those days interacted with one another and formed the integrated enterprise of natural philosophy.[1] This had, as its basic aim, to improve our knowledge and understanding of the universe – and to improve our understanding of ourselves as a part of the universe. And around the time of Newton there was this great upsurge of excitement and confidence. For the first time ever, in the history of humanity, the secrets of the universe, hitherto wholly unknown, had been revealed and laid bare for all to understand – or at least, for all those who understood Latin and the intricate mathematics of Newton's *Principia*.

Today we look back at the great intellectual figures associated with the birth of modern science and we unhesitatingly divide them up into scientists on the one hand, philosophers on the other. Galileo, Johannes Kepler, William Harvey, Robert Boyle, Christiaan Huygens, Robert Hooke, Edmond Halley, and of course Isaac Newton are all scientists; Francis Bacon, René Descartes, Thomas Hobbes, John Locke, Baruch Spinoza and Gottfried Leibniz are philosophers. But this division is anachronistic. They did not see themselves in this fashion. Their work interacted in all sorts of ways, science with philosophy, philosophy with science. They all sought, in one way or another, to improve

our knowledge and understanding of the universe, to improve our understanding of how we can acquire knowledge of the universe, and to work out the implications, for our understanding of ourselves, of the new view of the universe that the new natural philosophy had ushered in.

There were good reasons why, in the 17th century, empirical science could not be split off from philosophy. Natural philosophers disagreed about crucial questions of method. Should evidence alone decide what theories are accepted and rejected, or does reason play a role as well? Different views about method had practical consequences for science itself: they had to be discussed as a part of science. Again, the new natural philosophy ushered in a new vision of the universe: it is made up of colourless, soundless, odourless corpuscles which interact only by contact. This metaphysical view had an impact on what scientific theories are to be accepted and rejected; natural philosophers held different versions of the view, and different attitudes to the influence the view should have on science: all this had to be discussed as an integral part of science. And again, the corpuscular hypothesis provoked profound philosophical problems about how it is possible for human beings to acquire knowledge of the universe, and how it is possible for people to be conscious, free and of value if immersed in the physical universe. Natural philosophers, of a more "philosophical" bent, grappled with these problems thrown up by the new vision of the universe.

And then, during the 18th and 19th centuries, natural philosophy died. It split into empirical science on the one hand, and philosophy on the other. Increasingly, scientists ignored philosophy, and philosophers ignored science. The two parts, pursued more or less independently of one another, lack the rigour and the intellectual value of the integrated enterprise of natural philosophy, as we shall see in what follows. Science and philosophy are pale shadows of the unified and glorious enterprise that gave birth to them, natural philosophy.

2. When and Why did Natural Philosophy Die?

Two major factors led to the death of natural philosophy, to its splintering into science and philosophy. First, Newton's ideas about method, as set out in the *Principia*, had an immense impact.[2] Natural philosophers began to take for granted that they had in their possession an assured method for the acquisition of knowledge. This involved basing everything on *evidence*. Evidence alone provided the means for deciding what should be accepted and rejected in natural philosophy, or in science as it came to be called, and anything not amenable to empirical testing had no place in science. Secondly, the failure of natural philosophers to solve the philosophical problems associated with the new vision of the universe associated with the new natural philosophy led to philosophy being developed in ways which became more and more unrelated to, and irrelevant to, science. Attitudes developed in both science and in philosophy intensified the rupture, and tore natural philosophy apart.

When did natural philosophy die? It began to die almost immediately after its birth, as "philosophers" became increasingly remote from the outlook, thought and work of "scientists". This process continued throughout the 18th century, and became confirmed in the 19th century. In 1833, William Whewell coined the term "scientist".

I take the above two reasons for the death of natural philosophy in turn, in the next two sections.

3. Newton and Empiricism

Once Newtonian science was generally accepted, in England and especially in France, those natural philosophers who did what we today call science felt confident that the correct methods for natural science had been firmly established, were well known and required no more discussion. They were the methods set out by Newton in his "rules of reasoning in philosophy" in his *Principia*. Science is based on evidence. The scientist must base all his theorizing on observation and experiment. Not only did this mean scientists need no longer discuss questions of method as an integral part of science. It meant philosophy could play no role in science whatsoever, for of course philosophy is concerned with ideas that are not empirically testable, not based on evidence. General acceptance of a view that may be called *standard empiricism*, stemming from Newton, and from Francis Bacon and Locke, had a major role, then, in driving a wedge between science on the one hand, philosophy on the other – the demise of natural philosophy being the consequence. Standard empiricism, in one or other form, is still widely accepted today, by scientists and non-scientists alike. In the 20th century, Karl Popper articulated the division between science and philosophy in a striking and widely influential way with his *principle of demarcation*: a theory, in order to be scientific, must be empirically *falsifiable*.

4. Failings of Western Philosophy

Not only did scientists come to understand natural science in such a way that philosophy was excluded from science. Philosophers contributed to the growing gulf separating science from philosophy by becoming more and more remote, in their deliberations, from anything relevant to science. This came about because philosophers failed to come to grips with and solve – even to articulate – the fundamental philosophical problem thrown up by the new vision of the universe associated with the new natural philosophy. In what follows I shall argue that this problem ought to be formulated like this: How can our human world, imbued with sensory qualities, consciousness, free will, meaning and value, exist and best flourish embedded in the physical universe (as conceived of by modern science)?[3] Descartes came up with a possible solution to this problem – even though he did not formulate the problem as I have just done. His proposed solution is Cartesian dualism: there are two kinds of entities in existence, fundamental physical entities on the one hand, minds on the other. For leading philosophers who came after Descartes – Bishop Berkeley, David Hume, Immanuel Kant and others – Cartesian dualism seemed to imply (in effect) that we can only have knowledge of our minds, or of immediate experience. The long, intricate chain of events that takes place between external object and our inner experience of it seemed to imply that it is only the last event in this chain of events, our inner experience, that we can be aware of. As a result, philosophy became more and more remote from science. Experience seemed to be an impenetrable barrier between us and the physical universe, it being impossible to acquire knowledge of the unobservable physical universe. Those philosophers who did continue to try to understand how science acquires knowledge lost the optimism of the 17th century natural philosophers. The optimistic question "How can natural philosophy best acquire knowledge?" was converted into the pessimistic Kantian question "How is natural philosophy possible at all?" The Newtonian idea that science is

based exclusively on evidence came to seem, to many philosophers, hopelessly problematic. No one knew, in other words, how to solve the problem of induction – the problem of showing how it is possible to verify theory by means of evidence.

By the 20th century, philosophy had split into two schools: so-called "analytic" philosophy, and "Continental" philosophy. Analytic philosophers took seriously the problem of what philosophy could be and do given it took no account of evidence, and came to the conclusion that it must be devoted to analysis of concepts – perhaps somewhat analogous to the way mathematics might be thought to be based on analysis of such concepts as number, space, function, continuity, group, set. Analytic philosophers thus took up the task of analysing key concepts of philosophy: knowledge, mind, cause, reason, perception, consciousness, good, virtue, reality, freedom, justice, and so on. Ideas about what philosophical analysis is have evolved since the days of G. E, Moore and Ludwig Wittgenstein in the 20th century, but still today, most philosophers "in the analytic tradition" take it for granted that conceptual analysis is the proper task of philosophy.

Continental philosophy, on the other hand, emerged from, and is to be associated with, the "mind" part of the Cartesian mind/matter dichotomy. It tends to take immediate human experience as the basis for all thought, and is indifferent to, if not downright hostile towards, science and reason. Johann Fichte, Georg Hegel, Friedrich Nietzsche, Søren Kiekergaard, Martin Heidegger, Jean-Paul Sartre, Michel Foucault and Jacques Derrida are some of the figures associated with Continental philosophy. German idealism, phenomenology, hermeneutics, existentialism, structuralism, post-structuralism, postmodernism, and critical theory associated with the Frankfurt school are some of the movements associated with this approach.

Neither analytic philosophy, nor Continental philosophy, have much to say that is relevant to, or of interest to, science. And even most philosophy of science, from its emergence in the 20th century, fails to be of interest to scientists.

There are, of course, exceptions to this story. Bertrand Russell is one; and Karl Popper is another. But even these two figures, so sympathetic towards the scientific enterprise at its best, conform to the general pattern of retaining the sharp distinction between science and philosophy.[4] J. J. C. Smart and others have sought to articulate the view of the universe that emerges from modern science, and tackle the philosophical problems that this view engenders.[5] These developments, even though in the right direction, have failed to heal the gulf between science and philosophy. Most scientists probably agree with Steven Weinberg when he says "only rarely did it seem to me [that philosophy of science has] anything to do with the work of science as I knew it. ... I am not alone in this; I know of *no one* who has participated actively in the advance of physics in the post-war period whose research has been significantly helped by the work of philosophers".[6] John Ziman, a physicist, was, a few years before, even more dismissive. He declared "the Philosophy of Science ...[is] arid and repulsive. To read the latest symposium volume on this topic is to be reminded of the Talmud, or of the theological disputes of Byzantium".[7] Stephen Hawking at intervals pronounces very publicly that philosophy is dead.

5. Metaphysics and Method

As I have explained, two key factors were responsible for the demise of natural philosophy: widespread acceptance of standard empiricism – the view that science is based exclusively on evidence – and the failure of philosophers to solve philosophical

problems associated with the view of the universe associated with science. I now demonstrate that both these factors stem from quite fundamental intellectual failures. Correct these failures, and it becomes blindingly obvious that the splitting of natural philosophy into science on the one hand, philosophy on the other, was a profound intellectual disaster. We urgently need to resurrect natural philosophy, thus greatly enhancing the rigour, the intellectual and educational value, of both science and philosophy. In this section I concentrate on the first factor (the second one is discussed in section 6 below).

The key point to be made is that standard empiricism, despite being widely taken for granted still by scientists and non-scientists alike, is untenable in all its varieties. The weakest version of standard empiricism – a component of all stronger versions – can be formulated like this. The basic aim of science is truth, the basic method being to assess claims to knowledge impartially with respect to evidence alone. Considerations of simplicity, unity or explanatory power may legitimately influence what theory is accepted in addition to evidence, but not in such a way that the universe itself is assumed to be simple, unified, or such that explanations exist to be discovered (i.e. comprehensible). In science, *no factual thesis about the world can be accepted as a part of scientific knowledge independently of evidence, let alone in violation of evidence.*

But standard empiricism, though still widely taken for granted by scientists and non-scientists alike, is untenable. Theoretical physics persistently only accepts *unified* or *explanatory* theories, even though endlessly many empirically more successful disunified, non-explanatory rivals can always be concocted. This means that physics makes a persistent, substantial metaphysical (i.e. untestable) assumption about the nature of the universe: it is such that, at the very least, no seriously disunified, non-explanatory theory is true.[8] The universe is (more or less) physically comprehensible (i.e. such that physical explanations for phenomena exist to be discovered). Thus physics does make a persistent assumption about the universe independent of evidence – even, in a certain sense, in violation of evidence – and that means standard empiricism is false.[9]

This big, persistent assumption exercises a profound influence over physics, in determining, with evidence, what theories are accepted and rejected, and in influencing the direction in which physicists look in their attempts to develop new theories. But the assumption is, however, highly problematic and, in the more specific form accepted by physics at any given time, is almost bound to be false. We do not *know* that the universe is physically comprehensible; much less do we know it is comprehensible in the more or less specific way physics implicitly assumes it to be at any given stage in its development. Ideas about how the universe might be comprehensible have changed dramatically many times during the development of science, and the chances are that current ideas will turn out to be inadequate as well. The more or less specific assumption as to how the universe is physically comprehensible, implicit in physics at any stage of its development, influences both acceptance of theory, and the search for new theories, and yet this assumption is almost bound to be false. It is, in short, important for progress in physics that this assumption is made explicit, so that it can be critically assessed and, we may hope, improved.

In order to do this, we need to adopt and implement a new conception of science that I have called *aim-oriented empiricism*. This holds that we need to represent the metaphysical assumptions of science in the form of a hierarchy of assumptions, and

associated methods, the assumptions becoming less and less substantial, and more and more such that their truth is required for science, or the pursuit of knowledge, to be possible at all, as one goes up the hierarchy. In this way, a framework of relatively unproblematic, enduring assumptions and associated methods, high up in the hierarchy, is created within which much more substantial and problematic assumptions and associated methods, low down in the hierarchy, can be critically assessed and improved. Put another way, a framework of relatively unproblematic aims and methods for science is created within which much more problematic aims and methods can be improved. (A basic aim of physics, according to aim-oriented empiricism, is to discover truth problematically *presupposed to be physically comprehensible*.) That low-level assumption (or that low-level aim presupposing such an assumption) is to be chosen which (a) accords best with assumptions (or aims) higher up in the hierarchy, and (b) sustains – or best promises to sustain – the most empirically progressive scientific research programme. According to aim-oriented empiricism, there is something like positive feedback between improving knowledge, and improving aims and methods – improving knowledge-about-how-to-improve-knowledge. Physics adapts its methods to what it discovers about the universe.[10]

Aim-oriented empiricism, if ever put explicitly into scientific practice, would amount to the rebirth of natural philosophy. For aim-oriented empiricism demands that theoretical knowledge, metaphysics, ideas concerning aims and methods – that is, ideas in the philosophy of science – and even philosophy, all interact with one another, the key feature of natural philosophy.

Ironically, Newton did not uphold standard empiricism. Newton formulates three of his four rules of reasoning in such a way that it is clear that these rules make assumptions about the nature of the universe. Thus rule 1 asserts: "*We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances*." And Newton adds: "To this purpose the philosophers say that nature does nothing in vain, and more is in vain when less will serve; for Nature is pleased with simplicity, and affects not the pomp of superfluous causes."[11] Newton understood that persistently preferring simple theories means that Nature herself is being persistently assumed to be simple (which violates standard empiricism).

Aim-oriented empiricist natural philosophy, if ever created, would be potentially, in a number of ways, a great improvement over what we have at present, the two dissociated parts, science and philosophy. To begin with, the meta-methodology of aim-oriented empiricism, facilitating evolving aims and methods of a science with evolving knowledge, has implications for all the branches of natural science, and not just for theoretical physics (all that we have seen so far). Aim-oriented empiricism requires different sciences to have different methods, as a result of having different specific aims; at the same time, it provides a unified framework for the whole enterprise of natural science – or, rather, of natural philosophy.[12] Aim-oriented empiricism is a more rigorous conception of science than standard empiricism because it acknowledges, and seeks to improve, influential and problematic assumptions that standard empiricism repudiates.[13] As I have argued elsewhere, aim-oriented empiricism is a synthesis of, and a great improvement over, the ideas of Popper, Kuhn and Lakatos,[14] and leads to the solution of fundamental problems in the philosophy of science: the problems of induction, the meaning of theoretical unification, and verisimilitude.[15] Aim-oriented empiricism does

better justice to explanation and understanding in science than does standard empiricism.[16] In moving from standard to aim-oriented empiricist science there is a profound increase in the scope of scientific knowledge and understanding, in that the thesis that the universe is physically comprehensible becomes a part of theoretical scientific knowledge. Aim-oriented empiricism provides a rational, if fallible method for the discovery of fundamental new theories in physics.[17] There are important implications for education.[18] And there are important implications for science, for the history and philosophy of science, and for the relationship between the two. The philosophy of science becomes a vital, integral part of natural philosophy.[19]

6. The Rebirth of Natural Philosophy

A major implication of aim-oriented empiricism is that *physicalism* is a basic part of current (conjectural) theoretical scientific knowledge. Physicalism, as understood here, asserts that the universe is physically comprehensible. It is such that the true physical "theory of everything" is unified. Some kind of unified pattern of physical law runs through all phenomena, actual and possible. The 17th century corpuscular hypothesis is an early, crude version of physicalism.

At once we are confronted with the fundamental problem that so baffled 17th century philosophers – the problem they failed to articulate properly, and tried to solve with versions of Cartesian dualism: If physicalism is true, how can our human world, imbued with sensory qualities, consciousness, free will, meaning and value, exist and best flourish? If the universe really is more or less as modern physics conceives it to be, what becomes of the meaning and value of human life?

Natural philosophers of the 17th century – whether proto-scientists or proto-philosophers, took for granted that the silence of physics about the experiential – colours, sounds, smells as we experience them, sentience and consciousness as we experience them – means that all these experiential features do not exist out there in the real, objective world. For, if they did exist, physics would surely encounter them, predict and explain their occurrence. But it does not, and so, the argument runs, they do not exist.

All this is a blunder, as I have shown in some detail elsewhere.[20] Physics seeks only to describe, predict and explain what may be called the "causally efficacious" aspect of things, that aspect which determines how events unfold in time and space. The experiential, not being "causally efficacious" in the relevant sense, is not mentioned by physics. Furthermore, in an argument usually attributed to Thomas Nagel and Frank Jackson[21] but actually formulated by me many years earlier,[22] I have shown decisively that physics, and that part of science in principle reducible to physics, cannot predict the experiential, whether sensory qualities without us, or sensations within us. Furthermore, if physical theory is extended, by means of additional postulates, to include the experiential, it thereby drastically loses its astonishing explanatory power.

All this means that, *even if experiential features, without us in the world and within us do exist*, we can give good reasons why physics would say nothing about them, and can explain and understand why physics would say nothing about them. Hence, the silence of physics about sensory qualities external to us, and sensational qualities internal to us, provides no grounds whatsoever for holding they do not exist objectively in the world.

It becomes possible to hold that what we see, hear, touch and smell in ordinary perception really does exist out there in the world. An account of how our human world

exists in the physical universe becomes possible that differs profoundly from that of Cartesian dualism – and differs from philosophical doctrines expounded over the centuries since Descartes' time. An account of perception emerges which holds that what we know about most directly in perception is things external to us, not our inner representation of them. Darwinian theory has a crucial part to play in this general account, in that Darwinian theory helps explain how and why purposive living things have come to proliferate so amazingly in our world. Darwinian theory needs, however, to be reformulated to do justice to the evolution of purposiveness, sentience, consciousness, free will, meaning and value.[23] All in all, we can begin to see how we can make sense of our human world, imbued with experiential features, consciousness, free will, meaning and value, even though embedded in the physical universe as understood by modern science.

The upshot of the arguments of this section and the one before is that we need to recreate natural philosophy – a synthesis of science and philosophy. Philosophy, in particular, needs to be transformed so that it takes up its proper task of tackling the problems for our understanding of ourselves thrown up by what science tells us about the universe and ourselves. The splitting of natural philosophy into science and philosophy arose out of intellectual blunders and failings. Once these are put right, it becomes obvious that natural philosophy needs to be resurrected.

There are profound implications for education. No course in physics, in science, can be adequate which does not discuss the problems for our understanding of ourselves – how we can be conscious, free and of value – granted what modern physics, biology and neuroscience tell us about the universe and ourselves. And no course in philosophy can be adequate which does not include discussion of what modern science tells us about the universe and ourselves. All pupils and students need to encounter, and be given opportunities to explore, our fundamental problem of both life and thought: How can we exist and best flourish embedded as we are in the physical universe?[24]

7. How to Save the World

A century after the scientific revolution – which should perhaps be called "the natural philosophy revolution" – another profound intellectual revolution occurred: The Enlightenment. The fundamental idea of the Enlightenment – especially the French Enlightenment – was to learn from scientific progress (progress in knowledge of the new natural philosophy) how to achieve social progress towards an enlightened world. This is a profound idea. Unfortunately, in developing and applying this immensely important idea, the *philosophes* of the Enlightenment blundered. Instead of trying to help get progress-achieving methods, generalized from those of science, into personal, institutional and global life, the *philosophes* rather sought to apply misconstrued conceptions of scientific method to the task of improving knowledge about social phenomena. In effect, they sought to develop social inquiry, not as social *methodology* or *philosophy*, but as social *science*. This blunder was further developed throughout the 19th century, and built into academia in the early 20th century with the creation of departments of social science round the world.

The outcome is what we have, by and large, today: academia devoted primarily to the acquisition of specialized knowledge. First, knowledge is to be acquired; once acquired, it can be applied to help solve social problems.

But, as I have shown in some detail, here and elsewhere,[25] this is profoundly and damagingly irrational. We need a new, more rigorous kind of inquiry which gives intellectual priority to problems of living, and seeks to get into personal and social life, and into other institutions besides that of science – into government, industry, agriculture, commerce, the media, law, education, international relations – hierarchical, progress-achieving methods, designed to improve problematic aims, arrived at by generalizing the methods of science. This new kind of inquiry would seek to help humanity learn how to resolve its conflicts and problems of living in more just, cooperatively rational ways than at present. Its fundamental intellectual and humanitarian aim would be to help humanity acquire wisdom – wisdom being the capacity to realize (apprehend and create) what is of value in life, for oneself and others. Correcting the blunders we have inherited from the Enlightenment is long overdue.

8. Conclusion

We suffer from two profound, long-standing philosophical disasters – still unrecognised by philosophers today. The first is our failure to sustain, or recreate, natural philosophy, a synthesis of science and philosophy. Both science and philosophy are impoverished as a result. The second is our failure to develop a kind of academic inquiry rationally devoted to helping people realize what is of value in life. There is no doubt in my mind that these two failures are inter-linked.

There can hardly be any more important task for academic philosophers than to alert academic colleagues and the public to the existence of these long-standing instiutionalized philosophical blunders and, as a consequence, the urgent need for academic reform.

Notes

[1] This point was well made long ago by A. E. Burtt, *The Metaphysical Foundations of Modern Science*, Routledge and Kegan Paul, London, 1932. See also E. J. Dijksterhuis, *The Mechanization of the World Picture*, Oxford University Press, Oxford, 1969.

[2] For Newton's impact on his successors see P. Gay, *The Enlightenment: An Interpretation*, Wildwood, London, 1973.

[3] Two books that explore this problem, and argue that it is the fundamental problem of all of thought and life, are my *The Human World in the Physical Universe: Consciousness, Free Will and Evolution*, Rowman and Littlefield, Lanham, 2001; and *Cutting God in Half – And Putting the Pieces Together Again: A New Approach to Philosophy*, Pentire Press, London, 2010.

[4] For an account of Popper's ambivalent attitude towards natural philosophy see N. Maxwell, 'Popper's Paradoxical Pursuit of Natural Philosophy', in *Cambridge Companion to Popper*, edited by J. Shearmur and G. Stokes, Cambridge University Press, Cambridge, 2012.

[5] J. J. C. Smart, *Philosophy and Scientific Realism*, Routledge and Kegan Paul, London, 1963; T. Nagel, *The View from Nowhere*, Oxford University Press, Oxford, 1986; D. Chalmers, *The Conscious Mind*, Oxford University Press, Oxford, 1996.

[6] S. Weinberg, *Dreams of a Final Theory*, Hutchinson, London, 1993, pp. 133-134.

[7] J. Ziman, *Public Knowledge*, Cambridge University Press, Cambridge, 1968, p. 31.

[8] As I have put it in 'Arguing for Wisdom in the University', *Philosophia*, this issue, if scientists only accepted theories that postulate atoms, and persistently rejected theories that postulate different basic physical entities, such as fields — even though many field theories can easily be, and have been, formulated which are even more empirically successful than the atomic theories — the implication would surely be clear. Scientists would in effect be assuming that the world is made up of atoms, all other possibilities being ruled out. The atomic assumption would be built into the way the scientific community accepts and rejects theories — built into the implicit *methods* of the community, methods which include: reject all theories that postulate entities other than atoms, whatever their empirical success might be. The scientific community would accept the assumption: the universe is such that no non-atomic theory is true. Just the same holds for a scientific community which rejects, or rather ignores, all seriously disunified rivals to accepted more or less unified theories, even though these rivals would be even more empirically successful if they were considered. Such a community in effect makes the assumption: the universe is such that no disunified theory is true (unless approximate and implied by the true unified theory).

[9] This argument is spelled out in much greater detail in my *The Comprehensibility of the Universe: A New Conception of Science*, Oxford University Press, Oxford, 1998; *Is Science Neurotic?*, Imperial College Press, London, 2004, chs. 1-2 and appendix; 'Popper, Kuhn, Lakatos and Aim-Oriented Empiricism', P*hilosophia 32*, nos. 1-4, 2005, pp. 181-239; *From Knowledge to Wisdom*, Blackwell, Oxford, 1984; 2nd edition, Pentire Press, London, 2007 – especially 2nd edition, ch. 14; 'A Priori Conjectural Knowledge in Physics', in *What Place for the A Priori?*, edited by M. Shaffer and M. Veber, Open Court, Chicago, 2011, pp. 211-240. See also my 'Arguing for Wisdom in the University', *Philosophia*, this issue.

[10] For more detailed expositions of, and arguments for, aim-oriented empiricism see works referred to in note 9.

[11] I. Newton, *Principia*, University of California Press, Berkeley, vol. 2, 1962, p. 398.

[12] See N. Maxwell, *Is Science Neurotic?*, pp. 41-47.

[13] See works referred to in note 9.

[14] See my 'Popper, Kuhn, Lakatos and Aim-Oriented Empiricism'.

[15] See works referred to in note 9.

[16] See my *The Comprehensibility of the Universe*, especially chs. 4 and 7.

[17] See my *The Comprehensibility of the Universe*, pp. 219-223; *Is Science Neurotic?*, pp. 49-50.

[18] See my *What's Wrong With Science? Towards a People's Rational Science of Delight and Compassion*, Bran's Head Books, Frome, 1976 (2nd ed., Pentire Press, London, 2009); 'Science, Reason, Knowledge and Wisdom: A Critique of Specialism', *Inquiry 23*, 1980, pp. 19-81; 'Philosophy Seminars for Five-Year-Olds', *Learning for Democracy*, Vol. 1, No. 2, 2005, pp. 71-77 (republished in *Gifted Education International*, Vol. 22, No. 2/3, 2007, pp. 122-127).

[19] See my *The Comprehensibility of the Universe*, pp. 26-33; *Is Science Neurotic?*, ch. 2.

[20] See my 'Physics and Common Sense', *British Journal for the Philosophy of Science 16*, 1966, pp. 295-311; 'Can There Be Necessary Connections between Successive Events?', *British Journal for the Philosophy of Science 19*, 1968, pp. 1-25 (reprinted in

R. Swinburne, ed., *The Justification of Induction*, Oxford University Press, Oxford, 1974, pp. 149-174); 'Understanding Sensations', *Australasian Journal of Philosophy 46*, 1968, pp. 127-146; *From Knowledge to Wisdom*, ch. 10; 'The Mind-Body Problem and Explanatory Dualism', *Philosophy* 75, 2000, pp. 49-71; *The Human World in the Physical Universe*, especially ch. 5; *Cutting God in Half – and Putting the Pieces Together Again: A New Approach to Philosophy*, especially ch. 3; 'How Can Life of Value Best Flourish in the Real World?', in *Science and the Pursuit of Wisdom: Studies in the Philosophy of Nicholas Maxwell*, ed., L. McHenry, Ontos Verlag, 2009, pp. 3-5, 38-56; 'Reply to Comments on *Science and the Pursuit of Wisdom*', *Philosophia*, 38, Issue 4, 2010, pp. 677-684; 'Three Philosophical Problems about Consciousness and their Possible Resolution', *Open Journal of Philosophy*, vol. 1, no. 1, 2011, pp. 199-208; 'Arguing for Wisdom in the University', *Philosophia*, this issue.

[21] T. Nagel, 'What is it Like to Be a Bat?', *The Philosophical Review* 83, 1974, pp. 435-450; F. Jackson, 1986, 'What Mary Didn't Know', *Journal of Philosophy* 3, 1986, pp. 291-295.

[22] See 'Arguing for Wisdom in the University' for a discussion.

[23] See my *The Human World in the Physical Universe*, ch. 7; *Cutting God in Half – And Putting the Pieces Together Again: A New Approach to Philosophy*, ch. 8.

[24] For a guide as to how this fundamental problem might be explored, see my *Cutting God in Half – And Putting the Pieces Together Again: A New Approach to Philosophy*.

[25] See my 'Arguing for Wisdom in the University', *Philosophia*, this issue, and works referred to in that paper in notes 1 and 2.