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The Field of Science and Religion as Natural Philosophy

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Abstract *''Natural philosophy'' is an important term from the history of science because it was used to describe the study of nature during medieval and early modern Europe. This article gives an overview of the history of natural philosophy, since the use and eventual disuse of the term helps one to understand the emergence of modern science. Following a suggestion by the historian of science Peter Dear, I argue that the term deserves to be rehabilitated because it draws attention to the complexities of scientific theorizing. The article concludes with an argument that the field of science and religion should be seen as an updated version of natural philosophy.*

Key words: Natural philosophy; History of science; Science and religion; Scientific revolution; Methodological naturalism

Introduction

For many scientists and the educated public, the question ''when did science begin?'' seems to have an easy answer; was it not during the Scientific Revolution where scientists overcame the misguided notion that nature was best explained by appealing to ancient authorities? Was it not during the Scientific Revolution where Western culture learned the value of careful observations and experiments? Nevertheless, if one reads historians of science on this question, one will quickly discern uneasiness with this answer, primarily because much of our terminology of science does not map neatly onto the activities of our predecessors.[1] The English word ''scientist,'' which has a specific identity within contemporary culture, was coined only in 1833, and the Latin term *scientia* could refer to any body of knowledge that contained necessary universal terms.[2] When Thomas Aquinas considered in the S*umma Theologica* whether theology could be a *scientia*, he was not asking whether it could be given an experimental or empirical foundation. The luminaries of the Scientific Revolution understood themselves to be natural philosophers doing natural philosophy—Isaac Newton's crowning achievement is often translated in English as ''The Mathematical Principles of Natural Philosophy''.[3] As I will explain in what follows, many historians worry that using science and natural philosophy as synonyms is a category mistake because they convey different assumptions about how to study the natural world.

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Since the question ''when did science begin?'' depends crucially on how one understands the relationship between natural philosophy and science, the first half of the article will explore the history of the term ''natural philosophy.'' I will argue that the transition from natural philosopher to ''scientist'' is an important part of Western history, and it begins to explain the fragmented nature of knowledge within the sciences today. In the second half, I will use this history to argue that the term natural philosophy can still play a useful role both in describing the nature of science and in explaining the emergence of the field of religion and science over the past few decades.

What is natural philosophy?

If one takes an expansive view of natural philosophy, then it becomes difficult to trace its beginning, which is why the historian Edward Grant argues, ''Natural philosophy began with no name to designate it . . .''[4] One might say that humans are born natural philosophers, for the ability to speculate about the world is perhaps the distinguishing characteristic of our species. But when historians of science refer to natural philosophy, they are often not using the term in the general sense but are instead referring to the specific style of explaining nature that developed within Europe, particularly within the medieval universities.[5] Before discussing some characteristics of that style, I will briefly sketch its history.

Study of the natural world had only a subsidiary role in the outlook of the Christian church Fathers. While the study of nature could help settle issues of Biblical interpretation and provide moral lessons for the discerning observer, it also could distract one from the revealed truths of Christianity. Augustine argued in *The Confessions* that those who desire knowledge of nature ''for its own sake'' commit the intellectual vice of curiosity, whose moral status was not rehabilitated until the seventeenth century.[6] Moreover, Augustine's epistemology cast doubt on the validity of conclusions drawn from nature alone. As the historian Peter Harrison explains,

> The investigation of the sensory world was not only an idolatrous pursuit, but it was a futile one as well, for if the meaning of nature was determined by the meaning of scripture, the symbols which were to be found in the physical world could not of themselves constitute any intelligible pattern. Their ordering principles lay beyond them, embedded in the eternal truths of the spiritual or intelligible world.[7]

Early Christian thought had a decidedly Platonic orientation, with a focus on the eternal and celestial rather than the earthly and temporal.[8]

By at least the thirteenth century, however, the study of nature took a much more prominent role among the Christian intelligentsia, not coincidently because of its turn away from Platonic to Aristotelian philosophy. Aristotle's philosophy was more oriented towards study of the natural world because he did not accept Plato's belief that sensible objects are derivative of and dependant upon eternal forms, but believed that form belongs to the object itself.[9] Furthermore, Aristotle's

epistemology—with its emphasis on knowledge beginning with sense experience and rationality as a uniquely human characteristic—was optimistic about the ability of secular learning to discern the causes that underlie the phenomena of nature. The occasion for the shift towards Aristotle was the reintroduction of many of the classic Greek and Latin texts from the Islamic cultures that bordered Western Europe. Just as Christians before them, Islamic intellectuals had found Greek philosophy to be well suited to the defense and promotion of Islam, with the result being a sophisticated culture with many medical, mathematical and technological achievements.[10] This esteem for Greek philosophical texts along with the conquering of land that was part of Alexander the Great's conquest meant that Islamic philosophers were able to translate and preserve many texts that were unknown to Western Europe.[11] As Latin Christendom learned of the Islamic achievements, it created a strong demand for translations, texts and commentaries from Arabic libraries.

Although Aristotle's philosophy was naturally compelling to many philosophers, its widespread acceptance can be explained by the way Aristotelianism addressed a number of specific challenges that confronted medieval Europe.[12] The first challenge was that of Islam, which was the first major intellectual rival to Christianity since the assimilation of Neo-Platonic thought by early Christian theologians.[13] The undeniable achievements of Islamic culture made it incumbent on Christian thinkers to show the compatibility of Aristotelian philosophy with Christian doctrine. Furthermore, the emphasis of Aristotelianism on natural philosophy offered a common framework and focus for arguments against those who did not accept Christian revelation.[14]

A second challenge was provided by theologians of the eleventh and twelfth centuries—such as Anselm and Peter Abelard—who had attempted, but not succeeded, in providing a compelling philosophical grounding for Christian dogma.[15] The value of adapting Aristotelianism, with its particular understanding of substances and universals, was that it offered promising ways to explicate the doctrines of the Trinity, Incarnation and transubstantiation.[16]

The third challenge was more practical; with the rise of urban universities, questions were raised about the relation of church authority to non-theological portions of the curriculum. The general solution of medieval Aristotelians was to affirm philosophy and theology as autonomous disciplines, which allowed for a secular Faculty of Arts where students focused on Aristotle's texts before proceeding to the graduate faculties to study law, medicine or theology.[17] Natural philosophers were free to follow the dictates of reason as long as they did not overstep into matters of theology. This institutional settlement proved effective, and Aristotelian natural philosophy became so entrenched in university education up until the late seventeenth century that it is hard to overstate its influence. The historian Stephen Gaukroger summarizes, ''Aristotelianism was not just the dominant interpretation ... it was in effect constitutive of natural philosophy: it provided the problems that natural philosophy dealt with, the means of solving them, and criteria for what counted as a satisfactory explanation.''[18] The unique blend of Christianity and Aristotelianism of the medieval schoolmen is also commonly referred to as Aristotelian scholasticism or scholasticism.

The nature of natural philosophy

When considering the differences between natural philosophy and science, there are two important aspects of Aristotelian philosophy as appropriated by medieval Europeans. The first is a separation of theoretical knowledge from practical knowledge. To use the Greek terminology, Aristotle made a distinction between *techne* and *epistme* (the corresponding Latin terms are *ars* and *scientia*, or arts and sciences, respectively). *Techne* refers to knowledge concerned with how to make or do things, such as building a house, and *episteme* was demonstrative knowledge of a theoretical kind.[19] This distinction is represented within Greek social structures; whereas *techne* was the domain of the manual laborer, *episteme* was the domain of the free man of the city-state.[20] This produced a natural philosophy with different goals than modern science. Aristotelians were not interested in prediction and control but rather understanding, which meant placing the natural world in its proper context within the world system.

This dichotomy between explaining and manipulating nature created boundaries between disciplines that would surprise modern expectations. For instance, astronomy was not a part of proper natural philosophy during the medieval period, for it was merely concerned with the practical matters of creating calendars and tracking stars. Natural philosophical questions, by contrast, were concerned with what the heavens were made of and what moved the stars.[21] In a similar way, geometry and arithmetic had a low profile in the curriculum because mathematics was conceived of instrumentally, a matter of *techne* rather than *episteme*.[22] Mathematics was thought to be more useful for manipulating nature than understanding it because quantities could not speak to an object's essence or nature. Whereas mathematicians merely coordinated quantities, the natural philosopher could offer causal explanations utilizing some combination of Aristotle's four causes—material, formal, efficient and final.[23] Therefore, when Francis Bacon complained that Aristotelian scholastics were more interested in verbal arguments than changing nature for human benefit, he was attacking their conception of *scientia*.[24] For Aristotelians, once one intervenes in nature—including experimentation—one has altered its ''natural'' state, and it can no longer be useful for natural philosophy.

A second feature of medieval natural philosophy is its tight integration with theology. While theologians and philosophers in the Aristotelian tradition distinguished between truths known by reason and revelation, theological authorities repeatedly condemned the idea that there could be inconsistencies between the two, and the universities were structured to help prevent such conflicts. Theologians had to complete the Arts curriculum before entering the Theology Faculty, and as a result theologians often pursued questions of natural philosophy. As scholasticism developed throughout the centuries, theologians increasingly used their theological commentaries to answer natural philosophical questions.[25] It is thus not surprising that theology and natural philosophy fit together in a harmonious view of the world. For natural philosophers of the medieval period, the world was to be analyzed in terms of perfections and purposes, where contemplation of the natural world yielded wisdom of God and

God's creation. Natural philosophy and theology could never be separated entirely, for God's perfection provided the metric against which objects in the world were judged. And for Christian theologians like Thomas Aquinas, *scientia* is not just a set of propositions but also a habit of mind that helps one to live the moral life.[26]

The theological orientation of medieval natural philosophy has led one historian of science to argue that concern for God and God's creation ''was the central pillar of [natural philosophy's] identity as a discipline, both with respect to its subject-matter and to its goals, its purposes, and the functions it served. This is what, more than anything else, distinguishes it from our modern science.''[27] The theological content of natural philosophy again raises the problem of viewing natural philosophers and scientists as equivalents; for if one presents someone like Isaac Newton as a scientist, one is likely to overlook the theological context and content of his writings. To ask, ''how did Newton reconcile his religion with his science?'' is already to misrepresent his work.[28]

Natural philosophy and the Scientific Revolution

While it is tempting to say that natural philosophy ended with the rise of the self-styled ''new philosophy'' of the seventeenth century, it is more accurate to say that natural philosophy was not displaced but transformed during the Scientific Revolution.[29] The main characteristics of natural philosophy are still evident during this period, but what changes is the rejection of the contemplative ideal of knowledge of medieval scholasticism. The historian John Henry summarizes the transformation:

> The story [of the Scientific Revolution] is not primarily one of the invention of new techniques, or the discovery of new methods, it is a story of social and cultural changes which led to the rise in social and intellectual status of mathematical or craft practitioners, and allowed the amalgamation of what had previously had been humbler sciences and arts with the elite natural philosophy which had been developed in the medieval universities.[30]

It is only with a more active conception of knowledge—*techne* as a marker of *episteme*—that mathematicians and skilled practitioners are believed to offer insight into the natural world. One key figure in this change of attitude toward knowledge was Francis Bacon.[31] Bacon, who was the ''philosopher of the new science'' for most English natural philosophers, argued: ''There is no sign more certain and more noble than that of fruits. In religion we are warned that faith be shown by works. It is altogether right to apply the same test to [natural] philosophy.''[32] After the Scientific Revolution, the mark of true knowledge becomes one's ability to effect change in the natural world, and as a result, scientific and technological achievements become increasingly connected in the public mind.

While an active conception of knowledge is more in line with modern science, those who investigated nature during this time still called themselves natural

philosophers, and more significantly, shared many of the aims of medieval natural philosophy. Aristotle's natural philosophy was a complete interdependent system that could account for the entire natural world. In a similar way, the aim of many natural philosophers of the Scientific Revolution was not just to prove Aristotle wrong but also to find a comprehensive system of nature as a replacement.[33] The primary significance of Descartes' philosophy, for example, is neither his method nor geometrization of nature, but ''... constructing, from prime matter upward and from God downward, a functional equivalent to the Aristotelian philosophy of nature.''[34] From a historical perspective, Descartes the natural philosopher is more significant than Descartes the epistemologist.[35]

But the primary reason for linking the Scientific Revolution with natural philosophy is its religious orientation, which is evident when examining ''the mechanical philosophy'', the major new conception of nature in the seventeenth century.[36] The distinctiveness of the mechanical philosophy is that it replaced dominant organic metaphors for nature with inorganic ones. Nature was compared to a machine, which meant it was subject to the mechanist physics that engineers of the period applied to their technological innovations (e.g., fountains, pipe organs, etc.).[37] Not only did this encourage an experimental attitude towards nature, but it also meant that mathematical models could be treated realistically, a move that was ultimately vindicated in the work of Isaac Newton. Descartes' version is the most well-known example of the mechanical philosophy, but it is far from the only form. In England, Pierre Gassendi's mechanical philosophy was more popular because it closely fit the empirical orientation of English natural philosophy.[38]

While the mechanical philosophy introduced a strong emphasis on causal reductionism into Western science, many of its early advocates had strong theological reasons for supporting it.[39] In the upheaval of post-Reformation Europe, theologians became increasingly worried about the danger of skepticism or, even worse, atheism. For thinkers such as Gassendi and Robert Boyle, the mechanical philosophy provided a satisfactory defense of God's existence. While this is surprising because modern expectations closely associate reductionism and atheism, ''... the paradox is that among those seventeenth-century scholars who did most to usher in the mechanical metaphors were those who felt that, in so doing, they were enriching rather than emasculating conceptions of divine activity.''[40] According to Gassendi, the proof of God's existence is an empirical inference from the nature of matter. Because matter is inert, it does not have the ability for self-motion, much less to organize in the complex ways displayed in the natural world. Motion in the world is primarily a result of the initial creative act, and the only purpose in the world is divine purpose.[41] Just as a watch exhibits no purpose except that of the artisan who constructed it, so too nature only reveals the purpose and perfection of the divine watchmaker. While the image of God as a perfect craftsman was standard in medieval texts, Gassendi's novelty is that he wedded it to a new philosophy of nature. The purposes that Aristotle had attributed to nature were now ridiculed by the mechanical philosophers as the fancies of an exuberant imagination.[42]

In summary, some of the aims and methods of early modern natural philosophers seem strange when compared to modern science. For instance, Isaac Newton's work is an exemplar of the ''new philosophy'' of the seventeenth century, both because of his (albeit modified) mechanical explanations of nature and his explicit appeals to divine intervention and design.[43] While one would not want to overemphasize the differences between natural philosophy and science—otherwise the appearance of modern science will seem something like a miracle—one also would not want to assume that they are exact equivalents. It is the recognition of their family resemblances that allows one to credibly explain the transition from one to the other.

From natural philosophy to modern science

A more plausible date for the end of natural philosophy is the nineteenth century, and not simply because the word ''scientist'' was coined during that period. The transition away from the theological orientation of natural philosophy to modern science is evident in the transformation of the institutions of American higher education during this time.[44] In the United States prior to 1870, colleges functioned as the intellectual arm of American Protestantism by serving to further a Christian civilization and worldview.[45] Science was seen as an effective tool for demonstrating God's existence and attributes independently of the peculiarities of the various Christian denominations in post-Enlightenment America.[46] As the historian George Marsden explains, ''... in the first heyday of evangelicalism in the United States, objective scientific thought was not tinged with the guilt of fostering secularism. Rather it was boldly lauded as the best friend of the Christian faith and of Christian culture generally.''[47] Consequently, the justification for including science within the curriculum was primarily a theological one; those who were enthusiastic for science's technological potential often went to separate institutions that were primarily dedicated to applied science.[48]

To a significant extent by the end of the nineteenth century, the ''doxological'' view of science—where science was to supplement the theological mission of American colleges—was being replaced with a more assertive view of science, where scientific inquiry became the raison d'être of the university.[49] In contrast to the knowledge claims of revelation, tradition, or religious experience, it was argued that scientific inquiry brought the promise of slow, unrelenting progress towards truth. It is hard to underestimate the changes in American higher education that resulted. One key change was that science became professionalized, meaning standards were implemented that could distinguish scientists from amateurs. Even with the rise of interest in natural theology, natural philosophy had been only peripheral to the educational aims of the college and was often undertaken by ''gentlemen'' or clergy, those with sufficient leisure time and resources to pursue their investigations. Furthermore, the institution of disciplinary standards led to the compartmentalizing of knowledge into different disciplines, an idea that

would have been utterly out of place in college education before 1850.[50] College curriculums had been designed with little variation, so that all students would be equipped with the necessary skills to contribute to society, and professors had full latitude to research the topics they wished because research was generally considered secondary to teaching. The institutionalization of science meant dividing problems into small, manageable pieces using methods and languages understandable only to the select few with the necessary training.[51] Not coincidentally, during the same period, similar disciplinary boundaries arose within the humanities—a subject area that itself was an innovation of the nineteenth century.[52]

Another prominent feature of modern science that emerged during this period, and that is closely related to its professionalization, is the establishment of ''methodological naturalism'' as the norm of scientific discourse.[53] After 1870, scientists increasingly avoided invoking the supernatural as an explanation for phenomena within the natural world, thus helping to sever the link between science and natural theology. This move toward naturalism helps to explain why the work of Charles Darwin was considered significant, even though many of his supporters did not accept the mechanism of natural selection—Jean-Baptiste Lamarck's version of evolution was more popular until the early twentieth century.[54] Darwin's hypothesis represented a general approach to scientific explanation, though many scientists disagreed with the details.

This is not to say that science became hostile to religion during this period, because many scientists continued to practice their faith unaffected by the dominant scientific theories. In fact, for many, the most pernicious threat to Christianity was the historical-critical approach to the Bible that was prominent in Germany.[55] The scope of scientific explanation became narrower, and scientists preferred to claim ignorance when they could not specify a naturalistic cause.[56] Just as a religious orientation was the defining feature of European natural philosophy, so the exclusion of matters of religion from scientific discussions could be a defining feature of science in its modern form. Because of these developments within the science community, most colleges by the beginning of the twentieth century had dropped their natural theology course requirement, if they still offered such a course at all.[57]

In summary, the changes that occurred during the last half of the nineteenth century, where modern science emerged with many of its current characteristics, were at least as dramatic as the changes during the seventeenth century and obviated the need for the term natural philosophy. As specialization occurred within the academy, many disciplines wanted to distinguish themselves from the field of philosophy that had been their progenitor. Furthermore, there was a general hostility in the nineteenth century, following the ideals of Baconian science and Common Sense Philosophy, to ''speculation'' or metaphysics.[58] As many of the former philosophical issues broke off into their own disciplines, philosophy was left with problems that had little prospect of being resolved. By the end of the nineteenth century, the term natural philosophy was on the way out; and few objected to its demise.

The future of natural philosophy

Having given a brief history of the rise and fall of natural philosophy, I will now make an argument about the future of the term. Following a suggestion by the historian of science Peter Dear, I will argue that natural philosophy should be rehabilitated because it could play a useful role in scientific discourse.[59]

The first reason relates to the new, active ideal of knowledge of the seventeenth century, where the fundamental criterion for true knowledge is the ability to produce effects in nature. This ideal has been unquestionably persuasive; for the ''new philosophers'' of the Scientific Revolution down to modern scientists, when pressed as to why one should accept the truth of a particular theory, defenders of a theory will usually point to its practical efficacy. In other words, theories are true because they work.[60] However, the combining of *techne* and *episteme* (i.e., technical control and philosophical understanding) creates a tension within modern science because they cannot be reduced to one another. The philosophical explanations that have led to technological achievements have often undergone constant and sometimes drastic revisions.[61] For instance, though Maxwell's theory of electromagnetic aether provided the prediction of radio waves, the technological achievement of the radio does not prove the existence of the aether.[62] Many theoretical entities, such as caloric or phlogiston, were similarly useful for a time but are now rejected. These and other examples from the history of science show that while technological achievements are cumulative and progressive, the explanations that undergird them seem to have a ''shelf life.''[63] As the philosopher Larry Laudan explains, ''I daresay that for every highly successful theory in the past of science which we now believe to be a genuinely referring theory, one could find half a dozen once successful theories which we now regard as substantially non-referring.''[64] Whether one is inclined towards a moderate form of scientific realism or the stronger position of instrumentalism, *techne* does not always mean *episteme*.

Unfortunately, at least since the nineteenth century there has been in Western culture a strong scientism that has not always appreciated the ambiguities of theory construction and evaluation. For the Logical Positivists of the early twentieth century, for example, the goal of science was to isolate and accept only those (non-analytic) statements that are founded directly on experience. Their methodological principle was verification, where a statement was accepted as meaningful only if there was a way to empirically verify it. Science was said to be objective because its laws and statements were based on a large body of empirically verified propositions. Philosophy itself could make no claims about the world but was restricted to the logical analysis of scientific statements.

However, this view of science—where observations and theory are strictly distinguished—was significantly challenged in the second half of the twentieth century, most famously by Thomas Kuhn.[65] Kuhn argued that a scientist's work is mostly ''puzzle solving,'' the attempt to reconcile a given framework with anomalies encountered in the data.[66] The framework itself is not up for criticism because it is the commitment to that framework which makes experimental activity possible. Because of arguments by Kuhn and others, the neat split between

theory and observations made by the Logical Positivists is widely rejected as unworkable. Observation statements are inextricably theory-laden, meaning all observations are conditioned by presuppositions. Historians of science since Kuhn have made even more evident the role of presuppositions through their remarkable studies showing how important context is for understanding the development and even acceptance of scientific theories.[67]

The lesson of post-Kuhnian philosophy of science is not that all beliefs are equally rational, but rather that rationality is local, meaning that rational decisions cannot be separated from the contexts in which they occur.[68] The ''view from nowhere'' is a chimera, and the term ''objectivity'' is best reserved for those beliefs that have undergone a rigorous intersubjective testing, rather than for beliefs untainted by personal perspective.[69] Philosophical analysis can and does play an important role in assessing the reasonableness of theories because scientists must make complex judgments in specific situations about data, instruments, and theories, among other things. Different scientists can draw significantly different conclusions, even with the same access to data, and textbooks do not often capture the state of ''play'' within a discipline.[70] The retrieval of the category of natural philosophy, then, provides a way to acknowledge the complex epistemological issues that arise when evaluating theories and opens up a space for legitimate disagreement.

A second reason for the revival of the term natural philosophy is the fragmented nature of science today, which makes it difficult to reconcile different theories into a coherent picture of nature. While a few scientists dream of a theory of everything, developing a comprehensive philosophy of nature is largely a relic of natural philosophy and irrelevant to the everyday work of a scientist. Unfortunately, this focused problem-solving approach of modern science has its drawbacks. The concept of nature has always been important in Western thought because of its large implications for religion, society and human nature. Furthermore, the plasticity of the concept of nature means that it is a potent weapon for larger philosophical agendas. For instance, Richard Dawkins presents a view of nature where human behavior is largely determined by small bundles of molecules. Though his view is rather pessimistic, it gains most of its plausibility because it is said to be based on a scientific view of nature, though this is far from the only conclusion that one can draw from biology or science at large.[71] This leads to the question, given the large amount of issues that depend on the idea of nature, should it not be a more focused topic for interdisciplinary research? Should not the search for a comprehensive philosophy of nature—a key element of natural philosophy—be more central to a scientist's identity?

The need for more consideration of natural philosophical topics is one reason for the explosion of interest about the concept of emergence,[72] especially among the science and religion community. Emergence presents a holistic vision of nature where the properties of the ''wholes'' are not fully specifiable or determined by the ''parts'' of which they are composed. While some have suggested there is a faddish element to its popularity, I think emergence represents a healthy move to question historical assumptions.[73] After all, at one time the mechanical philosophy was also a fad. Causal reductionism has been part of natural philosophy ever since

the rise of the mechanical philosophy, but the mechanical metaphor has been undermined on several fronts in the twentieth century. From a physics perspective, the idea that nature is composed of tiny bits has been shown to be increasingly inaccurate as one descends the scale of nature.[74] On a biological level, the Darwinian revolution demonstrates that nature is far from static; rather, it is in a state of flux that has led to increasing novelty and sophistication. Since ''the mechanistic model has now been wholly discredited in science,'' we need to critically examine alternatives like emergence theory.[75]

The value of finding a workable philosophy of nature is not merely to help settle religious disputes but also to foreground and analyze assumptions that create major theoretical problems within science itself. For example, consider another problem created by the mechanical philosophy. Though not all early mechanists were enthusiastic about mathematical approaches to nature, the vision of a homogenous material universe governed by mathematical laws proved extremely persuasive.[76] However, the early modern mechanists did not think everything in the universe could be mathematized; after all, what formula could capture the qualitative experience of smelling a rose? The fact that the mechanical worldview required a soul in order to explain the existence of sensible qualities was a positive.[77] But this conceptual framework has created a number of problems, specifically with respect to human nature. The mind–body problem in its modern form—the attempt of twentieth- and twenty-first-century philosophy and psychology to reconcile qualitative experience with nature—begins when the soul is rejected as a scientific category.[78] However, the problem of reconciling consciousness with matter whose properties are fully describable by mathematics has become so intractable that for many, from behaviorists down to eliminative materialists, the only workable solution is to deny that phenomenal experience exists.[79] This counterintuitive, perhaps even self-contradictory, position illustrates how larger assumptions about nature can influence research programs, and also explains why many are drawn to emergence theory as a solution to the mind–body problem.[80] In summary, it is to be hoped that the retrieval of the term natural philosophy might spur more consideration about how scientific theories might cohere into a philosophy of nature, while also providing a way to describe the work of those who are already undertaking such research programs.

But perhaps the desire to find a suitable philosophy of nature presupposes too much modernist optimism. Many philosophers and historians are not sanguine about the chances of finding an adequate philosophy of nature, for such totalizing narratives inevitably obscure the local and particular character of scientific activity. Thus, some philosophers and historians now refer to the ''disunity of science'', which looks at science as a ''ramshackle structure with little coherence among its various parts.''[81] Instead of trying to unify all of science under a single discipline or method, they counsel a deeper appreciation of the diversity of practices that count as science. I think there is something to be said for this view and believe that it does not undermine the need for the category of ''natural philosophy.'' Just as one does not have to believe in God in order to debate theology, so one does not have to believe that a final philosophy of nature is possible in order to enter debates about the strengths and weaknesses of various

proposals. The main purpose of the category of ''natural philosophy'' is not to enforce a particular vision of that term but rather to mark a place where such debates can legitimately take place. Thus, I would welcome advocates of the disunity of science as (unknowing) participants in the field of natural philosophy.

The third and final reason for renewing natural philosophy as a scientific term is that it helps to explain the popularity of the science and religion movement over the past several decades. As recounted above, a number of historians of science have argued that in the nineteenth century there was a large-scale transformation from the religiously oriented natural philosophy to modern science, which excluded appeals to the supernatural in the practice of science.[82] However, some scientists and philosophers of this period took a stronger position, arguing that science and religion are competing worldviews that cannot be reconciled. According to this view, scientific knowledge is not neutral with respect to religious belief but promotes a naturalistic and skeptical outlook that undermines religion in almost all forms. For example, Thomas Huxley, himself a prominent advocate for the professionalization of science, famously argued, ''Extinguished theologians lie about the cradle of every science as the strangled snakes beside that of Hercules; and history records that whenever science and orthodoxy have been fairly opposed, the latter has been forced to retire from the lists, bleeding and crushed, if not annihilated, scotched, if not slain.''[83] This rhetoric foreshadowed the widespread perception of ideological conflict between science and religion in the twentieth century, even if the story that science and religion have perpetually conflicted was an invention for political purposes by nineteenth-century historians, such as John William Draper.[84]

Nevertheless, over the past few decades there has emerged a ''field'' of science and religion, where scholars have produced a number of works illustrating that there is more to the relationship of science and religion than God-of-the-Gaps approaches suggest.[85] It is not coincidental that this field emerged after the work of Kuhn—Ian Barbour's classic work *Issues in Science and Religion* appeared shortly after the *Structure of Scientific Revolutions* and interacted heavily with it—because Kuhn's work brought renewed focus to the values and assumptions that scientists bring to data.[86] When discussing why certain paradigms are preferred over others, Kuhn argued that theory choice is not merely a matter of assessing the empirical evidence because scientists are sometimes, in revolutionary moments, confronted with multiple, empirically equivalent paradigms. In such moments, theory choice is made with the help of extra-empirical cognitive values, such as a preference for theories that are coherent, simple and fertile. This has led some theologians to argue that theological beliefs can provide additional criteria for evaluating theories.[87] For example, why would it be invalid for one's theological convictions to influence one's interpretation of quantum mechanics?[88]

This leads to a controversial question: now that the weaknesses are apparent in the positivism that helped to usher out the religiously oriented natural philosophy of early modern Europe, is it again legitimate for religious beliefs to influence the justification of scientific theories? Is it appropriate for religious beliefs to not merely influence choice among major scientific theories, but to instigate the

formation of new paradigms? It is not surprising that science and religion scholars come down on both sides of this question. There are those who argue that while religious beliefs can influence the development or application of scientific theories, the truth of any particular worldview or religion should not be presupposed when scientific theories are justified.[89] Advocates of this position typically argue that there is no such thing as a Christian, Jewish or Buddhist science. Yet, there are others who are influenced by postmodernism and thus bring a more pluralist sensibility to bear on the question. For instance, Nancey Murphy argues that a consequence of moving to a holist epistemology means acknowledging the way religious and/or philosophical positions can function as control beliefs, which are beliefs that influence the type of scientific theories that one accepts or rejects.[90] The implication is that persons with different control beliefs may hold mutually exclusive positions that are based on the same data. For Murphy, this sort of pluralism does not imply skepticism as long as one can continually and successfully address the problems that arise against one's position. Thus, even among the science and religion community, there is uncertainty about what role religion should play in the practice of science.

I do not want to attempt to settle this complex issue here, and think it would be unwise to use the term natural philosophy to advocate for one side or the other. Rather, I would argue that if we return to the term natural philosophy, it would be for the modest goal of allowing scientists to more freely acknowledge the religious beliefs—theistic, non-theistic, agnostic, or atheistic—that shape their interpretative horizon. When religion is strictly excluded from scientific discussions, unacknowledged theological or anti-theological beliefs can masquerade as scientific fact. A better solution is to have as wide and diverse community of inquirers as possible, so that through intersubjective criticism one can assess whether or not one's religious or philosophical views have unduly influenced interpretation of the data. This model requires enough sophistication on the part of its participants to openly recognize and scrutinize the religious and philosophical beliefs that are operative in any discussion. The purpose of the term natural philosophy would be to provide a conceptual space where such scrutiny would be possible.

In conclusion, the term natural philosophy has had a long and complex role in the history of science, and the decline of its use helps to illuminate some distinct features of modern science. While the exact seventeenth-century meaning of natural philosophy is irretrievable, I agree with Dear that the term should be revived for the twenty-first century because it could play a useful role in drawing attention to the ambiguities of scientific theorizing, including the way religious and philosophical views function in theory choice. There need not be anything particularly religious about the renewed use of natural philosophy, because religion is only one element of the larger context of scientific work. Even if one does not agree with their larger philosophical aims, the interdisciplinary field that often goes under the title ''sociology of scientific knowledge'' has produced a large body of work illustrating the way science can be shaped by the culture in which it occurs.[91] Nevertheless, the field of science and religion would form an important part of the natural philosophical enterprise, for science and religion scholars

continually probe the role of presuppositions in scientific theorizing and evaluation. I conclude, then, that the field of science and religion should be seen as an updated form of natural philosophy.

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Endnotes

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4 Edward Grant, *A History of Natural Philosophy: From the Ancient World to the Nineteenth Century*, (New York: Cambridge University Press, 2007), 1.
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9 Ibid., 48.
10 Ibid., 175ff.
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12 Here I follow Stephen Gaukroger, *The Emergence of a Scientific Culture: Science and the Shaping of Modernity, 1210–1685* (New York: Oxford University Press, 2006).
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14 Ibid., 55.
15 Ibid., 60ff.
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18 Ibid., 48.
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20 Peter R. Dear, *The Intelligibility of Nature: How Science Makes Sense of the World* (Chicago: University of Chicago Press, 2006), 9.
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24 For an account of Bacon's importance, see Stephen Gaukroger, *Francis Bacon and the Transformation of Early-Modern Philosophy* (Cambridge; Cambridge University Press, 2001).
25 Grant, *A History of Natural Philosophy*, 273.
26 Peter Harrison, ''The Natural Philosopher and the Virtues,'' in *The Philosopher in Early Modern Europe: The Nature of a Contested Identity*, ed. Conal Condren, Stephen Gaukroger and Ian Hunter (New York: Cambridge University Press, 2006), 207. Pierre Hadot makes a similar argument about ancient philosophy in *What Is Ancient Philosophy?* (Cambridge: Harvard University Press, 2002).
27 Cunningham, ''How the Principia Got Its Name,'' 381.
28 To make this point, Richard Popkin suggests that the question should not be ''why one of the world's greatest scientists should have spent so much time thinking and writing about religious matters,'' but ''why did one of the greatest anti-Trinitarian theologians of the 17th century take time off to write works on natural science, like the *Principia Mathematica*?'' Richard H. Popkin, ''Newton's Biblical theology and his Theological Physics,'' *Newton's Scientific and Philosophical Legacy*, ed. P.B. Scheuer and G. Debrock (Dordrecht: Kluwer, 1988), 81. See also Stephen Snobelen's ''To Discourse of God: Isaac Newton's Heterodox Theology and his Natural Philosophy,'' in *Science and Dissent in England, 1688–1945,* ed. Paul B. Wood (Aldershot: Ashgate, 2004), 43.
29 Cunningham, ''How the Principia Got Its Name,'' 381.
30 John Henry, *The Scientific Revolution and the Origins of Modern Science*, 2nd ed. (New York: Palgrave, 2001), 13.
31 Gaukroger, *Francis Bacon and the Transformation of Early-Modern Philosophy.*
32 As quoted in Markku Peltonen, *The Cambridge Companion to Bacon* (Cambridge: Cambridge University Press, 1996), 35.
33 However, Stephen Gaukroger argues that what came to be termed ''experimental philosophy'', which was associated above all with Boyle and the Royal Society, should be seen as an anti-systematic form of natural philosophy. See *The Emergence of a Scientific Culture*, 352ff.
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36 Steven Shapin, *The Scientific Revolution*, 12.
37 Dennis Des Chene, *Spirits and Clocks: Machine and Organism in Descartes* (Ithaca, NY: Cornell University Press, 2001), 4.
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39 John Hedley Brooke, *Science and Religion: Some Historical Perspectives* (Cambridge: Cambridge University Press, 1991), 118.
40 Ibid., 118.
41 Osler, *Divine Will and the Mechanical Philosophy*, 193.
42 Peter R. Dear, *The Intelligibility of Nature*, 19ff.
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45 Ibid., 20.
46 Ibid., 24.
47 George M. Marsden, *Understanding Fundamentalism and Evangelicalism* (Grand Rapids: W.B. Eerdmans, 1991), 129.

48 Jon H. Roberts and James Turner, *The Sacred and the Secular University*, 22. A similar story can be told of England, where clergy were in control of education: see Frank M. Turner, ''The Victorian Conflict between Science and Religion: A Professional Dimension,'' *Isis* 69 (1978): 356–376.
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50 Jon H. Roberts and James Turner, *The Sacred and the Secular University*, 83.
51 Peter R. Dear, *The Intelligibility of Nature*, 175.
52 Jon H. Roberts and James Turner, *The Sacred and the Secular University*, 75ff.
53 Ibid., 28.
54 Peter J. Bowler, *Charles Darwin: The Man and His Influence* (Cambridge: Cambridge University Press, 1996), 167ff.
55 John Hedley Brooke, *Science and Religion*, 263ff.
56 Jon H. Roberts and James Turner, *The Sacred and the Secular University*, 29ff.
57 Ibid., 33.
58 Ibid., 35.
59 Peter R. Dear, *The Intelligibility of Nature*, 173ff.
60 Ibid., 5.
61 Ibid., 4.
62 Ibid., 3.
63 Peter Lipton, ''The Truth About Science,'' *Philosophical Transactions of the Royal Society B* 360 (2005): 1269.
64 Larry Laudan, ''A Confutation of Convergent Realism,'' *Philosophy of Science* 48 (1981): 35.
65 For a description of Kuhn's impact on twentieth-century philosophy of science, see his obituary in the *Social Studies of Science* 27: 3 (June 1997): 483–502.
66 Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 3rd ed. (Chicago: University of Chicago Press, 1996).
67 For a discussion of this, see the introduction in Steven Shapin, *The Scientific Revolution.*
68 This is a major emphasis of Alasdair MacIntyre's tradition-based account of rationality. See Alasdair MacIntyre, *Three Rival Versions of Moral Enquiry* (Notre Dame: University of Notre Dame Press, 1990).
69 Arthur Fine, ''The Viewpoint of No-One in Particular,'' *Proceedings and Addresses of the American Philosophical Association* 72 (November 1998): 10ff.
70 In other words, textbooks offer a particular perspective on debates within a discipline. See discussion of textbooks in the David Kaiser, *Pedagogy and the Practice of Science: Historical and Contemporary Perspectives* (Cambridge: MIT Press, 2005).
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74 Paul Davies and John R. Gribbin, *The Matter Myth: Dramatic Discoveries That Challenge Our Understanding of Physical Reality* (New York: Simon & Schuster, 1992), 11ff.
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77 John Hedley Brooke, *Science and Religion: Some Historical Perspectives*, 117ff.
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81 Kuhn, *The Structure of Scientific Revolutions*, 49. See also Peter Louis Galison and David J. Stump, *The Disunity of Science: Boundaries, Contexts, and Power* (Stanford: Stanford University Press, 1996).
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89 Mikael Stenmark, *How to Relate Science and Religion: A Multidimensional Model* (Grand Rapids: W. B. Eerdmans, 2004), 248.
90 Nancey Murphy, ''Postmodern Apologetics, or Why Theologians *Must* Pay Attention to Science,'' in *Religion and Science: History, Method, Dialogue*, ed. W. Mark Richardson and Wesley J. Wildman (New York: Routledge, 1996), 115. Murphy's account of control beliefs follows Nicholas Wolterstorff's position, found in *Reason within the Bounds of Religion* (Grand Rapids: Eerdmans, 1976).
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