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The Implications of the Provisionality of Science

in the Dialogue with Theology

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In this paper, I want to note that there is a significant degree of provisionality to the findings of the natural sciences, and that this must have a bearing on any dialogue between these sciences and theology. Each generation within the scientific community seems to have thought that the scientific enterprise was essentially complete; all that remained to be done was to achieve an increasing precision of measurement. In his 1871 inaugural lecture as the first Cavendish Professor of Physics at Cambridge University, James Clerk Maxwell spoke critically of a tendency he discerned among some of his fellow scientists:¹

This characteristic of modern experiments - that they consist principally of measurements - is so prominent, that the opinion seems to have got abroad that in a few years all the great physical constants will have been approximately estimated, and the only occupation which will then be left to men of science will be to carry on these measurements to another place of decimals.

Maxwell himself regarded this viewpoint, which he studiously avoids attributing to any of his colleagues, as unduly pessimistic. In his view, a combination of human creativity and the "unsearchable riches of creation" meant that science was far from complete.

The view that all things worth knowing were already known may, however, be found in the writings of many noted nineteenth-century scientists. For example, Max Planck relates how he found himself uncertain what subject to study at the University of Munich in 1875. His inclination to study the natural sciences was rubbished by the then Professor of Physics at the university, who declared that nothing worthwhile remained to be discovered.² Robert A. Millikan - whose investigations of the electron broke new ground - recalls how physics was widely regarded as a "dead subject" in American academic circles during the early 1890s.³ Such views were widespread, and can be found in many scientific writings of the period. The leading American astronomer Simon Newcomb felt able to assert in 1888 that more or less everything of importance had been seen and measured; what remained was to consolidate this body of knowledge:⁴

So far as astronomy is concerned, we must confess that we do appear to be fast approaching

the limits of our knowledge. True, there is still a great deal to learn. Every new comet that appears must be found by someone, and I do not grudge the finder the honors awarded him. At the same time, so far as we can see, one comet is so much like another that we cannot regard one as adding in any important degree to our knowledge. The result is that the work which really occupies the attention of the astronomer is less the discovery of new things than the elaboration of those already known, and the entire systemization of our knowledge.

With the passage of time, there has been increasing recognition of the provisionality of scientific understanding.⁵ As Karl Popper has pointed out, part of the paradox of the scientific method is that while science is the most critically tested and evaluated form of knowledge available, it is nevertheless tentative and provisional.⁶ Science is to be seen as an "unended quest," whose findings may be up-to-date but are never final. As techniques are refined and conceptual frameworks modified, the understandings of one generation of natural scientists give way to those of another. Although there is a clear degree of continuity between the understandings of successive generations, this can be argued to be based more on the methods which they applied than on the outcome of their application.

The history of the scientific enterprise makes it abundantly clear that theories which were widely accepted in one generation - on the basis of the best evidence available - were superseded in following eras. For example, Newtonian mechanics and his theory of universal gravitation were widely regarded as correct in the eighteenth and nineteenth centuries, not on account of any sociological factors predisposing the scientific community to accept them, but simply because they offered the best explanation of the available observations. Yet the Newtonian world-view has now been superseded by the Einsteinian, on account of the explanatory and predictive successes of the general theory of relativity. Perhaps the most famous example of this over-confidence in existing scientific paradigms is Lord Kelvin's assertion, made in the closing years of the nineteenth century, that all that remained for physics to achieve was to fill in the next decimal place.⁷ The abandonment of the concept of "ether" and advent of quantum mechanics would demonstrate the provisionality of much of what appeared to be settled at the end of that century.⁸

Similarly, Newton's corpuscular theory of light was widely accepted in the eighteenth century, before being displaced by Fresnel's elastic solid ether theory, which envisaged a wave model of light. Fresnel's theory was strikingly successful in terms of its predictions and explanations, and also possessed the admirable qualities of simplicity and coherence. Yet the light-theories of both Newton and Fresnel were both ultimately superseded by the quantum approach to light, developed by Einstein as a means of explaining the photoelectric effect.⁹ There have thus been radical discontinuities in understanding in the history of the natural sciences, even though the fundamental methods of investigation of the world, and their accompanying assumptions, have remained unchanged, save for technological advances.

It will thus be clear that to base the interaction of theology and the natural sciences on the basis of the outcome of the application of their methods runs the risk of characterizing and defining the nature of that interaction on provisionalities. The inevitable result of this would be an understanding of the interaction which is temporary and potentially superficial. The natural sciences are breaking new ground, gradually rendering obsolete those understandings of the world which once seemed secure. Yet the methods and assumptions by which those provisional understandings are gained remain virtually the same - namely, that there is an independent reality to the world, the ordering and structure of which can be investigated empirically and expressed mathematically by the human mind.

A theology which is grounded in the alleged "certain findings" of the natural sciences will therefore find itself outdated with every advance in scientific understanding. The many eighteenth-century British theologians who sought to forge an alliance between Newtonian physics and Christian theology are nowadays regarded with a

degree of pity mingled with historical curiosity, not to mention a slight dash of Schadenfreude. While there is no doubt that the early eighteenth-century proponents of a Newtonian-style natural theology, or some variant of a "physico-theology," developed ideas which are of purely historical interest, it is important to realize that these were seen as being at the cutting edge of advanced theological speculation by their proponents and at least some of their contemporary public. What now seems quaint and hopelessly outmoded was then seen as thoroughly up-to-date.

Without in any way endorsing the intensely problematical assumptions of Thomas Kuhn's model of scientific revolutions, there can be no doubt that Kuhn has demonstrated that today's scientific certainties are routinely overthrown by a later generation.¹⁰ "Today, most scientists believe that . . ." - prefaced to a statement that is taken to be correct - has a disconcerting tendency, with the passage of time, to become "Yesterday, most scientists believed that . . .", prefaced to a statement which is now taken to be wrong - even though it was once believed to be right within the scientific community. A theology which is derived from, or justified with reference to, such "certainties" is thus destined for oblivion with the passage of time.

The study of the history of Christian theology indicates the need to avoid becoming committed to the accepted scientific wisdom of the day. As we have already noted, English theologians of the eighteenth century developed quite sophisticated understandings of the interaction of science and theology, based on the assumption that the Newtonian worldview had been demonstrated to be correct beyond reasonable doubt.¹¹ Similarly, both William Paley's *Natural Theology* and the *Bridgewater Treatises* were thoroughly contemporary in terms of their scientific assumptions; the erosion of those scientific assumptions inevitably entailed a corresponding reduction in the plausibility of the appended - and dependent - theology.¹² Going back further, the development of medieval theology often shows an unsettling dependence upon certain widely-held (yet largely non-empirical) "scientific" assumptions, deriving from the Aristotelian physics of the period. The biblical exegesis and theological analysis of that period tend to reflect the unconscious incorporation of Aristotelian ideas on the basis of the implicit assumption that these were "correct."¹³ As a result, there was intense resistance to new approaches to biblical interpretation which called these settled Aristotelian presuppositions into question. Through a subtle and largely unconscious process of reasoning, a text which was originally interpreted in the light of Aristotelian presuppositions subsequently became regarded as proof of those Aristotelian presuppositions.¹⁴

So what are the implications of this exploration for the dialogue in science and religion? Well, perhaps most obviously, we need to avoid the simplistic belief that the latest scientific theory is right! Paradigm shifts happen, and are important for theology. To fail to appreciate this is to trap theology in the latest equivalent of Newtonian mechanics, which will be displaced at some future point. More interestingly, the factors noted above suggest that it is the working assumptions of the sciences - such as a belief in the ordering of the universe, in the ability of the human mind to discern such ordering, and to represent it mathematically - which may prove a more fruitful basis for a dialogue between theology and the natural sciences.

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2. Max Planck, *A Scientific Autobiography*. New York: Philosophical Library, 1949, 8.
3. Robert A. Millikan, *The Autobiography of Robert A. Millikan*. New York: Houghton, Mifflin, 1950, 23-4. On Millikan, see Robert Hugh Pargon, *The Rise of Robert Millikan: Portrait of a Life in American Science*. Ithaca, NY: Cornell University Press, 1982.
4. Simon Newcomb, "The Place of Astronomy among the Sciences," *The Sidereal Messenger* 7 (1888), 69-70.
5. For some useful reflections on this theme, see John Maddox, *What Remains to be Discovered: Mapping the Secrets of the Universe, the Origins of Life, and the Future of the Human Race*. New York: Free

- Press, 1998.
6. Karl R. Popper, *Conjectures and Refutations: The Growth of Scientific Knowledge*. London: Routledge & Kegan Paul, 1963.
 7. See William Dampier, *A History of Science*. Cambridge: Cambridge University Press, 1938, 382; Lawrence Badash, "The Completeness of Nineteenth-Century Science," *Isis* 63 (1973), 48-58.
 8. A. A. Michelson, and E. W. Morley, "On the Relative Motion of the Earth and Luminiferous Ether," *American Journal of Science* 34 (1887), 333-345; S. Goldberg, and R. Stuewer, *The Michelson Era in American Science, 1870-1930*. New York: American Institute of Physics, 1988; Stanley Goldberg, "Poincaré's Silence and Einstein's Relativity," *British Journal for the History of Science* 5 (1970), 73-84; T. Hirose, "Theory of Relativity and the Ether," *Japanese Studies in the History of Science* 7 (1968), 37-53; T. Hirose, "The Ether Problem, the Mechanistic World View, and the Origins of the Theory of Relativity," *Historical Studies in the Physical Sciences* 7 (1976), 3-82; Andrew Warwick, "The Sturdy Protestants of Science: Larmor, Trouton and the Earth's Motion through the Ether," in Jed Z. Buchwald (ed.), *Scientific Practice: Theories and Stories of Doing Physics*. Chicago: University of Chicago Press, 1995, 300-343.
 9. On which see Albert Einstein, "Über einen die Erzeugung und Verwandlung des Lichtes betreffenden heuristischen Gesichtspunkt," *Annalen der Physik* 17 (1905), 132-148.
 10. See Thomas Kuhn, *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press, 1962. For indications of some concerns over Kuhn's proposals, see Paul Hoyningen-Huene, "Kuhn's Conception of Incommensurability," *Studies in History and Philosophy of Science* 21 (1980), 481-92; Maben Walter Poirier, "A Comment on Polanyi and Kuhn," *The Thomist* 53 (1989), 259-279; Cordell Strug, "Kuhn's Paradigm Thesis: A Two-Edged Sword for the Philosophy of Religion," *Religious Studies* 20 (1984), 269-279.
 11. John Gascoigne, "From Bentley to the Victorians: The Rise and Fall of British Newtonian Natural Theology," *Science in Context* 2 (1988), 219-256; Larry Stewart, "Seeing through the Scholium: Religion and Reading Newton in the Eighteenth Century," *History of Science* 34 (1996), 123-165.
 12. John Hedley Brooke, "Science and the Fortunes of Natural Theology: Some Historical Perspectives," *Zygon* 24 (1989), 3-22; Neal C. Gillespie, "Divine Design and the Industrial Revolution: William Paley's Abortive Reform of Natural Theology," *Isis* 81 (1990), 214-229.
 13. E.g., see L. W. B. Brockliss, "Aristotle, Descartes and the New Science: Natural Philosophy at the University of Paris, 1600-1740," *Annals of Science* 38 (1981), 33-69; William E. Carroll, "San Tommaso, Aristotele e la creazione," *Annales Theologici* 8 (1994), 363-376; Edward Grant, *The Foundations of Science in the Middle Ages: Their Religious, Institutional and Intellectual Contexts*. Cambridge: Cambridge University Press, 1996; Alister E. McGrath, "The Influence of Aristotelian Physics upon St Thomas Aquinas's Discussion of the Processus Iustificacionis," *Recherches de theologie ancienne et medievale* 51 (1984), 223-229.
 14. Alister E. McGrath, *The Foundations of Dialogue in Science and Religion*. Oxford: Blackwell Publishing, 1998, 118-20..