Keith B. Miller

Article

Doubt and Faith in Science and Religion

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In popular discussions and debates on science and religious faith, it is commonly assumed that faith is founded on personal certainty whereas science is based on skeptical inquiry. "To have faith" is almost synonymous in popular conversation with "to believe despite the evidence." The scientific community, on the other hand, presents its conclusions as tentative and subject to revision based on evidence. I argue that this perceived contrast between science and religious faith is misleading and drives yet another unnecessary wedge between these two important paths to pursuing truth. In reality, both scientific inquiry and religion are founded on the acceptance of fundamentally unprovable assumptions, and are subject to correction and change in response to new observations and new experience.

The modern elevation of scientific explanations over religious claims has its roots in the nineteenth century. In his study of the origins of unbelief during the Victorian period, James Turner argues that one of the primary causes of the abandonment of religion as a path to truth was the rise of "… intellectual uncertainties about belief that produced the conviction that knowledge about God lay beyond human powers, if such a Being existed."[1] Furthermore, at the same time, science was providing increasingly persuasive explanations of the natural world, including humans, without reference to God. Scientific explanations were seen as displacing religious ones.

Darwin's work provided a scientific framework for understanding human origins which extended to the human mind and emotions. Anthropologists

> conveyed the impression that religious beliefs, having evolved to meet purely natural individual and social needs, were entirely explicable in those terms … If the idea of God could be accounted for naturalistically, supernatural explanations became supererogatory and therefore dubious.[2]

This view was extended to other areas of science such as brain physiology and psychology in explaining the mind and soul, raising questions about the limits of human knowledge. Reflecting this growing skepticism, Darwin wrote on the matter of knowing God,

> But then arises doubt—can the mind of a man, which has, as I fully believe, been developed from a mind as low as that possessed by the lowest animal, be trusted when it draws such grand conclusions.[3]

The cultural ascendancy of science over religion was also aided by the early nineteenth-century dominance of Paley's argument from design for the existence of God. As stated by Turner,

> No demonstration showed more forcefully how science led to nature's God than the argument from design. No proof of God compelled more nearly universal assent than the argument from design. No theology exuded more confidence than the argument from design.[4]

Both the rejection of God and metaphysics by the appeal to naturalistic scientific

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explanation, and the use of the design argument for the existence of God, were predicated on the rational superiority of scientific knowledge over spiritual knowledge. Turner suggests, "Admiring natural theology as the irrefutable demonstration of God, church leaders had put so much energy into it that they had neglected to cultivate carefully other paths …"[5]

The consequence of this history is that today science is often described as being based on observational "facts" and that its conclusions are founded on tested, or at least testable, claims. Science is thus seen by many as the only path to more rational knowledge—to the "truth." Science also is presented as based on skepticism and doubt; its conclusions, tentative and continually subject to revision based on evidence. Religion, by contrast, is perceived as being impervious to change and based on faith in unsubstantiated beliefs. Religious beliefs are thus presumed to be destroyed by doubt, and are seen as being in conflict with the pursuit of rational knowledge.

These views are caricatures and significantly misrepresent the reality of both the scientific enterprise and religious faith. Lack of appreciation for the role of doubt and faith in both science and religion has resulted in barriers to a productive dialogue between scientists and people of religious faith.

Doubt and Faith in Science

Doubt and Uncertainty in Science

As stated by Henry Bauer, "Over the last few centuries, the authority of science came to supersede that of religion precisely because science seemed to offer more certain knowledge, at least about the tangible world."[6] However, in conflict with that perception, Bauer concludes that "… no general claim to certainty made globally in the name of science can be sustained."[7] Is our scientific understanding really that uncertain?

There are a number of sources of uncertainty in the pursuit of scientific explanation. These various types of uncertainty are very different in their scope and in their implications about the nature of scientific knowledge. Some of the important types of uncertainty do not have a fundamental bearing on the question of the relative roles of doubt and faith in science. These include (1) uncertainty due to the limits of measurement (ubiquitous because all scientific measurements have some range of error); (2) uncertainty in the validity of scientific conclusions resulting from human error, as well as personal and cultural bias; and (3) the inherent indeterminism of nature.

The lack of absolute precision in measurement does not invalidate those measurements, and the development of new technologies and methods enable measurement errors to be systematically reduced. Errors introduced by human bias have the potential of being corrected by the critical review of a culturally diverse global scientific community. While humans will always be fallible, specific human errors can ultimately be found and corrected. Lastly, the uncertainty introduced by the fundamental limits of nature, such as Heisenberg's Uncertainty Principle and Quantum Theory as well as limits to predictability by inherently random or chaotic processes, is a result of our advancing understanding of nature rather than being based on our ignorance.

However, there are sources of uncertainty in science that do generate significant doubt about our ability to ever fully know all of created reality, or to know that we know it. These are limitations to scientific knowledge that are not subject to resolution in any potential future. They are the primary focus of this discussion, and include (1) the methodological limits of knowing in science; (2) the uncertainty due to the inherent limitation of human knowledge; and (3) the uncertainty due to untestable assumptions.

Probably the clearest statement of the methodological limits of science is by Paul de Vries. He used the term methodological naturalism to describe the legitimate purview of science as one limited to explaining and interpreting the natural world in terms only of natural processes and causes. He describes scientific inquiry as follows:

> The goal of inquiry in the natural sciences is to establish explanations of contingent natural phenomena strictly in terms of other contingent natural things—laws, fields, probabilities. Any explanations that make reference to supernatural beings or powers are certainly excluded from natural science … The natural sciences are limited by method to naturalistic foci. By method they must seek answers to their questions within nature, within the non-personal and contingent created order, and not anywhere else. Thus, the natural

> sciences are guided by what I call methodological naturalism.[8]

In other words, science cannot investigate the existence or action of supernatural agents. Supernatural agents are not constrained by physical limitations, and agents that are unconstrained in their effects on the natural world are not useful scientific explanatory causes. They are effectively black boxes.[9] The question of the existence, or not, of supernatural causal agents active in the natural world cannot be answered by appeal to scientific investigation. Thus, the existence and role of an entire possible realm of reality lie outside of the ability of science to test and explore. This is not to say that there is no observational warrant for belief in the supernatural, but that science cannot test (confirm or disprove) that belief. Science can, and does, proceed within both theistic and nontheistic worldviews.

Our current scientific knowledge of the natural world is part of an ongoing historical process, and as such is incomplete and always will be. One of the central characteristics of the scientific enterprise is that its conclusions are tentative and potentially subject to correction and revision. The tentative nature of science enables it to respond to new observations and to new ways of conceptualizing previous observations. It is this ability to reformulate its understanding of the natural world, however fitfully, that is rightly understood as the key to the success of science in advancing our understanding of the natural world. However, the inherent tentative nature of scientific conclusions also implies that our knowledge will never be complete.

Science is always embedded in a historical context; it is limited by the body of knowledge, theoretical conceptions, and technological capabilities existing at the time. Science at any time is a product of that time. As Nicholas Rescher states,

> Our theorizing about the nature of the real is a fallible estimation, the best that can be done at this time, in this particular state of the art. Our science is a historical phenomenon; it is one transitory state of things in an ongoing process.[10]

In emphasizing the historical context of scientific knowledge, Rescher makes the observation that "if there is one thing we can learn from the history of science, it is that the scientific theorizing of one day is looked upon by that of the next as deficient."[11] He states further,

> There is nothing epistemically privileged about the present—any present, our own prominently included. Such a perspective indicates not only the incompleteness of our knowledge but its presumptive incorrectness as well.[12]

Our current knowledge and understanding of reality is thus not only incomplete, but also in ways unknown and unknowable to us—wrong. As expressed by Rescher,

> We must come to terms with the fact that—at any rate, at the scientific level of generality and precision—*each* of our accepted beliefs *may* turn out to be false, and many of our accepted beliefs *will* turn out to be false.[13]

This is not some form of fatalism, but simply a recognition that our state of knowledge is imperfect and always will be. Without such an awareness there would be no motivation to continue to investigate the universe, correct false conceptions, and open new windows to our understanding.

It is important to understand that science always has a context in time and place. Our scientific knowledge is always part of a broader historical trajectory and embedded in a particular cultural and social context at particular places in particular times. David Livingstone has emphasized the importance of place in understanding the scientific enterprise. He states, "… science is not above culture; it is part of culture. Science does not transcend our particularities; it discloses them. Science is not a disembodied entity; it is incarnated in human beings."[14] The scientific understanding of the physical world at a particular time and place is an expression of the social, political, and philosophical views of the culture in which that science is practiced. These cultural influences affect what aspects of the natural world we give attention to and how we perceive, interpret, and communicate our observations.

How we see and understand the physical world is built upon the historical heritage of ideas and theory passed on to us. Even our understanding of "facts" is subject to the current view of the nature of reality. According to Bauer,

> One of the modern recognitions by philosophers of science … is that facts are theory-laden: that is, there is no such thing as a definite piece of indisputable knowledge about the world whose meaning is not in some way colored by preexisting belief about the world.[15]

There are very few unambiguous timeless facts about nature. Although this may seem to leave science without a solid foundation, it is merely a recognition of our human limitations and the absence of absolute certainty.[16]

Perhaps the most inescapable sources of doubt, and the ones of which we are most unaware, are the unprovable assumptions that underpin all scientific knowledge. All the things that we know, and all of the ways of knowing them, depend on underlying assumptions that cannot themselves be proven. Michael Polanyi has strongly argued that it is not possible only to believe what is objective and certain knowledge, and to reject all else. He states,

> Objectivism has totally falsified our conception of truth, by exalting what we can know and prove, while covering up with ambiguous utterances all that we know and *cannot* prove, even though the latter knowledge underlies, and must ultimately set its seal to, all that we *can* prove.[17]

And he further says, "Our formally declared beliefs can be held to be true in the last resort only because of our logically anterior acceptance of a particular set of terms, from which all our references to reality are constructed."[18]

To accept as true any of our scientific understandings of the natural world relies on a whole set of assumptions about the nature of reality, and of the nature of our own existence and ability to perceive that reality. Without these fundamental assumptions, there would be no accepted path to knowledge. We proceed in our study of physical reality by taking for granted a common set of unproven shared beliefs about that reality. As stated by Os Guinness,

> When we set out to know something we do not proceed by *proving* everything we know before we know it. If we are to know anything, we must proceed on the basis of certain things which *cannot be proved but which must be presupposed*.[19]

Guinness provides a fitting conclusion to this discussion of doubt in science.

> Rationality is part of our greatness, but it also serves to keep us humble because rationality itself must be assumed by faith … In a profound sense we doubt not only because we are ignorant of something but because we are absolutely certain of nothing.[20]

Faith in Science

So what unprovable assumptions underlie the scientific enterprise? In what ways does science rest on faith?

Some assumptions are so fundamental, not just to science but to any interaction with the physical world, that they rarely if ever are brought to our conscious awareness. We assume that an objective physical reality exists, and that our senses provide access to at least some true aspects of that external reality. That is, we assume that our perceptions are not merely creations of our mind, and that there is a reality that corresponds to our sensory experience. The challenge to the existence of a knowable external reality was famously raised by René Descartes. He proposed an "evil demon" that presents a complete illusion of an external world including our assumed perceptions of it.[21] This same idea is reflected in more contemporary arguments that we are merely "brains in a jar," and expressed in science fiction stories such as "The Matrix." There is actually no way to disprove such arguments, but we proceed by faith, on the assumption of the reality of our sensory experience. At the same time, we are also aware that our senses can sometimes deceive us.

The debate over which fundamental presuppositions are necessary for the conduct of science is illustrated by the views of the eighteenth-century contemporaries David Hume and Thomas Reid.[22] The skeptic Hume argued that science was limited to describing our perceptions, avoiding any speculation about the existence of an external physical reality. Reid, however, was an advocate of common sense as the only secure foundation for philosophy and science. He argued that not only our senses, but also the reality of the physical external objects that cause them, must be starting points for philosophical reflections. He endorsed the basic reliability of both our sensory and mental faculties. The presupposition of common sense is fundamental and it is not possible to provide independent grounds for its acceptance.

Reid also argued that, according to reason, belief and action should match. As Gauch illustrates this point, "… a skeptics's mouth may say that we cannot be sure that a car is a real or hard object, but at a car's rapid approach, the skeptic's feet had better move!"[23] Reid further argued that the deeper questions of common sense are, Why does the physical world exist

at all, and why are we constituted so that the world is comprehensible to us?[24] These deeper questions could only be answered by appeal to a worldview, and for Reid that worldview was a Christian one.

Granting the existence of an objective external physical reality, in our pursuit of scientific knowledge we further assume that the universe has certain qualities. We assume that the universe is intelligible—that it behaves in regular and predictable ways. Scientific explanation often refers to "natural laws" that "govern" physical processes. This is a metaphorical way of communicating the regularities of the physical universe that we seek to describe in the language of mathematics. Science is the study of such regularities. In fact, any event in the universe that is inconsistent with known natural regularities remains outside current scientific explanation.

In developing our explanatory models of the universe, we also apply certain expectations about the nature of physical reality. For example, simplicity is preferred over complexity. Given a set of alternative explanations for a phenomenon, we favor the one that is less complex and that requires the fewest number of assumptions. This is referred to as "Occam's razor" or the principle of parsimony. This tool for selecting between alternative theories avoids the problem of multiplying auxiliary, or ad hoc, hypotheses to protect increasingly complex explanations from falsification. There is no logical reason to reject highly complex explanations, but as a practical matter simpler theories are preferred to complex ones because they are more testable.

There is also a very powerful aesthetic underlying the preference for simplicity—particularly, mathematical simplicity. This encompasses the pursuit of beauty in the description of physical reality. The desire to describe physical phenomena and forces with mathematical equations of simplicity, symmetry, and beauty has driven scientific discovery for centuries. Mathematicians often describe equations as beautiful or elegant. The drive to develop a single "theory of everything" to unite all the known forces into a single equation is also a pursuit of beauty and simplicity. An aesthetic element seems fundamental to science, yet there is no a priori reason why the universe must abide by our sense of order and beauty. Many connections have also been made between mathematics, music, and art.[25] At an emotional and experiential level, a recent neurological study has shown that the same area of the brain is involved in appreciating mathematical beauty and the beauty of art.[26] Our trust in our human aesthetic sense is clearly a driver in formulating our scientific understanding of the universe.

A further very important assumption underlying the doing of science, is that the scientific enterprise is more than a socially constructed phenomenon. It is accepted as a path to truth. Science is understood as a progressive enterprise that builds on previous knowledge. We do not continually retest accepted explanations, but seek to understand remaining gaps in our current theoretical framework.[27] To do this we must trust in the general reliability of the current scientific paradigm. This is the "normal science" of Thomas Kuhn.[28] Even when there is a major paradigm shift (a Kuhnian "revolution"), previous observations are not thrown out but are understood in a different light and incorporated into a new more-comprehensive paradigm.

How Then Does Science Progress?

On what basis can we say that science is progressive? Nicholas Rescher proposes two ways in which science can be understood to progress. One aspect of progress is that scientific investigation brings more and more phenomena under its explanatory framework. This includes the development of both new tools and new theoretical models. Rescher states,

> For all of recent science has a clear thrust of development—using ever more potent instruments to press ever further outward in the exploration of physical parameter-space, forging more and more powerful physical and conceptual instrumentalities for the identification and analysis of new phenomena.[29]

The other aspect of progress is that "science is marked by an ever-expanding predictive and physical control over nature."[30] These historical aspects of science suggest a directional trend not only toward more comprehensive explanations of the physical universe, but also toward increasingly true ones.

Fundamentally, science can progress toward increasingly true understandings of the physical universe because those understandings are being tested against a physical reality that exists independently of us. The history and character of the universe is what it is regardless of our current conceptions of it. Some

of those conceptions more accurately reflect the objective reality of the universe than others.

However, given our limited knowledge and human error, how is it that science does actually manage to progress? What prevents us from continually pursuing errant conceptions, and never coming any closer to an understanding of the true nature of physical reality? The answer lies in the fact that science is a communal activity conducted by a diverse group of practitioners. Within this community, scientific ideas compete with each other for acceptance. As stated by George Kneller, "Science is kept critical through competition between theories. Rival theories expose one another's weaknesses by their own successes, the less fertile theories eventually being abandoned."[31] Theories that successfully predict new observations gain acceptance by the community, and those that do not are rejected.

This competition among alternative interpretations serves not only to reveal those theories with the greatest explanatory power, but also to root out those that have been affected by human error or confirmation bias, and occasionally even deliberate fabrication.[32] This is one of the critical roles of professional peer review. It functions as a filter, though imperfect, through which scientific research must pass. Bauer states,

> … individual frailties or imperfections must run the gauntlet of communal scrutiny, with the result that much of the error, bias, and dishonesty that exists within the ferment of frontier science does not enter the scientific literature.[33]

That literature, in turn, makes new ideas and interpretations available to the worldwide scientific community for testing and further confirmation or rejection.

The central role of community for the conduct and progress of scientific research is the reason that scientific consensus carries such importance. The scientific consensus on a particular question represents the best current understanding because it has passed through the critical filters of review and testing.[34] As pointed out by Bauer, what we understand as objectivity in science, is not a characteristic of individuals, but of communities.

> The apparent objectivity of science results not from the accumulation of the individual objectivities of scientists but from the fact that the scientific community … works through consensus because there is no other way to play effectively.[35]

In a research environment isolated from outside critical review, the opportunity for significant error and misguided and futile research programs is great. Probably the most famous example of such a failure is that of the breeding efforts directed by Trofim Lysenko in Stalinist Russia.[36] Supported by Stalin, Lysenko's work was based on a commitment to Lamarckian concepts of the heritability of acquired characteristics and on a rejection of natural selection. In isolation from the global scientific community and with the banning of all other genetic research, "Lysenkoism" resulted in a decline in agricultural production and set Soviet biological science back decades.

Because science only works in community, the work of individual scientists must always be placed before that community for critical review and testing. As emphasized by Bauer,

> One of the things wrong with the popular, classical definition of the scientific method is the implication that solitary people can successfully do good science, for example, frame hypotheses and test them.[37]

Furthermore, he states, "If one understands that science is inescapably a cooperative enterprise, one can appropriately view as pseudoscience any claims made from outside the competent, relevant scientific community."[38] Isolation is an invitation to error and self-delusion.

The scientific community is a very conservative one, and it is resistant to novel ideas that stand in conflict with the accepted scientific consensus. This resistance to novelty is not any flaw in science that arises from the fallibility of the human beings who are doing science. Far from it.

> This resistance is actually the foundation of the trustworthy strength of science. The conservatism of the scientific community ensures that science itself is conservative and conserved, that new notions must prove themselves quite compellingly, with overwhelming evidence, before they win the day.[39]

The new radical ideas of today can become the consensus of tomorrow. However, they must first be demonstrated to have greater explanatory and predictive power than the reigning paradigm.

My field of geology has seen several such radical ideas move from the margins to mainstream through the persistent accumulation of evidence and effective response to critiques. Although Alfred Wegener's original proposals of continental drift were met with great skepticism, the construction of the powerful explanatory model of plate tectonics in the middle decades of the twentieth century transformed nearly all aspects of the earth sciences.[40] Several scientific debates during my own professional career also illustrate the hard work involved in having a radical new idea accepted. One of these was the proposal that the channeled scablands of Washington State were formed catastrophically by floods from glacial Lake Missoula, and another was the asteroid impact theory for the end-Cretaceous extinction.[41]

Doubt and Faith in Religion

Doubt and Uncertainty in Religion

There are as wide a variety of types of doubt and uncertainty in religion as there are in science. One type of doubt is that which is highly personal and particular. These are doubts that arise from personal spiritual experience, experiences with particular religious communities or individuals, or from perceptions of the history of particular religious groups. Such doubts may involve questioning aspects of the character of God (such as God's goodness or omnipotence) as understood by different religious communities, or questioning the very existence of God or other spiritual realities.

Less particularly, there are doubts that arise from apparent contradictions between received doctrine and human experience, and between doctrine and evidence from observations of the physical universe. Although much of the popular view of conflict between science and faith arises from common misconceptions of both science and religious faith,[42] there are still genuine points of tension. The very real tensions and unanswered questions that result can call into question long-held beliefs about God and God's relationship with humans and the physical creation. Resolution of such questions is illusive, and the resulting doubts are an unavoidable aspect of the life of religious faith.

Since the monotheistic faiths rely on written revelation as well as other forms of spiritual enlightenment, there are all of the attendant uncertainties associated with the preservation and proper interpretation of that recorded revelation. The processes of accurately copying texts, translating from ancient languages, understanding historical and cultural contexts, and so forth, introduce elements of uncertainty in the accuracy and meaning of the existing documents. That preserved revelation must then be interpreted and applied within a modern cultural and historical context entirely foreign to its origin. It must be continually adapted to new situations and new challenges.

Lastly, all spiritual revelation is limited. Just as scientific knowledge is incomplete, so is our spiritual knowledge. We do see through a glass darkly. This is not a cause for despair or abandonment of spiritual wisdom and insight, but a simple recognition of human fallibility and a call to humility. As stated by Guinness, "The root of doubt is not in our faith but in our humanness."[43]

Faith in Religion

It might seem that talking about faith in religion is comparable to talking about the wetness of water. However, perhaps to the surprise of many, the role of faith in religion is actually not that much different from its role in any other pursuit of knowledge, including the conduct of scientific investigation of the natural world.

The most fundamental unproven assumption is that a divine spiritual reality exists. Many faiths see the divine as grounding and infusing all of physical reality—of being a creative force. For the Abrahamic faiths, there is the additional assumption that there is a personal God who has, in different ways and times, communicated to humanity. This is not substantially different from the assumptions of science discussed above—that there is an objective physical reality, and that our senses provide access to true aspects of that reality. Our life experience may confirm these assumptions, but they must be taken on faith.

That the existence of the spiritual cannot be tested—or proven—by physical observation does not make it unreasonable to believe. Michael Polanyi states:

> God cannot be observed, any more than truth or beauty can be observed. He exists in the sense that He is to be worshipped and obeyed, but not

> otherwise; not as a fact—any more than truth, beauty or justice exist as facts.[44]

To demand observational proof of God's existence is in actuality to reduce God to a natural agent. As Polanyi further argues,

> It is illogical to attempt the proof of the supernatural by natural tests, for these can only establish the natural aspects of an event and can never represent it as supernatural. Observation may supply us with rich clues for our belief in God; but any scientifically convincing observation of God would turn religious worship into an idolatrous adoration of a mere object, or natural person.[45]

Having faith is not the antithesis of *knowing,* but its foundation. As stated by Guinness, "Without faith there is no knowledge. All true faith depends on knowledge. Knowledge and faith are inseparable."[46] Furthermore, "… the fact that assumptions are necessary for knowledge shows that knowledge and faith are not archenemies, as often supposed, but blood brothers."[47]

All knowledge is based on assumptions that cannot be proven but must be presupposed. Furthermore, as we have already seen, scientific knowledge is limited by its method to understanding the physical universe only in terms of material observable agents. Religion is the pursuit of understanding those things that transcend the physical. Each pursuit rests on a set of initial assumptions. Physicist Richard Feynman has commented on the validity of the pursuit of extra-scientific truth. He states:

> But if a thing is not scientific, if it cannot be subjected to the test of observation, this does not mean that it is dead, or wrong, or stupid … Scientists take all those things that can be analyzed by observation, and thus the things called science are found out. But there are some things left out, for which the method does not work.[48]

As with science, religion is seen by its practitioners as more than a culturally constructed phenomenon. It is pursued as a pathway to spiritual truth. Given a set of basic assumptions, we seek to advance our understanding of the nature of God and the implications of that knowledge for human actions and moral values. Religious views are not static but change over time. Both progressive revelation and the human pursuit of God result in a more complete understanding of the divine.

How Does Theology Progress?

Our understanding of the supernatural is subject to change by encounter with the spiritual that is affirmed by the believing community. Religion (theology) also changes in response to interactions with other realms of knowledge, and by resolving its own internal conflicts. Alfred Whitehead has observed that "Theology itself exhibits exactly the same character of gradual development [as science], arising from an aspect of conflict between its own proper ideas."[49] He further states:

> Science is even more changeable than theology. No man of science could subscribe without qualifications to Galileo's beliefs, or to Newton's beliefs, or to all his own scientific beliefs of ten years ago. In both regions of thought, additions, distinctions, and modifications have been introduced.[50]

No area of knowledge is static if its objective is the pursuit of truth—of understanding reality as it truly is. To claim otherwise is to commit the hubris of assuming that perfect and complete knowledge has already been obtained. Recognition of the current incompleteness and tentativeness of current knowledge is not to reject objective truth, but to affirm it. The pursuit of knowledge in both the natural and supernatural realms is the never-ending work of more accurately and completely describing the truth that we already know exists. Whitehead's comments are again relevant.

> It is a general feature of our knowledge, that we are insistently aware of important truth, and yet that the only formulations of these truths which we are able to make presuppose a general standpoint of conceptions which may have to be modified.[51]

The confidence that there is a set of unchanging truths is what drives our efforts to more fully apprehend them and to seek correction. "(Religion's) principles may be eternal, but the expression of those principles requires continual development."[52]

The Reformed theologian Barrett Gritters has discussed what it means for the church to be "always reforming." He argues that "the reformers never wanted anything more than to (1) reject what was in error, (2) sharpen what was unclear, and (3) retain everything else."[53] The conservative nature of theology that is both resistant to change yet open to challenge and correction, is not unlike the conservative nature of consensus science. However, to be open to needed change and correction requires

dialogue in a diverse religious community. Only when challenged by dissenting views, can potential error be recognized and valuable new insights be gained. Again, as in science, isolation greatly increases the opportunity for significant error and self-deception. Religious practice and the search for theological truth cannot be an individual enterprise but must take place within a community.

Doubt and Uncertainty Are Important for the Search for Truth in Science and Religion

An important conclusion from the above discussion is that doubt is of critical value in the pursuit of knowledge—any knowledge. Progress in science requires the recognition of the incompleteness and potential error of our current understanding of the natural world. As Feynman has stated,

> All scientific knowledge is uncertain. This experience with doubt and uncertainty is important. I believe that it is of very great value, and one that extends beyond the sciences … If we were not able or did not desire to look in any new direction, if we did not have a doubt or recognize ignorance, we would not get any new ideas.[54]

Unwillingness to entertain potential error is an invitation to remain in error with stubborn confidence. Feynman further argues, "… it is the admission of ignorance and the admission of uncertainty that there is a hope for the continuous motion of human beings in some direction that doesn't get confined, permanently blocked …"[55] Our hope for progress rests in acknowledgment of our current ignorance.

The demand for definitive and certain answers is not only unrealizable, but prevents us from advancing our understanding to more closely approach that objective truth that exists outside us. Rescher encourages us to embrace the uncertainty and incompleteness of our knowledge.

> We yearn for absolutes but have to settle for plausibilities; we desire what is definitively correct but have to settle for conjectures and estimates … But in science, as in the moral life, we can operate perfectly well in the realization that perfection is unattainable …
>
> For the fact that perfection is unattainable does nothing to countervail against the no less real fact that improvement is realizable—that progress is possible.[56]

We do not pursue what we have already obtained. Unanswered questions and doubts are not barriers or reasons for discouragement, but the basis for our longings and strivings. "The value of an ideal, even of one that is not realizable, lies not in the benefit of its attainment … but in the benefits that accrue from its pursuit."[57] This applies no less to theology and religious practice than to the pursuit of scientific understanding. Certainly, as religious people we should recognize that we "see through a glass, darkly"[58] and are seeking an elusive and unattainable goal. It is in striving to live our religious and moral lives in accordance with spiritual truth, while humbly recognizing our own limitations and failures, that we grow in spiritual understanding and wisdom.

Apparent conflicts between our religious beliefs and current scientific understandings of the natural world, and theological conflicts within our religious communities, serve to focus our attention on those areas where error may lie, and where new ideas may need to be entertained. These tensions should not paralyze us, but encourage us to pursue truth with both humility and confidence. Whitehead encourages us,

> We should wait: but we should not wait passively, or in despair. The clash is a sign that there are wider truths and finer perspectives within which a reconciliation of a deeper religion and a more subtle science will be found.[59]

Furthermore, he says, "A clash of doctrines is not a disaster—it is an opportunity."[60] Such opportunities for growth in scientific knowledge and spiritual wisdom will not come if we isolate ourselves from other voices and hide within our own echo chambers.

Doubts about our theological beliefs and religious practice provide the opportunity to correct error or inform ignorance. Alternatively, resolution of doubt may also serve to reaffirm and strengthen established beliefs. Guinness has described the nature of doubt as being in two minds.

> To believe is to be "in one mind" about accepting something as true; to disbelieve is to be "in one mind" about rejecting it. To doubt is to waver between the two, to believe and disbelieve at once and so to be "in two minds."[61]

Doubt is not something to fear as though it were a failure of religious faith. Rather, it should be a motivator to seek truth more diligently and humbly. Doubt should also not cause us to be "… tossed back and forth by the waves, and blown here and there by every wind of teaching and by the cunning and craftiness of people …"[62] Religious doctrine is conservative and resistant to change, and rightly so. But it is also reformational and must be open to challenge and, if needed, correction. There is no value, or moral high ground, in holding onto a false belief in the face of persuasive theological argument and spiritual witness requiring its rejection.

Again, as argued by Guinness, "If doubt is eventually justified, we were believing what clearly was not worth believing. But if doubt is answered, our faith has grown stronger still."[63] Doubt is a tool that if used bluntly can destroy well-founded belief, but if used rightly is critical to discovering error and advancing our knowledge.

> The value of doubt is that it can be used to detect error … If doubt can be turned destructively against truth so that it is dismissed as error, doubt can also be used constructively to prosecute error disguised as truth.[64]

This applies equally to both the scientific enterprise and to religious doctrine and theology.

Conclusions

Scientists proceed with limited knowledge and evidence, and they must recognize uncertainty. The theoretical frameworks that guide scientific research and exploration of the natural world are not static but evolve with new observations and new philosophical perspectives. Science is rooted in history and takes place within a broad, diverse community that provides a necessary corrective.

Similarly, religious faith is accompanied by doubt and uncertainty. We must question our theological assumptions and commitments in order to avoid serious error. One important role of the global Christian community is to provide correction—to challenge individuals and local faith communities to reevaluate perspectives and positions. Our faith is also molded by our experience in the world. Revelation is progressive and inextricably intertwined with the history of God's people. Through the witness of the Holy Spirit and the work of God in the body of Christ, the church has over the centuries been challenged to reconsider old assumptions and scriptural interpretations. Furthermore, our understanding of God's character has evolved in response to historical events and new discoveries, including those in the sciences.[65] Thus Christian theology is not static, but dynamic. Like science, faith is open-ended and unfinished. ✻

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Notes

[1]James Turner, *Without God, Without Creed: The Origins of Unbelief in America* (Baltimore, MD: Johns Hopkins University Press, 1986), 172.
[2]Ibid., 173–74.
[3]Nora Barlow, ed., *The Autobiography of Charles Darwin 1809–1882* (London: Collins, 1958), 93.
[4]Turner, W*ithout God, Without Creed*, 182.
[5]Ibid., 189.
[6]Henry H. Bauer, *Scientific Literacy and the Myth of the Scientific Method* (Urbana, IL: University of Illinois Press, 1992), 61.
[7]Ibid., 63.
[8]Paul de Vries, "Naturalism in the Natural Sciences: A Christian Perspective," *Christian Scholar's Review* 15 (1986): 388–89.
[9]Keith B. Miller, "The Misguided Attack on Methodological Naturalism," in *For the Rock Record: Geologists on Intelligent Design*, ed. J. S. Schneiderman and W. D. Allman (Berkeley, CA: University of California Press, 2009), 117–40. In this essay, I more thoroughly discuss why science cannot prove the existence of supernatural action or supernatural agents.
[10]Nicholas Rescher, *The Limits of Science*, rev. ed. (Pittsburgh, PA: University of Pittsburgh Press, 1999), 38.
[11]Rescher, *The Limits of Science*, 36.
[12]Ibid., 37.
[13]Ibid., 34.
[14]David N. Livingstone, *Putting Science in Its Place: Geographies of Scientific Knowledge* (Chicago, IL: University of Chicago Press, 2003), 180.
[15]Bauer, *Scientific Literacy and the Myth of the Scientific Method*, 65.
[16]For more discussion of my thoughts on fact and theory, see Keith B. Miller, "Countering Public Misconceptions about the Nature of Evolutionary Science," *Southeastern Biology* 52 (2005): 415–27.
[17]Michael Polanyi, *Personal Knowledge: Towards a Post-critical Philosophy* (Chicago, IL: University of Chicago Press, 1962), 286.

[18]Ibid., 287.
[19]Os Guinness, *In Two Minds: The Dilemma of Doubt and How to Resolve It* (Downers Grove, IL: InterVarsity Press, 1972), 40.
[20]Ibid., 41, 42.
[21]René Descartes, *Meditations on First Philosophy 1641*, trans. J. Cottingham (Cambridge, UK: Cambridge University Press, 1996).
[22]See chapter four in Hugh G. Gauch, Jr., *Scientific Method in Practice* (Cambridge, UK: Cambridge University Press, 2003).
[23]Ibid., 121–22.
[24]Ibid.
[25]See the compilation of essays in Subrahmanyan Chandrasekhar, *Truth and Beauty: Aesthetics and Motivations in Science* (Chicago, IL: University of Chicago Press, 1987).
[26]Semir Zeki et al., "The Experience of Mathematical Beauty and Its Neural Correlates," *Frontiers in Human Neuroscience* 8 (2014): 1–12, https://doi.org/10.3389/fnhum.2014.00068.
[27]Henry Bauer makes the important point that a reigning scientific paradigm "… not only embraces what we think we know, it equally determines what we believe to remain unknown … The unknown unknown comprises what we do not even suspect" (Bauer, *Scientific Literacy and the Myth of the Scientific Method*, 74).
[28]For a thorough introduction to Kuhn's view of scientific paradigms and normal science, see Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 2nd ed. (Chicago, IL: University of Chicago Press, 1970).
[29]Rescher, *The Limits of Science*, 38.
[30]Ibid., 39.
[31]George F. Kneller, *Science as a Human Endeavor* (New York: Columbia University Press, 1978), 68.
[32]One well-known recent example of the important role of critical peer review is the case of "cold fusion." Two respected researchers made claims for the demonstration of nuclear fusion at room temperature: Martin Fleischmann and Stanley Pons, "Electrochemically Induced Nuclear Fusion of Deuterium," *Journal of Electroanalytical Chemistry* 261, no. 2A (1989): 301–8. The subsequent failure of others to replicate their experiment, and the discovery of errors and the absence of nuclear reaction products resulted in the rejection of the original claims. See Gary Taubes, *Bad Science: The Short Life and Weird Times of Cold Fusion* (New York: Random House, 1993).
[33]Bauer, *Scientific Literacy and the Myth of the Scientific Method*, 46.
[34]See my discussion of consensus in Keith B. Miller, "The Nature of Science and the Public Debate over Anthropogenic Global Warming," *Perspectives on Science and Christian Faith* 64, no. 4 (2012): 220–29.
[35]Bauer, *Scientific Literacy and the Myth of the Scientific Method*, 48.
[36]Vadim J. Birstein, *The Perversion of Knowledge: The True Story of Soviet Science* (New York: Basic Books, 2004).
[37]Bauer, *Scientific Literacy and the Myth of the Scientific Method*, 52.
[38]Ibid., 60.
[39]Ibid., 76.
[40]A. Hallam, *A Revolution in the Earth Sciences: From Continental Drift to Plate Tectonics* (New York: Oxford University Press, 1975).
[41]See Victor R. Baker, "The Channeled Scabland: A Retrospective," *Annual Review of Earth and Planetary Sciences* 37, no. 1 (2009): 393–411. Also, see L. W. Alvarez et al., "Extraterrestrial Cause for the Cretaceous-Tertiary Extinction," *Science* 208, no. 4448 (1980): 1095–108.
[42]See Miller, "Countering Public Misconceptions about the Nature of Evolutionary Science" and Miller, "The Misguided Attack on Methodological Naturalism."
[43]Guinness, *In Two Minds*, 39.
[44]Polanyi, *Personal Knowledge*, 279.
[45]Ibid., 284.
[46]Guinness, *In Two Minds*, 39.
[47]Ibid., 40.
[48]Richard P. Feynman, *The Meaning of It All: Thoughts of a Citizen Scientist* (Boston, MA: Addison-Wesley, 1998), 16.
[49]Alfred N. Whitehead, *Science and the Modern World: Lowell Lectures, 1925* (New York: The Macmillan Company, 1926), 261.
[50]Ibid., 261–62.
[51]Ibid., 262–63.
[52]Ibid., 270.
[53]Barrett Gritters, "What It Means to Be Reformed: Reformed, Yet 'Always Reforming,'" *The Standard Bearer* 92, no.11 (2016): 244–47.
[54]Feynman, 26, 27.
[55]Ibid., 34.
[56]Rescher, *The Limits of Science*, rev. ed., 157, 158.
[57]Ibid., 160.
[58]1 Corinthians 13:12 (King James Version).
[59]Whitehead, *Science and the Modern World*, 264.
[60]Ibid., 266.
[61]Guinness, *In Two Minds*, 25.
[62]Quotation taken from Ephesians 4:14 (New International Version of the Holy Bible, 2011).
[63]Guinness, *In Two Minds*, 16.
[64]Ibid., 47.
[65]Davis A. Young, *The Biblical Flood: A Case Study of the Church's Response to Extrabiblical Evidence* (Grand Rapids, MI: Wm. B. Eerdmans, 1995). This book provides an account of how the church's understanding of one part of scripture was impacted by the growing understanding of the character and history of the natural world.

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