

CHAPTER THREE

Does Science Discredit Religion?

In this debate, John Worrall argues that there are irreconcilable differences between science and religion. A fundamental difference pertains to methodology: science evaluates candidates for belief only on the basis of evidence, while religion patently does not. So, Worrall concludes that a properly scientifically minded person cannot give credence to religious belief. Del Ratzsch argues that the relation between religion and science is much less clear than that, and that the arguments that science discredits religion are not nearly so powerful as some have believed.

Science Discredits Religion

John Worrall

We get the ages of rock, and they get the rock of ages; we work out how the heavens go and they work out how to get to heaven.

– Old saying amongst some scientists

*Strong Son of God, immortal love,
Whom we, who have not seen Thy face,
By faith, and faith alone, embrace,
Believing where we cannot prove.*

– Tennyson, *In Memoriam*

1 Introduction

Science and religion are in irreconcilable conflict – or so I shall argue in this chapter. There is no way in which you can be *both* properly scientifically minded *and* a true religious believer.

This might seem a surprising thesis in view of the undoubted fact that many scientists (even some of the most eminent ones) were or are also religious believers of one sort or another. But this results, I hold, from a mixture of three factors: (i) a simple failure to think things through fully; (ii) a failure to be properly scientific (as I shall explain, this involves more than simply giving due weight to well-accredited scientific results and theories, it also involves bringing a scientific attitude to the appraisal of claims and the weighing of evidence in general); (iii) adopting the attitude hinted at in the first of my epigraphs – one that holds that science and religion not only do not conflict, they *cannot* conflict, because they cover quite different domains.

The structure of my argument is very simple. I begin by analyzing the attitude just mentioned in (iii), arguing that, when properly understood, that attitude is (essentially) untenable for a religious person – the cost of adopting it is too high. This entails that both the scientist and the religious believer are playing the same game; they are both making substantive, descriptive, “explanatory” claims about the way the world is. But then they must surely also play by the same rules – all such claims must be judged by how well they stand up to the evidence. This, of course, is indeed how claims in science are appraised and accredited. When religious claims are appraised in this way, however, they all turn out to be untenable. Science, or rather a scientific attitude, is incompatible with religious belief.

2 Two Separate Domains?

The view is perhaps increasing in popularity that science and religion are about different domains, are two different “non-overlapping magisteria” (NOMA), as the eminent biologist Stephen Jay Gould recently put it,¹ and hence that, when properly understood, there can be no conflict between them. I can see three ways in which that view might be interpreted.

On one interpretation the view simply attempts to legislate away any clash by creating a separate, “spiritual reality,” alongside ordinary “material reality” – science teaches us about the latter, religion about the former. But this is based on a confusion – it elevates a (perhaps natural, but clearly sloppy) way of speaking into an obviously untenable ontological doctrine. There is only one reality; that reality either does or does not contain a god, an afterlife, or whatever, just as it either does or does not contain quarks or superstrings or whatever; and the question that needs to be addressed about both sets of equally unobservable (alleged) entities is what evidence

1 See S. J. Gould, *Rocks of Ages: Science and Religion in the Fullness of Life* (London: Jonathan Cape, 2001).

we have for their existence.² To take an analogy: defenders of the paranormal, like Uri Geller, may speak loosely of "another reality" beyond the mundane one, but what they really mean of course is that extrasensory perception and psychokinetic powers are aspects of *this* reality – what else could they mean? If what they claim to be true is true, then ESP and psychokinetic powers are parts of this reality (what else?). The question is simply whether what they say is true (or rather, since they are talking about (alleged) things that are not directly observable, whether there is good evidence that what they say is true). If religion is committed to making allegedly factual assertions about the world, whether about its material *or* (supposed) spiritual aspects, then science and religion seem to be two competing "magisteria," not distinct ones.

Or are they? On a second way of understanding the NOMA view (perhaps to be thought of as a refinement of the first), religion does indeed make descriptive, factual assertions about the universe – even about some of its "material" aspects – but there is no conflict because religion kicks in only once science has gone as far as it can. Newton's theory may have given a perfect explanation of the movements of the planets (let's suppose), but of course it gives no explanation of how those planets were created. Religion should avoid interfering in the law-governed "mundane" reality of planetary motions (religious sentiments led even Newton himself to make a mistake here), but it comes into its own at the level of creation. One problem with this version of the view, as the example illustrates, is that the line between what science can explain and what it cannot has a habit of shifting – we do now have well-accredited theories of the formation of the solar system, ones radically at odds with those invented earlier by theists.

But, shifting or not, there always *is* a line – at any stage in science, there will be features of the universe (those described by the most fundamental theories then available) that science treats as "bottom line": being most fundamental exactly means that those theories cannot (to repeat: cannot *at that stage in science*) themselves be explained. The suggestion, then, might be that religion can penetrate to a deeper level, by explaining why those scientifically basic theories are true; and that there is no clash because, by definition, science has nothing to say at that deeper level. But think what such a claim would entail. Surely, in order to count not as mere speculative assertions, but as genuine *explanations*, any such ideas presented by religion would have to carry some rational warrant. But, on the assumption that there is only one set of standards for appraising substantive explanatory claims about the world in the light of evidence, this makes this second interpretation of the NOMA view incoherent. If all explanations involving substantive, synthetic claims about the world must satisfy the same criteria, then it is simply nonsense to claim that religion can explain the scientifically inexplicable. To deny the assumption and assert instead that there are different standards of explanation in the different fields is simple relativism. And I assume that this is acceptable to no one in this debate. For one thing, if we allow

2 Those of you who may have heard of "multi-universe" interpretations of quantum mechanics should not be confused. According to such interpretations (which, by the way, have precious little to recommend them), *the* universe has many (causally non-connected) sub-parts. (Again, there is nothing else they could mean!)

different standards for explanations in religion, why not also in the study of the paranormal, or voodoo or scientology or . . . and so the list goes on? (I will address this view again, from a somewhat different angle, later.)

I take it, then, that the only coherent version of the NOMA doctrine, the only one that thoughtful commentators might really want to defend, is quite different from the two so far considered. This third version sees religion as advancing no *descriptive* doctrine at all, as making no real claims about the way the world really is, but “only” as making claims about what is and what is not valuable, what is and what is not a worthwhile life. This view concedes to science exclusive rights to inform us about the world of fact (understood in the broad sense to include general structural features) and accepts that religion is restricted to the world of value. This is certainly the version advocated by Gould:

Science tries to document the factual character of the natural world, and to develop theories that coordinate and explain these facts. Religion, on the other hand, operates in the equally important, but utterly different realm of human purposes, meanings and values – subjects that the factual domain of science might illuminate, but can never resolve.³

Obviously, this view of religion does indeed eliminate any possibility of a clash between it and science.⁴ But at what a price! (My advice here to religious people would be to avoid scientists bearing gifts.) For one thing, the religious person who adopts this view cannot call on any of the usual justifications for whatever value system she endorses. She cannot, for example, claim that one ought to “love thy neighbor as thyself” *because* this is what pleases our loving creator. This justification, of course, along with any of its ilk, involves a claim of exactly the sort from which she must now abstain. Avoiding the conflict in this way means abstaining from asserting *any* descriptive claim – not just specific claims about Adam and Eve or the Virgin Birth or the like that thoughtful religious people often have difficulty with in any case, but also more general ones about our possessing souls, or even about the universe being the creation of a superhuman “entity” or “force” – and treating all such claims as, at best, merely metaphorical.

I concede to no one in my appreciation of the importance of issues about what sorts of lives are valuable, and about ethical issues more generally. But coming to a view on such issues is surely not the exclusive prerogative of religious people. (Gould acknowledges this and in fact quietly takes the “magisterium” of “religion” to consist in the discussion of ethical issues, whether or not based on religion in the more usual sense.⁵) More centrally for current purposes, it seems very doubtful that a religious faith stripped of any substantive descriptive claim about the universe, its history, and its creation can really count as a religious *belief*. The theologian Ian Barbour surely has it right:

3. Gould, *Rocks of Ages*, p. 4.

4. Actually it isn't so obvious – there is a substantial literature examining the issue of whether the domains of fact and value are logically distinct. Nonetheless, it is true.

5. “[I] construe as fundamentally religious (literally, binding us together) all moral discourse on principles that might activate the ideal of universal fellowship among people” (Gould, *Rocks of Ages*, p. 62).

[R]eligious language does indeed express and evoke distinctive attitudes. It does encourage self-commitment to a way of life; it acknowledges allegiance to ethical principles and affirms the intention to act in particular ways. But . . . these *non-cognitive* uses presuppose *cognitive beliefs*. . . . [R]eligious faith is not simply assent to the truth of propositions; but it does require the assumption that certain propositions are true. It would be unreasonable to adopt or recommend a way of life unless one believes that the universe is of such a character that this way of life is appropriate.⁶

And once a religious faith "requires" such beliefs about the universe, then the clash with science (or more accurately the scientific attitude) is inevitable. Or so I now go on to argue.

3 Three Types of Religious Belief, Three Types of Clash with Science

Many beliefs about the world, its origins, and structure have been, and are, held in the name of religion. In order to examine carefully the issue of whether science and religion clash, we need to differentiate at least three types.

Into the *first* category fall quite specific beliefs about the universe and its history that some believers have certainly held (and in some cases presently hold) on the basis of their religion, but which are directly inconsistent with well-accredited scientific theories. One example is the claim that the earth is stationary in absolute space and that the sun and other planets orbit it; another is the claim that there were two humans, Adam and Eve, who had no ancestors, either human or human-like, and of whom all humans are descendants (or, more generally, the claim that the universe was created with essentially the same flora and fauna it presently exhibits in 4004 BC). I shall take it that no one seriously disputes that such claims are indeed inconsistent with well-accredited scientific theories.⁷ However, no serious thinker any longer feels the need to defend the first claim on biblical grounds – even the Vatican now thinks that its attack on Galileo, and his Copernican allies, was a mistake (though it did take it until 1820 to remove Copernicus's *De Revolutionibus* from its Index of forbidden books). And none but a few (though very noisy) fundamentalists still feel the need to defend the second claim on biblical grounds. Again, even the Vatican seems to have reconciled itself to the idea that evolutionary theory is more than a mere "hypothesis."

I shall not go into details about either of these particular claims or others of similar status. There is, of course, an enormous literature on such matters. I shall simply assume that the upshot of this literature is that,

(1) on the one hand, such claims *are* directly inconsistent with well-accredited scientific theories (and indeed that where this is true it is the erstwhile religious claim that must, from a rational point of view, give way);

6 Ian G. Barbour, *Myths, Models and Paradigms: A Comparative Study in Science and Religion* (San Francisco: Harper and Row, 1974), p. 58.

7 Anyone in any remaining doubt about the ineradicable clash between so-called scientific creationism and real science should consult Philip Kitcher, *Abusing Science* (Cambridge, Mass.: MIT Press, 1982).

(2) while on the other hand, there is no need for a religious person to commit herself to any such precise claim. A person may remain, in a clear sense, a religious believer without committing herself to any such claim that is (or at any rate is so obviously) inconsistent with well-accredited scientific theories.

While having seemingly reconciled itself to the (likely) truth of Darwinism, the Vatican, if I have understood its position correctly, continues to insist that there is some point along the branch of the evolutionary tree from chemical molecules to current humans at which "souls" were "infused" into some organism.⁸ Such a belief, along with other relatively general beliefs about souls and like "entities," falls into a *second* category. This, I suggest, is the category of beliefs that while not, perhaps, directly inconsistent with any well-accredited theory in science nonetheless seem to be in a clear and strong sense contraindicated by science.⁹

Nothing in neurophysiology is directly inconsistent with the claim that alongside the 10¹¹ or so neurons in the human central nervous system with their chemically governed activity there is another entity called the "soul." (Any more than that Newtonian gravitational theory is directly inconsistent with the claim that the reason why every particle of matter in the universe attracts every other with a force proportional to the product of their masses and inversely proportional to the square of the distance between them is that each such particle possesses an immaterial mind which happens to will this to be the case.) It is just that neurophysiology has no need for such a hypothesis - the "soul" simply and increasingly has no role to play (any more than those particulate "minds" would have any role to play in gravitation theory). Neurophysiology is, of course, a science still very much in its infancy, but it has already made impressive strides in explaining, in its own - "purely material" - terms, phenomena such as memories and pains that earlier thinkers held were in some irreducible sense "mental" and hence required some sort of "mind" or "spirit" whose properties and states they were. The religiously inclined could, then, readily identify the "soul" with such a "mind" or "spirit." But minds or spirits separate from bodies are no longer seriously available. There remain interesting and challenging issues about whether or not human psychology is fully "reducible" to the laws of nature governing matter. But these are to do with whether or not mental *properties* can be reduced to material properties - no serious scientist (even if religiously inclined) still holds any version of the Cartesian dualist view of a mental *substance* that is separate from the matter of the brain and central nervous system.

The reason why the soul can play no role, and why the idea of it gets in the way of proper scientific theorizing, is that the idea not only has no empirical support, it inevitably - in principle - can have no such support. There is reason to think (from the way that progressive science is going) that all the observable effects here are produced by neurophysiology, and that the "soul" can therefore itself have no observ-

8 See again the sympathetic treatment in Gould, *Rocks of Ages*.

9 Of course, I take it here that talk of souls and the like is to be understood in some "literal" sense - one that, if true, would make a factual difference to the way the world is - and not in any "metaphorical" sense, or sense that makes claims about the existence of souls some sort of hidden moral injunction. As already indicated, I readily concede that all "conflict" between science and religion can be eliminated by going fully "metaphorical" or restricting religious claims entirely to claims about values.

able causal effects. There is a principle of good scientific reasoning, sometimes called "Occam's razor," that is incorporated in one form or other into every sensible system of scientific confirmation, and which states that if some notion plays no role in – if it can be excised without cognitive loss from – our system of knowledge, then it should be so excised. This principle is uniformly applied within science itself. The nineteenth-century idea of a space-filling aether – a mechanical medium that was alleged to be the seat of the electromagnetic field (and earlier the carrier of the disturbances that constitute light) – is now rejected by physics. But the notion was rejected not because it is actually inconsistent with any new, well-accredited scientific theory, but rather because it is – provably – otiose. Once we have the real science, in this case the special and general theories of relativity, then further postulating the aether makes no empirical difference – not only is there no empirical evidence of its existence, there *cannot be* any such evidence. The same applies to this sort of intermediate second category of religious claim, exemplified by the idea of the soul.

This second category of religious belief slides over into a third. Beliefs in this third category are the most general of all. One example would be a general belief that the universe was created by (whatever that might actually mean) a superhuman power (whatever that might actually be). A retreat to claims in this third category may bring with it, for the religious person, the advantage of avoiding the need to account for why two religious persons selected at random from the world's population are likely to have apparently quite different specific beliefs – those differences being clearly correlated with accidents of birth, culture, and geography. What you are likely to believe about the speed of light or the half-life of particular isotopes of uranium, if you hold any such beliefs at all, is unlikely to depend on whether you were born and educated in Shanghai, Sydney, or Suez. But what *specific* religious beliefs you are likely to hold, assuming you hold any, *are* highly dependent on where you were born and educated. This fact, which surely ought to be disturbing for the thinking believer, may, perhaps, be nullified if one resorts to the very general level of belief – perhaps all religious people agree that the universe is the creation of some sort of superhuman power, and perhaps all the more specific claims should be thought of as merely metaphorical (and it must be said, then, pretty misleading) ways of endorsing that general one. (I take it that something like this is what J. S. Haldane had in mind when he claimed that "behind the recognized churches, there is an unrecognised church to which all may belong."¹⁰)

A general claim of this kind not only fails to be inconsistent with any scientific claim, the structure of science itself guarantees its consistency. Let me first explain why this is so, and then why I, nonetheless, hold that belief in even such general claims is unscientific.

Explanation in science is essentially derivative. In order to avoid unnecessary complexities, assume we are back in the nineteenth century before relativity theory superseded Newtonian "classical" physics. If you had asked a scientist at that time why it is that the planets move in the way they do – why, for example, they move in (somewhat perturbed) elliptical orbits around the sun – he would have had a ready answer. He could show that the assertion that the planets move in that way follows logically

10 Gifford Lecture, 1927; quoted from Gould, *Rocks of Ages*, p. 92.

from Newton's theory of mechanics plus universal gravitation (actually together with an "initial condition" about the planet's velocity). *Given* that every material particle in the universe attracts every other with a force proportional to the product of their masses and inversely proportional to the square of the distance between them, then it follows that a planet must move in a (roughly) elliptical orbit around the sun. But suppose you asked such a nineteenth century scientist to explain in turn the "given" in that initial explanation - to explain why Newton's theory itself is true, not why he *thought* it was true (a question about evidence) but, assuming for the sake of argument that it is true, why the universe obeys Newton's theory rather than any other. Why, for example, is the gravitational force inversely proportional to the square of the distance rather than, say, to the cube of the distance? Our nineteenth-century physicist would be nonplussed by this question. Again, he can readily explain how he "*knows*" that it's the square of the distance - that assumption and only that assumption yields the right observational results - but we are now considering an ontological question, not an epistemological one: that of why the universe happens to obey this particular law (assuming that it does) rather than any other. And the only answer to that question that our physicist could give would be some variation on the theme of "that's the way the cookie crumbles." Relative to the state of science at the time, it had to be taken as just a "brute fact" that the universe instantiates Newton's theory.

Nothing, of course, prevents a scientist from *attempting* to go deeper, from attempting to explain why Newton's theory holds. Indeed, one eminent scientist who endorsed that attempt was Isaac Newton himself - he famously denied that gravity could be an "essential property" of matter, and hence denied that his theory could be the *ultimate* explanatory "bottom line." Newton was tempted by a Cartesian-style explanation of gravity in terms of some pressure gradient in an all-pervading elastic aether (though he himself established that Descartes's own particular explanation along these lines was hopeless). Suppose that Newton had succeeded, that he had produced a theory about the constitution of a space-filling plenum, pressures in which gave bodies a tendency to move towards one another in accordance with his principle of universal gravitation. The logical point would of course remain: while we would then have an explanation for the state of affairs described by Newton's theory, the facts about this plenum and its properties that did the explaining would then themselves be unexplained; *those* facts would be - as science would then have stood - unexplained explainers. Explanation must always start somewhere, no matter what stage science has achieved. Yesterday's "brute facts" may indeed become today's explained facts - if so, then science has made progress; but the logic of scientific explanation makes the existence of some "brute facts" inevitable at any stage.

This is what provides the (logically inevitable) latitude for the religiously inclined. Since the attempt to reduce gravity to the actions of an aether failed, the poor scientist cannot explain why the force of gravity between two bodies happens to be inversely proportional to the square of the distance between them; but the religious person, it seems, has no problem - that's how the creator willed it to be. Or, to take a more up-to-date example, the scientific cosmologist cannot explain why it was that the so-called escape velocity of matter at "Planck time" shortly after the Big Bang had the value it did - she must just take it as a "brute fact" (in that case a brute fact

reflecting an "initial condition" rather than a law of nature). The religious person can, as always, "explain" that value by invoking a creator and his wishes – and indeed can, in that case, add a little more to the story, as we "know" on scientific grounds that if the value of that escape velocity had been just a little different than it in fact was, then galaxies (and hence humans) could never have formed. God fixed the value of the escape velocity because he wanted it to be possible for humans to evolve.

Although the structure of science inevitably leaves religion free to *claim* it can give "deeper" explanations than science, what could *warrant* such claims? As I explained earlier, a version of the "no conflict" (NOMA) account can be developed by allowing different standards for explanations in the two fields. But only, as we saw, at the surely unacceptable cost of adopting a purely relativistic viewpoint. If, as I urge, we refuse to pay that cost, then the credentials of these alleged religious explanations must be examined in the same way, by the same standards, as are scientific explanations; but if judged in that way, then those alleged explanations fail.

Notice, first, that once everyone is playing by the same (exacting) rules, then any claim that religion is in a superior position from the point of view of explaining the world is logically misplaced. A religious explanation in terms of a creator and his intentions is just another (attempted) explanation, and, even were it accepted, then, exactly as the request for an explanation of the latest scientific theory can always be made, so we can request an explanation of the religious claim: Why did the creator choose an inverse square law rather than, say, an inverse cube one? Why was the possibility of human evolution part of the creator's plan? The idea that religion can do what science cannot by "explaining everything" is an illusion.

This shows that the religious "explanation" can, at best, achieve parity – in fact, parity is far beyond its reach. Let's retreat just a little and ask why it was, for example, that the attempt to explain the law of gravity in terms of pressure gradients in a plenum was eventually deemed to be a failure. It could obviously and trivially simply have been claimed that there is an all-pervading medium and that – without specifying exactly how – there just happen to be pressure gradients set up in it that account for the gravitational attraction. But such an "explanation" would never be accepted in science because it is entirely *ad hoc* (in the pejorative sense) – it permits no independent test. All the alleged explanation does is to deliver what we already know – indeed, in the form I gave it, it was precisely designed so as to deliver that and only that.

A successful explanation, one that will be accepted in science, on the contrary, is independently testable and passes independent tests – that is, it not only entails the results it set out to entail, it also makes, often surprising, and hitherto unsuspected, empirical predictions which turn out to be correct. Independent testability and success in independent tests are the key to scientific progress.¹¹ The explanation of Kepler's laws of planetary motion by Newton's theory was a scientific success (and the theory was correspondingly regarded as empirically highly confirmed), because that theory turned out to entail not only those laws (or rather, in fact, a modified version of them) but also a range of other testable predictions – about the precession of the equinoxes,

11 See, e.g., Lakatos, "Falsification and the Methodology of Scientific Research Programmes," repr. in *Philosophical Papers*, vol. 1 (Cambridge: Cambridge University Press, 1974).

the return of Halley's comet, and so on (and later of the existence of a hitherto unsuspected planet), all of which turned out to be correct. The wave theory of light, developed by the French physicist Fresnel in the early nineteenth century, not only explained known optical effects, like reflection and refraction, it also turned out correctly to predict the existence of hitherto unsuspected and surprising phenomena – such as that the center of the (geometrical) shadow of a small opaque disc held in light diverging from a point source is illuminated, and illuminated just as strongly as if no obstacle were held in the light's path.

The "explanation" of, say, the facts revealed by Newton's theory or the value of the "escape velocity" of matter (or, of course, of any other feature of the universe) by the postulation that those facts reflect the wishes of a creator is, on the contrary, essentially non-independently testable. It is not just that such postulations happen to fail to be independently testable as yet. They can never in principle be subjected to independent tests – precisely because, unlike real successful explanations, they are explicitly designed to yield the already known facts (inverse square attraction, value of the "escape velocity") *and nothing more*.

Science not only declines to accept theories that fail to be independently testable, it positively rejects them. When a whole series of investigators, including, as I mentioned, Newton himself, consistently failed to produce any deeper account of gravity in terms of pressure gradients in a mechanical medium that was independently testable, then science adopted the view that there was no such deeper account to be had, and, despite initial reservations, accepted that matter just does act on other matter at a distance. Similarly, the initial reaction to Maxwell's postulation of the electromagnetic field was that such a field could not simply be a mysterious, primitive feature of the universe; the electric and magnetic field strengths at each point of space had to reflect the contortions of some underlying mechanical space-filling medium (our old friend, the aether). But when a whole series of investigators (again including, interestingly enough, the chief scientific innovator, in this case Maxwell) tried and failed to produce "mechanical models" of the field that were independently testable and independently confirmed, science came reluctantly to the view that the field is indeed a *sui generis*, independent, primitive part of the furniture of the universe – that is, the mechanical aether, at least as an underpinning of the electromagnetic field, was rejected.

I conclude that this third and most general type of religious belief, although not actually inconsistent with any substantive scientific theories, nonetheless runs counter to the practices that have informed successful science; and hence such beliefs, too, are unscientific. Some particular religious beliefs are inconsistent with well-accredited scientific theories, but all are inconsistent with a scientific attitude. Religious belief must, as Tennyson so eloquently reminds us in the second of my two epigraphs, rely on faith; and faith is unscientific.

4 Objections, Complexities, and Some Food for Further Thought

Not everyone who has contributed to the – very extensive – literature on the relationship between science and religion is likely to be convinced by the above

argument. (Indeed, this may count as one of the all-time understatements, even by customary English standards!) In a longer treatment, objections would need to be met, complexities unraveled, and, above all, further confusions exposed and clarified. Let me end by indicating – in rough outline – some of the necessary elaborations, if only in an attempt to facilitate further thinking about the issue.

4.1 Belief in science

I have talked so far as if science and religion were two (conflicting) ways of generating beliefs about the world. In fact, however, the relationship between science and (outright) belief is not at all straightforward. As recent studies have underlined, it would be a bold thinker who, in view of the history of radical theory change in science, believed that our currently accepted best fundamental theories are true. If any sort of belief concerning those fundamental theories is rationally mandated, it is at best a belief in their *approximate* truth, which really amounts to the meta-level belief that those theories will be retained in “limiting-case form” in any future replacement theories. (Einstein’s relativity theory is logically inconsistent with Newtonian theory, but yields the latter as a fully adequate approximation for cases of bodies moving at velocities small compared to that of light.) Outright belief – if reasonable at all – would be reserved for statements of evidence and, perhaps, for lower-level theories (such as that matter has *some sort* of atomic structure) that seem so firmly entrenched that their replacement is inconceivable. (This is reflected in the currently most popular formal account of the relationship between theory and evidence in science – personalist Bayesianism. This sees rational agents as assigning probabilities (short of 1) to explanatory theories – probability 1 (effective certainty) being reserved for statements of evidence and of “background knowledge.”¹²) I need hardly say perhaps that this, if correct, *sharpens* the clash between science and religion: if outright belief at least in fundamental, explanatory theories is not rational – that is, not scientific – even in science, despite their enormous empirical success, then the same must apply *a fortiori* to religious explanatory claims, which have no empirical success at all.

4.2 Kuhnian “commitment” in science

In his interesting book *Myths, Models and Paradigms*, Ian Barbour suggests that developments in the philosophy of science – notably in Thomas Kuhn’s *The Structure of Scientific Revolutions* (1962) – have reduced the differences between science and religion to differences of degree, rather than kind. Barbour’s argument merits a more systematic rebuttal than can be given here. My response, however, is that it relies on

12 See, e.g., C. Howson and P. M. Urbach, *Scientific Reasoning: The Bayesian Approach*, 2nd edn (La Salle, Ill.: Open Court, 1993). I should add that there are a number of Bayesian, probabilistic arguments for religious claims that I lack space to consider here – see, e.g., R. Swinburne, “Argument from the Fine-tuning of the Universe,” in J. Leslie (ed.), *Physical Cosmology and Philosophy* (New York: Macmillan, 1990). [Swinburne’s argument is subjected to heavyweight criticism by Adolf Grünbaum in “A New Critique of Theological Interpretations of Cosmology,” *British Journal for the Philosophy of Science*, 51 (2000), pp. 1–43. See also Swinburne’s reply in “Comments on Grünbaum,” *British Journal for the Philosophy of Science*, 51 (2000), pp. 481–5. The arguments are tied to ideas about what can, and cannot, possibly count as an unexplained “brute fact.” Those ideas are considered briefly below.]

overinterpretation of Kuhn's views. Kuhn *does* suggest that successful, mature science requires "faith" in basic, paradigm-forming theories. Scientists must have faith in those theories in order, for example, not to promote "anomalies" into outright falsifications – holding that work within the paradigm will eventually solve them. However, nothing like religious faith is necessary here. Scientists' "commitments" are temporary, pragmatic, and defeasible. One needn't have believed in the absolute truth of Newton's theory in the nineteenth century to see that the anomalies for it posed by observations of Uranus's orbit were probably best dealt with within the Newtonian paradigm – ideas associated with that paradigm provided ways of approaching the problems with Uranus's orbit (perhaps, for example, there was another planet in the heavens, so far misidentified, and once its gravitational action on Uranus was taken into account, the anomaly would disappear). Whereas had a mid-nineteenth century scientist proposed to "abandon" Newtonian theory, he would have been left with absolutely no idea about how to proceed. Moreover, anomalies must eventually be resolved, and what counts as a resolution is clear and a fixed feature of science – scientific "faith" is temporary and eventually called to account (in this life!).

4.3 Worries about independent testability

My argument is oversimplified as it currently stands: not all accepted scientific explanations are independently testable. For example (there are many), the explanation of the failure to observe any stellar parallax that was (surely correctly) accepted in the seventeenth and eighteenth centuries was that there is indeed parallactic motion but available telescopes were not sufficiently powerful to observe it. (If we are on a moving observatory, the earth, then pairs of "fixed stars" ought to seem at least slightly further apart when we are at our nearest point to them than they do when we are furthest away.) This explanation itself was certainly not independently testable – it simply explained away the problem it was introduced to deal with. Is this not exactly like the religious "explanations" I have castigated as unscientific? But notice two things. First, the basic theories involved here – the Newtonian version of the Copernican view – were (massively) independently confirmed *in other areas, by other phenomena*. So the "faith" is underwritten. Moreover, the lack of independent testability of even the specific theory is again of temporary duration – if telescopes had continued to improve in accuracy and still no parallax was observed, then the Newtonian/Copernican view would have been in unambiguous trouble. The point about the difference between scientific and religious explanations therefore remains in tact.

4.4 Explanation as "understanding" or "making sense"

The discussion of the idea of scientific explanation has, in my view, been dogged from the beginning by certain associations of the word "explanation" that ought to be excised. It is natural to think that explanation has something to do with (human) understanding, or "making sense" of, the universe. The whole structure of scientific explanation surely shows, however, that this is a mistake – all such explanation is derivative, and that means that we don't ever really understand anything about the universe (why should we?). Instead, we simply attempt to describe it – eliminating

minor mysteries (why do the planets move in ellipses?) in favor of major mysteries (why do all bodies attract one another in a certain way?).

An objection to this that certainly merits consideration is that even scientists allow that some theoretical claims "make sense" (reflect what can reasonably be taken as "natural" states of the universe), while others cannot be simply accepted as "brute facts" but *demand* explanation. It can then be argued that there are certain claims that must always remain brute facts on any scientific account (one much discussed contender is the fact that "there is something rather than nothing"¹³), but which cannot rationally be taken as brute, and that this therefore gives rational credit to religious claims which can explain them (and hence remove their erstwhile brutish character).

I can in response here only state my own view: namely, that all conceptions about what "makes sense" or what are plausibly "natural" states of the universe are historically conditioned by the successful research programs at the time, and hence are themselves subject to change in the light of the always dominant criterion of independent empirical support. Aristotelians demanded an explanation for any motion, Newtonians only for any *change* in motion; pre-quantum theory explanation in physics demanded a determinist theory, now that is no longer taken for granted; once Newtonian theory was established (and the aether-reductionist approach had failed), scientists were happy (for a while!) to take hitherto barely thinkable, action-at-a-distance as a brute fact. I hold, then, that there is no such thing as a fact that "cannot be taken as brute" – the sort of assumption that a scientist is happy to take as reflecting a brute fact is historically conditioned and historically variable.

4.5 Am I the victim of an evidentialist prejudice?

Finally, I have made it clear that my whole argument rests on the assumption that a rational, scientific person needs good evidence before admitting God into her world view, just as she would before admitting, say, electrons into it. Alvin Plantinga has mounted a well-known defense of the striking claim that belief in God can be "properly basic" – that is, taken to require no evidence.¹⁴ Although again it requires detailed treatment which I cannot give here, I should at least indicate my response. This is that, on analysis, Plantinga's view amounts to no more than the obviously true descriptive claim that *some people as a matter of fact take* belief in God as basic. But this is no news, the question of course is whether or not they are *justified* in doing so; and, insofar as Plantinga has anything to say about this issue, it seems to rest on the sort of simple-minded relativism that I have throughout taken to be eschewed. His response, for example, to the obvious question of why in that case one couldn't take belief in a flat earth (or come to that, the innate superiority of the "Aryan" race) as "properly basic" seems to be simply that no Christian would in fact take – or is under any obligation to take – such beliefs as "properly basic." This, however, is plainly not the issue. The question is what such a Christian would say to someone

13 I cannot resist here citing Adolf Grunbaum's response to Richard Swinburne on this issue: "Surprisingly, Swinburne deems the existence of something or other to be 'extraordinary', i.e., literally out of the ordinary. To the contrary, surely, the most pervasively ordinary feature of our experience is that we are immersed in an ambiance of existence." ("New Critique," p. 3)

14 See, e.g., A. Plantinga, "Is Belief in God Properly Basic?", *Nous*, 15 (1981), pp. 41-51.

who *did* assert as "properly basic" (that is, on no basis at all) a claim that she, the Christian, found abhorrent - and, assuming that she would want to challenge that claim, how she would deal with the *tu quoque* objection. Long live evidentialism!¹⁵