The Demarcation of Science and Religion

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Introduction

What is science? What is religion? How do the two intersect? Historians of science address these questions by analyzing how the scientific and religious beliefs of particular scientists or cultures have interacted at specific times. Philosophers of science and religion, however, have sought to characterize the relationship between them in more general terms. Their endeavor has required defining science and religion in order to distinguish or "demarcate" them from each other by clear and objective criteria. During modern times, theologians and philosophers of science have attempted to make categorical demarcations between science and religion on various definitional grounds.

Defining Differences:

Some Philosophical Context

The neo-orthodox theologian Karl Barth (1886-1968), for example, asserted that science and religion have different objects of interest. Religion and theology focus on God's self-revelation through Christ; science studies the natural world. Barth maintained that science and religion use different methods of obtaining knowledge. Scientists can know the external world through rational and empirical investigation. Yet, because of human sin, man cannot know God from the visible testimony of the creation, that is, "from the things that are made" (Romans 1:20), as Saint Paul put it. Instead, human knowledge of God comes only if God reveals himself directly to man in a mystical or an a-rational way.

Existentialist philosophers such as Soren Kierkegaard (1813-55) and Martin Buber (1878-1965) also accepted a fundamental epistemological distinction between science and religion. According to both, scientific knowledge is impersonal and objective, whereas religious knowledge is personal and subjective. Since science concerns itself with material things and their functions, objective knowledge is possible, at least as an ideal. Religion, however, involves

a personal relationship with the object known (God) and a personal or moral response to him. Therefore, radical subjectivity characterizes religious endeavor. Or, to use Buber's well-known terminology, science fosters an "I-it" relationship between the knower and the known; religion, an "I-Thou" relationship.

A group of early-twentieth-century philosophers known as logical positivists also insisted that science and religion occupy separate and nonoverlapping domains, but for different reasons. According to the positivists, only empirically verifiable (or logically undeniable) statements are meaningful. Since science makes statements about observable material entities, its statements have meaning. Religious or metaphysical beliefs, however, refer to unobservable entities such as God, morality, salvation, free will, and love. Hence, by positivistic definition, they lack meaning. As Frederick Coppleston has explained, the principal tenet of positivism was that, since experience alone provides the basis for knowledge, "the scientific method was the only means of acquiring anything that could be called knowledge" (Coppleston 1985, 117-18). Hence, positivism not only distinguishes between science and religion, but it does so on grounds that deny objective warrant to religious belief.

Models of Interaction:

Defining the Issues

Contemporary philosophers of science and religion generally recognize that science and religion do represent two distinct types of human activity or endeavor. Most acknowledge that they require different activities of their practitioners, have different goals, and ultimately have different objects of interest, study, or worship. For these reasons, some have suggested that science and religion occupy either completely separate "compartments" or "complementary" but nonoverlapping domains of discourse and concern. These perspectives have been formalized as two models of science-religion interaction known, respectively, as compart mentalism and complementarity. Compart mentalism (associated with Barth, Kierkegaard, and positivists) asserts that science and religion inevitably offer different types of descriptions of different types of realities. Complementarity (as articulated principally by neuroscientist Donald M. Mackay in the 1970s) allows that science and religion may sometimes speak about the same realities but insists that the two always describe reality in categorically different but complementary ways (that is, with so-called "incommensurable" languages). Both of these models deny the possibility of either conflict or specific agreement between science and religion. Science, properly understood, can neither support nor undermine religion since the two

represent distinct and nonintersecting planes of experience and knowledge. Both complementarity and compart mentalism thus presuppose the metaphysical or religious neutrality of all scientific theories.

Contemporary philosophers such as Alvin Plantinga, Roy Clouser, and J. P. Moreland have questioned the strict separation of science and religion. They point out that it does not follow from the real differences between them that science and religion must differ qualitatively in every respect. Thus, philosophers have noted that religions as well as sciences make truth claims. Moreover, science and religion often seem, at least, to make claims about the same subject in clear Propositional language. For example, both make claims about the origin and nature of the cosmos, the origin of life, and the origin of man; both make claims about the nature of human beings, the history of certain human cultures, and the nature of religious experience. Religions, like sciences, may be right or wrong about these subjects, but few contemporary philosophers of science (though not necessarily theologians or scientists) now agree that science and religion never make intersecting truth claims. Historical religions in particular (such as Judaism, Christianity, and Islam) make specific claims about events in time and space that may either contradict or agree with particular scientific theories.

Indeed, as Plantinga has argued, many (though not all) scientific theories have metaphysical and religious implications. Plantinga cites several examples of scientific theories, which, if taken as claims about truth rather than merely as instrumental devices for ordering experience or generating hypotheses, have clear metaphysical import. He notes that various cosmological explanations for the fine-tuning of the physical constants (the so-called "anthropic" coincidences) either support or deny a theistic conclusion; that sociobiology and theism give radically different accounts of human altruism; and that neo- Darwinian evolutionary theory, *contra* theism, denies any detectable design or purpose in creation.

On this latter score, many evolutionary biologists agree with Plantinga's assessment. Francisco Ayala, Stephen Jay Gould, William Provine, Douglas Futuyma, Richard Dawkins, Richard Lewontin, and the late G. G. Simpson, for example, all agree that neo-Darwinism (taken as a realistic portrayal of the history of life) postulates an exclusively naturalistic mechanism of creation, one that allows no role for a directing intelligence. As Simpson put it: "man is the result of a purposeless and natural process that did not have him in mind" (Simpson

1967, 344-5). In any case, these theories deny, *contra* classical theism, any discernable evidence of divine purpose, direction, or design in the biological realm. From a Darwinian point of view, any appearance of design in biology is illusory, not real. Thus, even if God exists, his existence is not manifest in the products of nature. As Francisco Ayala has explained: "The functional design of organisms and their features would ... seem to argue for the existence of a designer. It was Darwin's greatest accomplishment to show [however] that the directive organization of living beings can be explained as the result of a natural process, natural selection, without any need to resort to a Creator or other external agent" (Ayala 1994,4-5). As Richard Lewontin and many other leading neo-Darwinists have noted, organisms only "appear" to have been designed.

Statements such as these clearly illustrate why attempts to impose a strict separation between science and metaphysics or science and religion have been increasingly questioned. Where scientific theories and religious doctrines are taken as truth claims (as both scientists and religious believers usually require), some scientific theories may be taken as either supporting or contradicting religious doctrines. Indeed, many would argue that there is no reason to exclude the possibility that some truth claims of religion may be evaluated rationally on the basis of public evidences. Several of the examples cited above suggest that scientific discoveries or theories may well contradict religious doctrines. Other examples suggest the possibility that science may also provide support for the truth claims of religion. Archaeological evidence may support biblical assertions about the history of Israel or early Christianity; cosmological or biological evidence may support various theological conceptions of creation; and neurophysiological or psychological evidence may support religiously derived understandings of consciousness and human nature. While many religious practitioners would acknowledge with Barth and Buber that religious commitment requires more than intellectual assent to doctrinal propositions, it does not follow that the propositional truth claims of religion may not have an evidential or rational basis.

Hence, recent work on the relationship between science and religion has suggested limits to the complementarity and compart mentalism models. While most philosophers of science and religion would agree that compart mentalism and complementarity model some aspects of the relationship between science and religion accurately, many now assert that these models do not capture the whole of the complex relationship between science and religion. Real conflict and real

agreement between scientific and religious truth claims has occurred and is possible. Theories of science may not always be religiously or metaphysically neutral.

Yet, contemporary defenders of the complementary model contend that the alleged metaphysical implications of scientific theories represent illicit or unsupported extensions of scientific theory, not the science itself. They assert that statements such as those cited above about the meaning of Darwinism, for example, do not represent science per se, but "para-scientific" reflection about science or a pseudoscientific "apologetic" for philosophical naturalism. Such reflection may reveal the predilections of scientists (for example, or Simpson), but it does not demonstrate any real implications of science.

Those critical of complementarity agree that Ayala's statements do reflect metaphysical biases these statements may lack empirical support. Yet, for them it does not follow that either Gould's or Simpson's articulation of Darwinism is inaccurate. Nor does it follow that Darwinism does not constitute a scientific theory. Many scientific theories reflect the biases of scientific theorists. Some are inadequately supported or fallible. Does that mean that they are necessarily unscientific? This discussion begs a more fundamental question. Can scientific theories have metaphysical implications? If not, why not? Could Darwin, for example, formulate a scientific theory specifying that life arose as a result of *exclusively* naturalistic forces such as natural selection and random variation? Could he, as a scientist, deny that divine guidance played a causal role in the process by which new species are created? Many historians of science now agree that Darwin meant to exclude a causal role for God in his theory of evolution. They also agree that competing theories implied just the opposite. Is Darwinism, then, unscientific? Indeed, was all nineteenth-century biology prior to Darwin unscientific? If so, on what grounds? What exactly is science?

History of the Demarcation Issue

Such questions lead inevitably to the center of one of the most vexing issues in the philosophy of science, namely, the demarcation issue. Identifying scientific theories or truth claims and distinguishing them from religious or metaphysical truth claims (as opposed to religious practices or rituals) seems to require a set of criteria for defining science. But what exactly makes a theory scientific? And how can scientific theories be distinguished or demarcated from pseudoscientific theories, metaphysical theories, or religious beliefs? Indeed, should they be?

In a seminal essay, "The Demise of the Demarcation Problem" (Laudan 1988a, 337-50), Larry Laudan explains that contemporary philosophers of science have generally lost patience with attempts to distinguish scientific theories from nonscientific theories. Demarcation criteria (criteria that purport to distinguish true science from pseudoscience, metaphysics, and religion) have inevitably fallen prey to death by a thousand counter-examples. Many theories that have been repudiated on evidentiary grounds express the very epistemic and methodological virtues (for example, testability, falsifiability, repeatability, and observability) that have been alleged to characterize true science. By contrast, some highly esteemed theories lack one or more of the allegedly necessary features of science.

Laudan notes that, following Aristotle, science was first distinguished from nonscience by the degree of certainty associated with scientific knowledge. Science, it was thought, could be distinguished from nonscience because science produced certain knowledge (*episteme*), whereas other types of inquiry, such as philosophy or theology, produced opinion (*doxa*). Yet, this approach to demarcation ran into difficulties. Unlike mathematicians, scientists rarely provided strict logical demonstrations (deductive proofs) to justify their theories. Instead, scientific arguments often utilized inductive inference and predictive testing, neither of which produced certainty. Moreover, these limitations were clearly understood by philosophers and scientists by the late Middle Ages. For example, William of Ockham (c. 1280-c. 1349) and Duns Scotus (c. 1265-c. 1308) specifically refined Aristotelian inductive logic in order to diminish (but not eliminate) the fallibility known to be associated with induction. Further, as Owen Gingerich has argued, some of the reason for Galileo's conflict with the Roman Catholic Church stemmed from his inability to meet scholastic standards of deductive certainty, standards that he regarded as neither relevant to, nor attainable by, scientific reasoning. By the late Middle Ages, and certainly during the scientific revolution, scientists and philosophers understood that scientific knowledge, like other knowledge, is subject to uncertainty. Hence, attempts to distinguish science from nonscience began to change. No longer did demarcationists attempt to characterize science on the basis of the superior epistemic status of scientific theories; rather they attempted to do so on the basis of the superior methods science employed to produce theories. Science came to be defined by reference to its method, not its certainty or its content.

This approach also encountered difficulties, not the least of which was the consistent presence of disagreement about what the method of science actually entails. During the seventeenth century, the so-called mechanical philosophers insisted, contrary to Aristotelians, that scientific theories must provide mechanistic explanations. Yet, Isaac Newton (1642-1727) formulated a theory that provided no such mechanistic explanation. Instead, his theory of universal gravitation described mathematically, but did not explain, the gravitational motion of the planetary bodies. Despite provocation from Gottfried Wilhelm Leibniz (1646-1716), who defended the mechanistic ideal, Newton expressly refused to give any explanation for the mysterious "action at a distance" associated with his theory of gravitational attraction.

Similar debates about scientific method occurred during the nineteenth century. Some scientists and philosophers regarded the inductive procedures of John Stuart Mill (1806-73) and William Herschel (1738-1822) as representative of the true scientific method. Others articulated the so-called *vera causa* ideal, which limited science to previously known or observable causes. Still others, such as C. S. Peirce (1839-1914) and William Whewell (1794-1866), insisted that predictive success constituted the most important hallmark of true science, whether or not theoretical entities could be observed directly. Yet, Peirce and Whewell also acknowledged that explanatory power, as opposed to predictive success, characterized scientific theorizing in some contexts. Such lack of agreement brought havoc upon the demarcationist enterprise. If scientists and philosophers cannot agree about what the scientific method is, how can they distinguish science from disciplines that fail to use it? In any case, there may well be more than one scientific method. Historical sciences, for example, use distinctive types of explanations, inferences, and modes of testing. If more than one scientific method exists, then attempts to mark off science from nonscience by using a single set of methodological criteria will almost inevitably fail.

As problems with using methodological considerations grew, the demarcationist enterprise again shifted ground. Beginning in the 1920s, philosophy of science took a linguistic, or semantic, turn. The logical-positivist tradition held that scientific theories could be distinguished from nonscientific theories not because scientific theories had been produced via unique or superior methods, but because such theories were more meaningful. Logical positivists asserted that all meaningful statements are either empirically verifiable or logically undeniable.

According to this "verificationist criterion of meaning," scientific theories were more meaningful than philosophical or religious ideas because scientific theories referred to observable entities, whereas philosophy and religion referred to unobservable entities. This approach also subtly implied the inferior status of metaphysical beliefs.

Yet, positivism eventually self-destructed. Philosophers came to realize that positivism could not meet its own verificationist criterion of meaning: The verificationist criterion turned out to be neither empirically verifiable nor logically undeniable. Furthermore, positivism misrepresented much actual scientific practice. Scientific theories refer to unverifiable and unobservable entities such as forces, fields, atoms, quarks, and universal laws. Meanwhile, many disreputable theories (for example, the flat-Earth theory) appeal only to "common sense" observations. Clearly, positivism's verifiability criterion would not achieve the demarcation for which philosophers of science had hoped.

With the demise of positivism, demarcationists took a different tack. Karl Popper (1902-94) proposed falsifiability as a demarcation criterion. According to Popper, scientific theories can be distinguished from metaphysical theories because scientific theories can be falsified (as opposed to verified) by prediction and observation, whereas metaphysical theories cannot. Yet, this, too, proved to be a problematic criterion. First, falsification turns out to be difficult to achieve. Rarely are the core commitments of scientific theories directly tested via prediction. Instead, predictions occur when core theoretical commitments are conjoined with auxiliary hypotheses (hence, always leaving open the possibility that auxiliary hypotheses, not core commitments, are responsible for failed predictions). Newtonian mechanics, for example, assumed as its core three laws of motion and the theory of universal gravitation. On the basis of these assumptions, Newton made a number of predictions about the positions of planets in the solar system. When observations failed to corroborate Newton's predictions, he did not reject his core assumptions. Rather, he altered some of his auxiliary hypotheses to explain the discrepancies between theory and observation. For example, he amended his working assumption that planets were perfectly spherical and influenced only by gravitational force. As Imre Lakatosh has shown, Newton's refusal to repudiate the core of his theory even in the face of anomalies enabled him to refine his theory and eventually led to its tremendous success (Lakatosh 1970, 189-95). The explanatory flexibility of Newton's theory

did not function to confirm its "nonscientific status," as the Popperian demarcation criterion would imply.

Studies in the history of science have shown the falsifications ideal to be simplistic. The role of auxiliary makes many scientific theories, including in the so-called hard sciences, difficult, if not impossible to falsify conclusively on the basis of one failed or anomaly. Yet, some theories (for example, Earth, phlogiston, and heliocentrism) have been eventually falsified in practice by the judgment of the scientific community regarding the preponderance of data. This fact raises a difficult question for demarcationists. Since the theories of phlogiston and a flat Earth have been overwhelmingly falsified, they must be falsifiable and, therefore, scientific. Are such falsified theories more scientific than currently successful theories that have the flexibility to avoid falsification by a single anomaly? Is a demonstrably false theory more scientific than one that has wide explanatory power and may well be true? Further, Laudan shows that it is absurdly easy to specify some prediction, any prediction, that, if false, would count as a conclusive test against a theory (Laudan 1988b, 354). Astrologers and phrenologists can do it as easily as, indeed, astronomers and physiologists.

Such contradictions have plagued the demarcationist enterprise from its inception. As a result, most contemporary philosophers of science regard the question, "What methods distinguish science from nonscience?" as both intractable and uninteresting. What, after all, is in a name? Certainly not automatic epistemic warrant or authority. Increasingly, then, philosophers of science have realized that the real issue is not whether a theory is scientific, but whether a theory is true or warranted by the evidence. Hence, as philosopher Martin Eger has summarized it: "[d]emarcation arguments have collapsed. Philosophers of science don't hold them anymore. They may still enjoy acceptance in the popular world, but that's a different world." Or, as Laudan expresses it: "If we could stand up on the side of reason, we ought to drop terms like 'pseudo-science' .... they do only emotive work for us" (Laudan 1988a, 349).

Demarcation Arguments in the Creation-Evolution Debate

Despite the rejection of demarcation criteria by philosophers of science, these criteria continue to be employed in various ideologically charged scientific debates. Perhaps the most dramatic example has occurred in the so-called creation-evolution debate. Both sides have asserted that theories espoused by the other depart from established canons of the scientific method. Creationists such

as Duane Gish and no less a personage than Karl Popper himself have referred to Darwinian evolutionary theory as an unscientific "metaphysical research program" (Popper 1988, 145). For their part, defenders of evolution have employed these same tactics to discredit any possibility of a scientific theory of creation and to exclude the teaching of creationist interpretations of biological evidence in U.S. public high schools.

In 1981-82, during the Arkansas trial over the legitimacy of teaching "creation science," the Darwinist philosopher of science Michael Ruse cited five demarcation criteria as the basis for excluding any creationist theory from public education. According to Ruse, for a theory to be scientific it must be (1) guided by natural law, (2) explanatory by natural law, (3) testable against the empirical world, (4) tentative, and (5) falsifiable. Ruse testified that creationism, with its willingness to invoke divine action as a cause of certain events in the history of life, could never meet these criteria. He concluded that creationism might be true but that it could never qualify as science. Presiding Judge William Overton agreed, ruling in favor of the American Civil Liberties Union (ACLU), at whose behest Ruse had testified, and citing Ruse's five demarcation criteria in his ruling.

After the trial, some philosophers of science, including Larry Laudan and Philip Quinn (neither of whom supported creationism's empirical claims), repudiated Ruse's testimony as either ill-informed about the status of the demarcation problem or disingenuous. Both argued that Ruse's criteria could not distinguish the a priori scientific status of creationist and evolutionary theory. They insisted that only specific empirical, as opposed to methodological, arguments could accomplish this.

Indeed, upon further examination, Ruse's demarcation criteria have proven problematic, especially as applied to the debate about biological origins. For example, insofar as both creationist and evolutionary theories constitute historical theories about past causal events, neither explains exclusively by reference to natural law. The theory of common descent, arguably the central thesis of Darwin's *Origin of Species* (1859), does not explain by natural law. Common descent does so by postulating a hypothetical pattern of historical events that, if actual, would account for a variety of currently observed data. In the fifth chapter of the *Origin*, Darwin (1809-82) himself refers to common descent as the *vera causa* (the actual cause or explanation) of a diverse set of biological observations. In Darwin's theory of common descent, as in historical theories generally,

postulated causal events (or patterns thereof) do the explanatory work. Laws do not. Hence, Ruse's second demarcation criterion, if applied consistently, would require classifying *both* creationist theory and the Darwinian theory of common descent as unscientific.

Similar problems have afflicted Ruse's remaining demarcation criteria. Theories about the past rarely employ the exclusively predictive methods of testing required by Popper's falsifiability criterion. Theories of origins generally make assertions about what happened in the past to cause present features of the universe to arise. Such theories necessarily attempt to reconstruct unobservable past causal events from present clues or evidences. Methods of testing that depend upon the prediction of novel or future events have minimal relevance to historical theories of whatever type. Those who insist that testing must involve prediction, rather than compare the explanatory power of competing theories, will find little that is scientific in any origins theory, evolutionary or otherwise.

Analyses of the other demarcation criteria articulated by Ruse have shown them similarly incapable of discriminating the a priori scientific status of creationist and evolutionary theories. Accordingly, during a talk before the American Association for the Advancement of Science (AAAS) in 1993, Ruse repudiated his previous support for the demarcation principle by admitting that Darwinism (like creationism) "depends upon certain unprovable metaphysical assumptions."

The Future of the Demarcation Issue

The demarcationist arguments employed in the origins controversy almost inevitably presuppose a positivistic or neopositivistic (that is, Popperian) conception of science. Some have wondered, therefore, whether new developments in the philosophy of science might make demarcation tenable on other grounds. Yet, recent non-positivistic accounts of scientific rationality seem to offer little hope for a renewed program of demarcation.

Philosophers of science Paul Thagard and Peter Lipton have shown, for example, that a type of reasoning known as "inference to the best explanation" is widely employed not only in science, but also in historical, philosophical, and religious discourse. Such work seems to imply that knowledge is not as easily classified on methodological or epistemological grounds as compartmentalists and demarcationists once assumed. Empirical data may have metaphysical

implications, while unobservable (even metaphysical) entities may serve to explain observable data or their origins.

More recent work on the methods of the historical sciences has suggested that the methodological and logical similarity between various origins theories (in particular) runs quite deep. Philosopher of biology Elliot Sober has argued that both classical creationistic design arguments and the Darwinian argument for descent with modification constitute attempts to make retrodictive inferences to the best explanation. Other work in the philosophy of science has shown that both creationist and evolutionary programs of research attempt to answer characteristically historical questions; both may have metaphysical implications or overtones; both employ characteristically historical forms of inference, explanation, and testing; and, finally, both are subject to similar epistemological limitations. Hence, theories of creation or "intelligent design" and naturalistic evolutionary theories appear to be what one author has termed "methodologically equivalent." Both prove equally scientific or equally unscientific provided the same criteria are used to adjudicate their scientific status (provided that metaphysically neutral criteria are used to make such assessments). These two theories may not, of course, be equivalent in their ability to explain particular empirical data, but that is an issue that must be explored elsewhere.

See also Design Argument; Epistemology; God, Nature, and Science

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