



Reductionism: Help or Hindrance in Science and Religion?

Michael Poole

Summary

Claims have been made that the natural world — the subject matter of science and its many methods — is all there is. If these allegations were substantiated, they would threaten religious beliefs. But arguments rather than assertions, however vocal and frequent, are needed. One such argument that has been offered is that the constitution of the material world can be exhaustively accounted for by ‘reducing’ its constituents into successively smaller parts until nothing is left unaccounted for. The question as to whether this reduction is a help or a hindrance to the scientific enterprise is considered, as is the question of whether this practice renders science necessarily atheistic.

Are we simply highly complex chemical mechanisms with computers on top – just atoms and molecules? Are our thought processes ‘nothing but a pack of neurons’?¹ Certain scientists have made claims like these, claims that go under the general name of ‘reductionism’. One expression of this belief comes from the late Francis Crick who, along with James Watson and Maurice Wilkins was awarded a Nobel prize for identifying the structure of DNA. In his book, *The Astonishing Hypothesis*, Crick writes

The Astonishing Hypothesis is that ‘You’, your joys and your sorrows, your memories and your ambitions, your sense of personal identity and free will, are in fact no more than the behaviour of a vast assembly of nerve cells and their associated molecules.²

Such a pronouncement seems to threaten religious beliefs and certainly Crick shows little sympathy for religion in chapter 12 of his book, entitled ‘Dr Crick’s Sunday Morning Service’. He claims that ‘the beliefs of most popular religions ... by scientific standards ... are based on evidence so flimsy that only an act of blind faith can make them acceptable ... If revealed religions have revealed anything it is that they are usually wrong.’³ Claims like this reveal a view, sometimes promulgated in popular media presentations, that ‘faith’ = unevidenced belief = credulity. This caricature is often associated with the more extreme forms of reductionism. To be fair to Crick, however, later in his book he tones down some of his more extreme claims, saying ‘the words *nothing but* in our hypothesis can be misleading if understood in too naive a way ... The Astonishing Hypothesis may be proved correct. Alternatively, some view close to the religious one may become more plausible’.⁴

As a foil to Crick’s ‘astonishment’, it is appropriate to cite an opposite source of ‘astonishment’, this time expressed by a geneticist who took the path from atheism to faith, well into his biomed-

1 A neuron is a nerve cell. This phrase was suggested by Francis Crick as how Lewis Carroll’s Alice might have put Crick’s hypothesis in Crick, F. *The Astonishing Hypothesis*, London: Simon & Schuster (1994), p. 3.

2 *Ibid.*, p. 3.

3 *Ibid.*, p. 258.

4 *Ibid.*, p. 261f.



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ical career. Francis Collins, the director of what is one of the most significant biological enterprises at the beginning of the twenty-first century, the National Human Genome Institute in Washington, describes his personal journey to faith and, applying his faith to his work, asks, ‘Well, what then should we as Christians say about the study of the human genome? First, we can and should experience astonishment at the elegance and beauty of the genome. Second, we must study the genome if we believe in the mandate to heal.’⁵

Whichever of the two reasons for ‘astonishment’ are preferred, clearly there is a theological issue raised by the reductionist claim that we are ‘nothing but a pack of neurons’.

Reductionism

Reductionism gets its name from explaining ‘wholes’ by reducing them to explanations in terms of their parts. ‘Briefly put,’ says Ian Barbour, ‘reductionism is taken to imply that religion is just psychology, psychology is basically biology, biology is the chemistry of large molecules, whose atoms obey the laws of physics, which will ultimately account for everything!’⁶ Chemical compounds like common salt and methylated spirits can be explained as made up of smaller constituents, the elements sodium, chlorine, carbon, hydrogen and oxygen. The elements themselves can then be

5 Collins, F. ‘The Human Genome Project: Tool of Atheistic Reductionism or Embodiment of the Christian Mandate to Heal?’, *Science and Christian Belief* (1999) 11(2), 110. See also Collins, F. *The Language of God*, New York: Free Press (2006).

6 Barbour, I.G. *Issues in Science and Religion*, London: SCM Press (1966) p. 7.

explained in terms of the protons, neutrons and electrons that make *them* up and these in turn are explained in terms of quarks and so forth. It is rather like peeling an onion, layer by layer.

None of this sounds particularly threatening to religious beliefs and neither is it. But if we start on the downward ladder of explanation from a little higher up, at the level of the macromolecules that make up our bodies, it prompts the earlier question as to whether humans are *just* atoms and molecules? Was a video on nutrition right in its title 'You Are What You Eat'? Certainly we do not now share with Descartes the expectation of finding a 'soul' located in the pineal gland. Furthermore, it is true that if every atom and molecule in our bodies were taken away, there would be nothing left. So, in the highly restricted sense of our physical make-up, we are atoms and molecules. We are

Enough water to fill a ten-gallon barrel;
enough fat for seven bars of soap;
carbon for 9,000 lead pencils;
phosphorus for 2,200 match heads;
iron for one medium-sized nail, and so forth.⁷

We may be left feeling a little uneasy about such a description. Is that *all* there is to be said about us: a list of common chemicals that could be purchased for a few pounds? The meaning of the word 'all' is, of course, the nub of the matter.

Amber, flashing words

Lovers know there is much more to be said about each other than can be expressed in a chemical list. It is not that the chemical list is wrong, just inappropriate and grossly inadequate for courtship. Assertions like, 'we are simply highly complex chemical mechanisms'; 'we are just atoms and molecules'; 'we are only physical material' and 'we are nothing but a collection of protons, neutrons and electrons' are suspect on account of their inclusion of the words 'simply', 'just', 'only' and 'nothing but'. These words act as a warning to keep intellectually alert and to watch carefully for what follows them – they serve as 'amber, flashing words'. Take those words away and the statements that follow are perfectly valid. So it begins to look as though there may be more than one sort of reductionism – one which makes non-contentious statements about what makes up our bodies and another which seems to go far beyond that by claiming that physical descriptions/explanations constitute the sum total of all there is to be said. These two sorts of reductionism are commonly regarded as the major ones, and for reasons that we shall see shortly, they go by the rather clumsy terms *methodological reductionism* and *ontological (metaphysical) reductionism*, respectively, terms that need unpacking. There is also a third sort, *epistemological reductionism*, which I shall also describe briefly for the sake of completeness.

Methodological reductionism

Arthur Peacocke provides a clear definition of methodological reductionism when he writes that

The breaking down of unintelligible complex wholes into their component units, finding the structures of those pieces and what functions they can perform, and then fitting them together as best one can, at least theoretically, to see how they function together in a complex whole is such a common ploy in experimental science that most practising scientists would consider it scarcely worth remarking upon.⁸

The approach is central to the scientific enterprise and goes a long way to explaining the huge success of science; the identification of the structure of DNA, already referred to, is a particular case

of such fruitfulness. Another example, from physics this time, concerns the properties of gases. If a gas is taken to consist of a large collection of molecules in random, continuous motion, gas pressure can be understood to arise from the continuous bombardment of these molecules on the walls of the containing vessel. The 'higher level' understanding of the properties of gases is well explained by an understanding of the properties of gas molecules.

Robert Boyle was one of the founder members of the Royal Society in 1660 and in his book, *A Disquisition about the Final Causes of Natural Things* (1688), he 'argues that the scientist, in his day-to-day work, need pay no attention to anything except the size, shape, texture, and motion of particles.'⁹ Yet one of the books he wrote was *The Christian Virtuoso*,¹⁰ subtitled *Shewing that, by being addicted to Experimental Philosophy [science], a man is rather assisted than indisposed to be a good Christian*. There is an important difference, as Boyle recognised, between reductionism as a *method* and the claim that the atom-and-molecule-story is the *only* valid account of the world. *Methodological reductionism* is theologically benign. It is a scientifically fruitful approach that presents no threat to religious belief: a definite help, not a hindrance.

Emergence

A possible pitfall, however, when applying the technique of methodological reductionism is that, by concentrating on the constituent parts, insufficient attention is given to the way the parts are arranged. The *organisation* of the constituents is very important. New properties may emerge in the whole, because of the way the parts are arranged, properties that are not possessed by the parts taken in isolation. Significant information can be lost if a system is only inspected at the *analytic* level. The *synthetic* level needs to be considered as well. For example, an electron and a proton combine to form something new – an atom of hydrogen. With a large number of hydrogen molecules, a new property, 'gaseous', emerges, a property of collections, a *colligative* property. The same applies for oxygen, but with a different combination of constituents.

A chemical example is that of combining the gases oxygen and hydrogen into the compound, water. Out of this chemical combination of the two gaseous elements a new property – wetness – emerges which is not possessed by either of the gases oxygen and hydrogen themselves. Furthermore, another property, that of being gaseous, has been lost in the process.

A further example of *emergence*, one that brings us closer to the relationship of science and theology, comes by considering the reductionist accounts of two books. One is a paperback copy of the Bible and the other is a copy of a railway timetable for 2006. At the atomic and molecular levels they both consist of a similar selection of the 92 naturally occurring elements. Thus they might be said to be essentially the same. At the next level up their descriptions may also be indistinguishable, for they both consist chemically of cellulose on which carbon, in the form of printer's ink, is distributed. They may physically have similar masses, volumes and shapes. Even at the next higher level their construction shows little difference, each having sheets of paper joined at one edge, the back and front being of stiff material, perhaps with colour printing on it. The black printer's ink inside is arranged from the same number, in excess of 26, of distinct shapes such as 'a', 'j', 'p', '5', '?'. Again, at this level, the two books might be said to be essentially the same. They both contain groups of these shapes, or symbols, even though the timetable has more numbers than letters. Many of these groups of letters are the same – the words. But what is different about the books is the way the words are organised into sequences, the sentences, to give them *meaning*. Taking this into account, one book is

7 Quoted by Howard, B.A. in *The Proper Study of Mankind* and cited in Joad, C.E.M. *Philosophy for our Times*, London: The Scientific Book Club (1942), p. 146.

8 Peacocke, A.R. *Reductionism in Academic Disciplines*, Guildford: Society for Research into Higher Education & NFER-Nelson (1985), p. 9.

9 Passmore, J. BOYLE, ROBERT (1627-1691) in *The Encyclopedia of Philosophy 1*, London: Collier Macmillan Publishers (1967) p.359.

10 *Virtuoso* – an experimenter or investigator in the arts or sciences.

already out-of-date and useless while the other is in many ways a timeless book. Out of the organisation of the individual words into sentences emerge new properties, those of *meaning* and *purpose*. In one case it means trains can be expected at particular times and the purpose is to enable passengers to plan their journeys. In the other book, 'the primary purpose of the sacred writings', to use Galileo's words, is 'the service of God and the salvation of souls'.¹¹

The sentence 'Elizabeth went to the shops to get some bread' loses all sense when expressed in the language of brain science

The property of life itself, though difficult to define precisely, is completely missed out in a study of the constituent atoms that go to make up living matter. Further up the scale of complexity, most scientists would regard consciousness as an emergent property of the high complexity of our brains. The sentence 'Elizabeth went to the shops to get some bread' loses all sense when expressed in the language of brain science, such as the firing of neurons, so is strictly non-reducible to such a level, which of course does not at all imply that the neuroscientist's description of Elizabeth's brain as she goes to buy bread is not perfectly adequate as far as it goes. The mind appears to be an emergent property of the brain.

Although the discovery and recognition of emergent properties are intrinsic to the scientific enterprise, science itself does not deal with matters of ultimate purpose and the meaning of life. Such matters lie outside its sphere of competence. Indeed, many biologists expressly avoid any form of teleological¹² explanation in biology. So, for example,

The theory of evolution through natural selection allows speculation about the function for which particular things are adapted, and so permits assertions about the purpose an adaptation serves, without any commitment to the idea of a designer who put it there for a purpose, and without the unscientific belief that the future utility of a feature somehow brings about its existence by a kind of backwards causation.¹³

But this does not, of course, entail that there is no 'designer' or 'purpose' in an ultimate sense, nor that evolution entails atheism. These are simply matters which science is not competent to address. It is therefore a methodological convention in science not to refer to First Causes (God) but to stick to immediate causes.

So, whereas methodological reductionism is theologically benign, new, emergent properties that may arise on account of the organisation of the constituents can be easily missed when considering only the component level, a reminder that the reductionist account taken in isolation is always bound to be incomplete.

Epistemological reductionism

'Epistemological reductionism can be described as the view that, if the theories and experimental laws formulated in one field of science (e.g. biology, psychology, sociology) can be shown to be special cases of theories and laws formulated in some other branch of science (e.g. physical chemistry, or biology, or in the neurosciences) then the former set of theories and experimental laws, is said to be reduced to the latter.'¹⁴

Epistemology concerns the nature and grounds of belief and knowledge, what we can know and how we know it. We have already met the idea that, if a gas is taken to consist of a large collection of molecules in random, continuous motion, then gas pressure can be understood in terms of the continuous bombardment of

gas molecules on the walls of the containing vessel. If, however, further assumptions are made – that the molecules take up no room and no energy is lost when they collide, it is possible to derive a common law of physics – Boyle's [gas] law¹⁵ – without even going into the laboratory to do an experiment. This illustrates how a theory at a higher level (gas pressure) can be reduced to a theory at a lower level (particles in motion), which is the essence of *epistemological reductionism*. Again, as with *methodological reductionism*, this represents a significant help in our understanding of the world and poses no challenge to religious belief.

Ontological reductionism

'Because of the success of methodological reductionism as a procedure for research, many scientists, who find such methods a necessity and successful, come to view the entities they are studying as 'nothing but' their components. Biological systems in this view are 'nothing but' complex patterns of atoms and molecules. Certainly, we could all agree, they consist of atoms and molecules. But many go on to imply – and this is a significant transition – that there is nothing else that is worth saying.'¹⁶

'Ontology', derived from the Greek word for 'being', is the study of what exists. The phrase *ontological reductionism* is given to the view that not only can complex systems be described in terms of their constituents, but that by so doing, *everything worth saying about them has been said*. This goes far beyond being a methodological principle. It is a philosophical position that is not entailed by the principle; it is a metaphysical¹⁷ belief, which is why it is sometimes called by the alternative name of *metaphysical reductionism*. In our earlier example, it would clearly be very different to say 'This book is *nothing but* carbon on cellulose' from saying, 'The book is carbon on cellulose'.

The 'amber, flashing words' which herald ontological reductionism are words like 'simply', 'just', 'only' and especially 'nothing but' and because of this, the late Donald MacKay dubbed ontological reductionism, 'nothing-buttery'.

The notice 'POLICE LINE DO NOT CROSS' is only blue lettering on white tape and the sign 'DANGER OF DEATH' by the electricity transformer is nothing but black and yellow paint on metal. Take the tape, the paint and the metal away and there is nothing left. But there is more to be said about these objects than the substances that make them up and we ignore that 'something extra', the emergent property of *significance*, at our peril.

Ontological reductionism, often abbreviated to just 'reductionism', is essentially a debunking tactic. Those who use it are seeking to belittle aspects of the world, with which they may disagree, by asserting that one way (a scientific way) of looking at things is all that matters. But it is important to distinguish between what is an unsupported assertion (however often made) and what is an argument to be evaluated, accepted or rebutted. By contrast with *methodological reductionism*, which has been described as theologically benign, *ontological reductionism* might be dubbed theologically 'malignant', since, if its claims could be justified, it would discount any kind of spiritual life, and indeed much else besides. As far as attaining a multilayered, nuanced understanding of the world is concerned, this sort of reductionism can be seen as a hindrance.

An area of study where this debunking has been particularly evident is in commentary on the nature of humankind. Some of those who reject the idea of humans as made in the 'image of God' have overplayed the continuity of humankind with the rest of the animal kingdom. The fact that 96% of the DNA between humans and

11 Galilei, G. (1615) 'Letter to Madame Christine of Lorraine, Grand Duchess of Tuscany, Concerning the Use of Biblical Quotation in Matters of Science' trans. in Seeger, R.J. *Galileo Galilei, his life and his works*, Oxford: Pergamon (1966), p. 271.

12 Teleology, from the Greek *telos*, 'end', is the study of the ends and purposes of things.

13 Blackburn, S. *The Oxford Dictionary of Philosophy*, Oxford: OUP (1994), p. 374.

14 Peacocke, *op. cit.* [8], p. 14.

15 Boyle's law states that 'For a fixed mass of gas at constant temperature, the volume varies inversely as the pressure'. This means that, provided no gas escapes and you don't heat it up or cool it, doubling the pressure halves the volume and so forth.

16 Peacocke, *op. cit.* [8], p. 11.

17 Metaphysics is the term now used for enquiries that raise questions about reality that are beyond the competence of science to address.

chimpanzees is virtually identical is used to bolster the idea that a human is *nothing but* a 'naked ape'. What this figure of 96% supports is our shared common ancestry with the chimpanzee. It should not be interpreted to mean that the 4% that differs is, in itself, what makes us human. At the genetic level the key differences between the human and the chimpanzee are likely to be the control regions that regulate the timing and expression of genes during embryonic development. But along with this commonality must be considered the enormous differences between these two members of the animal kingdom. These are evident in human technical achievement, social organisation and linguistic capabilities. True, chimps can make rudimentary tools such as tying two sticks together to get a banana from outside a cage that is out of reach of one stick alone. They can perform elementary communications in ASL (American Sign Language) and they have extensive social structures. But such attributes fall far short of space travel, literary works of art or the complexities of local and central government. This comparison of humans with chimpanzees highlights another problem of methodological reductionism, namely that the more one looks for what is common to everything, the more there is that one fails to take into account. After all, if we turn from the 96% of shared DNA to the constituent parts of DNA itself, we share 100% of our atoms with the chimpanzees! But, as hinted at the beginning of the paragraph, the biblical distinction between humankind and other members of the animal kingdom is not in *physical form* but in *spiritual nature*. Being made in the 'image of God' refers, among other things, to being able to enter into a spiritual relationship with God, which is best described at the personal level, not at the DNA level.

Naturalism

There is a thin dividing line between ontological reductionism ('nothing-buttery') and 'naturalism', a term that is generally understood to mean that 'ultimately nothing resists explanation by the methods characteristic of the natural sciences'. 'Naturalism' carries an additional assumption to *ontological reductionism*, namely, that all that exists is amenable to the methods of science. However, if science is the study of the natural world, it would appear powerless to study anything of a non-natural kind. Religious enquiry includes questions about whether anything *other* than the natural world (God?) exists, to which the natural world owes its existence; and it is no use going to science – the study of the natural world – to answer the question 'is there anything *other* than the natural world! The limitations of science to answer questions like these are highlighted in the requirement of the most recent version of *Science, The National Curriculum for England (2006)*. In the Key Stage 4 programme of study it states that 'Pupils should be taught: ... that there are some questions ... that science cannot address.'¹⁸

18 *Science: The National Curriculum for England*, London: Department for Education and Skills/ Qualifications and Curriculum Authority (2006), p. 37.

The naturalistic claim that 'ultimately nothing resists explanation by the methods characteristic of the natural sciences' raises the key question as to what counts as an explanation for something.¹⁹ First, it needs to be remembered that there are many different *types* of explanation. Two types of *reason-giving* explanations that are germane to the subject of this paper are those that provide explanations in terms of (scientific) mechanisms and those that explain in terms of divine agency and purpose. There is no logical incompatibility in the two statements 'In the beginning God created the heavens and the earth' (Gen 1:1) and 'In the beginning there was a Big Bang.' Scientific explanations are not the only possible explanations, nor necessarily the best explanations, depending on the matter in hand. An explanation of why the victim died might be a scientific one describing the effects of arsenic on the human body, but to the police, the type of explanation of greatest importance would concern agency and purpose.

To return to a point touched upon earlier when referring to teleology, it is a methodological convention in science to refer only to immediate causes, omitting all reference to First Causes. Hence science is concerned with explanations of physical mechanisms and not with explanations concerning God. There is no more need to mention the Creator when explaining the mechanisms of creation than there is to mention Henry Ford when explaining how a car works. No snub is implied. The scientific enterprise itself entails no denial of divine agency; it is outside its terms of reference and leaves the matter entirely open. This convention enables people of all faiths and none to work together on the common scientific enterprise. Individual scientists may take a naturalistic view, but if they do, they are going beyond science and importing metaphysical views of their own.

Conclusion

It is only when the scientifically fruitful tool of *methodological* reductionism is contaminated by the *metaphysical* notion of 'nothing-buttery' that tensions arise for religion:

That nothing-buttery poses a serious challenge to a religious perspective on life is almost self-evident. My belief is that it is this philosophical position adopted by many scientists, with the propaganda put out in its favour, rather than any specific scientific theories, which has been the major contributory factor to the widespread acceptance in society that science and religious belief are not only in conflict, but that science has made religion completely superfluous.²⁰

But such *ontological reductionism* forms no part of science itself. Where it is found among its practitioners, it is not because it is inherent in science, nor because science leads to it, but because it has been smuggled in from the beginning of the discussion.

19 Poole, M. W. 'Explaining or Explaining Away? – The Concept of Explanation in the Science-Theology Debate' *Science and Christian Belief* (2002) 14(2), 123 – 142.

20 Holder, R. D. *Nothing But Atoms and Molecules? Probing the limits of science*, Tunbridge Wells: Monarch (1993), p. 12.

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