FRUITFUL INTERCHANGE OR POLITE CHITCHAT? THE DIALOGUE BETWEEN SCIENCE AND THEOLOGY

by William A. Dembski and Stephen C. Meyer

Abstract.   The demand that epistemic support be explicated as rational compulsion has consistently undermined the dialogue between theology and science. Rational compulsion entails too restrictive a form of epistemic support for most scientific theorizing, let alone interdisciplinary dialogue. This essay presents a less restrictive form of epistemic support, explicated not as rational compulsion but as explanatory power. Once this notion of epistemic support is developed, a genuinely productive interdisciplinary dialogue between theology and science becomes possible. This essay closes by sketching how the Big Bang model from cosmology and the Christian doctrine of Creation can be viewed as supporting each other.

Keywords: epistemic support; explanatory power; interdisciplinary dialogue; rational compulsion; science; theology.

In his intellectual autobiography Rudolf Carnap observed, "If one is interested in the relations between fields which, according to customary academic divisions, belong to different departments, then one will not be welcomed as a builder of bridges, as one might have expected, but will rather be regarded by both sides as an outsider and troublesome intruder" (Carnap 1963, 11). Carnap learned the hazards of interdisciplinary bridgebuilding by bitter experience. To this day philosophers recall how Carnap's efforts to relate philosophy and physics were obstructed during his stint at the University of Chicago's philosophy department in the 1940s and 1950s.

Since Carnap's day, and in part because of Carnap's efforts, the bridges between philosophy and physics have become more firmly established, with philosophy of science and, in particular, philosophy of physics now accepted as legitimate subdisciplines of philosophy. Moreover, certain

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philosophers of physics have through their work gained recognition in the physics community. Those who come to mind include Abner Shimony, who holds doctorates in both physics and philosophy; David Malament, who has proved technical mathematical results in general relativity; and Arthur Fine, who has done original work on the foundations of quantum mechanics.

Still, it would be an overstatement to say that philosophers and physicists are engaged in active dialogue. Philosophy has traditionally been classified with the humanities, and physics with the natural sciences. Much of what philosophers do and much of what physicists do simply do not intersect. A moral philosopher's metaethical ruminations on the nature of duty and a physicist's tinkering with lasers in the laboratory do not seem to connect in relevant ways. Given this perception, it is not hard to see why interested outsiders are often regarded as pesky meddlers, not as individuals from whom disciplinary insiders might actually learn something pertinent to their endeavors.

The difficulties attendant on the interdisciplinary conversation between physics and philosophy, and between the humanities and the natural sciences more generally, often pale by comparison to those encountered in the interdisciplinary dialogue between theology and the natural sciences. Distinct disciplines have a hard time communicating, even those which prima facie we might think would want to communicate, for example, philosophy and physics. How much more difficult it is, then, to get theology and science communicating when, especially over the last one hundred years, they have been increasingly characterized in terms of either a warfare or a partition metaphor (i.e., either they're in unresolvable conflict or they're so thoroughly compartmentalized that no possibility of meaningful communication exists).

But let us suppose for the sake of argument that we are in a world, not of ideal rational agents, but of ideal amicable agents—amicable in the sense that the agents are willing to talk to, listen to, and learn from each other. In such a world, would a dialogue between theology and science be fruitful? Would it further inquiry? Would it foster an increased understanding of the world? Would it yield a net gain of knowledge to both theologian and scientist? Or would only one side in the dialogue profit? Would such a dialogue constitute merely polite chitchat between members of different intellectual communities? Would they at the end of the day conclude that nothing of any genuine consequence had been accomplished through the dialogue?

On the assumption that we in the sciences and theology are willing to communicate with and listen attentively to each other, let us pose the question: Are there any good reasons to think that scientists and theologians will actually learn something from each other's disciplines that will

be valuable to their own? To be sure, both will learn some new things from such a dialogue. The theologian may learn from the physicist that the universe began as an incredibly dense fireball whose genesis is known as the Big Bang, whereas the physicist may learn that theologians believe that God created the world by means of a divine logos. So the theologian and the physicist will each have a new piece of information about another discipline to add to their stock of knowledge. But how are these pieces of information to be integrated into the web of information that constitutes our knowledge of the world? And how might a theological piece of information affect a physicist's physical understanding of the world, and mutatis mutandis, how might a piece of information from physics affect a theologian's theological understanding of the world?

What underlies these questions is the issue of *epistemic support*. In the context of an interdisciplinary dialogue, epistemic support is concerned with how the acceptance of claims in one discipline might justify the acceptance of claims in another. Now philosophers have written extensively about epistemic support and say that their work is directly relevant to evaluating the nature of the dialogue between theology and science. Nevertheless, if we are naive in how we appropriate their work, we will come to an impasse in the interdisciplinary dialogue between theology and science. This essay will therefore seek to describe a conception of epistemic support that fosters a genuinely productive interdisciplinary dialogue between theology and science.

How, then, should we characterize the form epistemic support takes in the dialogue between theology and science? What will it mean for a scientific (alternatively, theological) claim A to support a theological (alternatively, scientific) claim B? Does it mean that B follows as a logical deduction from A, or that there is an airtight circumstantial case to be made for B, given A, or that it is irrational to reject B once A is taken for granted? Support in any of these senses is the very strong notion of rational compulsion. The notion of support for which we argue in this essay is considerably weaker and will be explicated by reference to explanatory power.

Failure to distinguish between a strong and a weak form of epistemic support has led to confusion in the dialogue between science and theology. Consider, for instance, what Ernan Mc Mullin means when he denies that the relation between the Big Bang and the creation of the universe by God can be characterized in terms of epistemic support: "What one could say . . . is that if the universe began in time through the act of a Creator, from our vantage point it would look something like the Big Bang that cosmologists are talking about. What one cannot say is, first, that the Christian doctrine of Creation 'supports' the Big Bang model, or, second, that the Big Bang model 'supports' the Christian doctrine of Creation"

(Mc Mullin 1981, 39). Contra Mc Mullin, we insist that the Big Bang model does support the Christian doctrine of Creation, and vice versa. Yet we will develop a more liberalized notion of epistemic support that allows fruitful interdisciplinary dialogue without requiring that scientific evidence compel religious beliefs or the reverse.

RATIONAL COMPULSION

Rational compulsion involves a far stronger notion of support than typically comes up within either science or theology, much less in the dialogue between the two. One feels rationally compelled to believe necessary truths like $2+2=4$. One may even feel rationally compelled to believe in the existence of certain medium-sized objects such as trees, cars, and people.[1] Nevertheless, a considerably weaker conception of epistemic support seems to prevail in science and theology and seems appropriate for characterizing any interdisciplinary connections between the two.

Our primary task, then, is to delineate a conception of epistemic support whereby the interdisciplinary dialogue between science and theology does not reduce to idle chitchat but can instead engender deeper understanding and sponsor further inquiry. Recent developments in the philosophy of science make possible just such a conception of epistemic support.[2] Nevertheless, before describing these, we wish to indicate by way of negation the form epistemic support must not take if it is to foster genuinely productive interdisciplinary dialogue between theology and science.

The bête noire that has at every turn obstructed meaningful dialogue between theology and science is the demand that epistemic support be conceived as some form of rational compulsion. Rational compulsion is our own term, but it seems to capture the conception of epistemic support presupposed in so many ill-fated attempts to bring science and theology into dialogue. It may therefore be helpful to consider this conception of epistemic support in some detail. First off, let us specify that rational compulsion constitutes a perfectly valid form of epistemic support. Indeed, if A rationally compels B, then it is irrational to deny B if one affirms A. In such cases, A clearly provides epistemic support for B.

In practice rational compulsion takes the form of an entailment relation, either strict or partial. For A to strictly entail B means that it is impossible for A to be true but B false. Strict entailment is typically what people mean when they refer to deduction or demonstration or proof. On the other hand, for A to partially entail B means that the conditional probability of B given A is greater than the unconditional probability of B by itself. Partial entailment is equivalent to what goes by the technical name probabilification, though partial entailment is not coextensive with the more classical notion of probable reasoning. Partial entailment is a

more general notion than strict entailment and properly subsumes it because A strictly entails B just in case the conditional probability of B given A is one.[3]

Whether strict or partial, entailment is a logical relation, with the directionality of the logic going from the antecedent to the consequent (i.e., from the thing doing the entailing to the thing entailed). In practice we know that A strictly entails B when we can find a logical argument that takes A as a premise and which by a series of logical machinations (usually deductions according to certain inference rules) leads to B as a consequence. On the other hand, we know that A partially entails B when we have reliable ways of assigning probabilities to claims involving A and B and find that the conditional probability of B given A is greater than the unconditional probability of B by itself.

We wish to stress that both strict and partial entailment yield what we have been calling rational compulsion. This is immediately obvious for strict entailment. Indeed, if it is impossible for B to be false if A is true, then if we affirm A we surely had better affirm B also. Still, we may wonder why partial entailment should also yield rational compulsion. Whereas strict entailment leaves no room for either (1) fallibility or (2) contingency or (3) degree or (4) doubt, partial entailment leaves room for all of these. If A strictly entails B, then (1) there is no possibility of being wrong about B if we are right about A; (2) B follows necessarily from A; (3) A epistemically supports B to the utmost and cannot be made to support B to a still higher degree; and (4) not only need we not but we also ought not to doubt B if we trust A.

On the other hand, none of these properties holds in general for partial entailment. Consider the following two claims:

A: There will be a heavy snowfall tonight.
B: Schools will be closed tomorrow.

Suppose that nine times out of ten when there is a heavy snowfall at night, schools close on the next day. Then if we see heavy snow accumulating tonight, we have good reason to expect that school will be closed tomorrow. Nevertheless, the four claims we just made about strict entailment in the last paragraph fail to hold for partial entailment. Thus (1) even though A may hold, we may still be mistaken for holding B; (2) there is no necessary connection between A and B; (3) the relation of support between A and B admits of degrees (for instance, the relation would be still stronger if ninety-nine times out of a hundred school were closed following a heavy snowfall, weaker if only two times out of three); and (4) we are entitled to invest B with a measure of doubt even if we know A to be true.

Nevertheless, partial entailment and rational compulsion remain inextricably linked. To see this, consider the following rumination by C. S. Peirce:

If a man had to choose between drawing a card from a pack containing twenty-five red cards and a black one, or from a pack containing twenty-five black cards and a red one, and if the drawing of a red card were destined to transport him to eternal felicity, and that of a black one to consign him to everlasting woe, it would be folly to deny that he ought to prefer the pack containing the larger portion of red cards, although, from the nature of the risk, it could not be repeated. . . . But suppose he should choose the red pack, and should draw the wrong card, what consolation would he have? (Peirce [1878] 1988, 1313–14)

Yes, you might end up with a black card if you choose from the deck consisting predominantly of red cards, but you will be much more likely to end up with a black card if you choose from the other deck. Hence, if your aim is to avoid everlasting woe, you had better choose a card from the predominantly red deck. Now the injunction "you had better choose the red deck" is certainly a form of rational compulsion.

Thus, rational compulsion arises even when we are dealing, not with certainties, but with probabilities. Suppose therefore that A and B are claims and that P is a probability that handles claims involving A and B. Then if $P(B|A)$ (the conditional probability of B given A) is greater than $P(B)$ (the unconditional probability of B), we are rationally compelled or obligated to invest more credence in B on the assumption of A than in B taken by itself. Moreover, since it is a basic property of probabilities that $P(B|A) = 1 - P(\sim B|A)$ ($\sim B$ is the negation of B), it follows that whenever $P(B|A)$ is greater than 1/2, then $P(\sim B|A)$ is less than 1/2. Thus, if we know that A has happened and that $P(B|A)$ is greater than 1/2, then if we must base a course of action on whether B occurs or not, we must suppose that B, and not its negation, will occur.[4] In this way we see that not only strict entailment, but also partial entailment, yields a form of rational compulsion.

The question now remains, Why won't rational compulsion do as an account of epistemic support in the dialogue between science and theology? We see two problems with this standard.

First, the logic of entailment constitutes an excessively restrictive conception of epistemic support for science itself. Scientists can rarely prove their theories from empirical evidence in either of the two senses of entailment discussed above. Indeed, no field of inquiry short of mathematics could progress if it limited itself to the logic of strict or partial entailment. Rather, most fields of inquiry employ alternate forms of inference known variously as the method of hypothesis, the hypothetico-deductive method, abduction, or inference to the best explanation. Yet the limits inherent in the logic of both scientific prediction and explanation ensure that even good theories cannot be affirmed with certainty without also committing

the fallacy of affirming the consequent. In the language of contemporary philosophy of science, empirical data often leave scientific theories under-determined. Yet if scientists cannot prove (or make rationally compelling) their own theories from empirical data, it seems doubtful that theologians will succeed in proving theological doctrines from data in this same way. Thus, it follows that if rational compulsion stands as the only way for science to provide epistemic support for theology, little fruitful dialogue between the two disciplines will occur. Indeed, since empirical evidence rarely compels (in the sense defined above) acceptance of theories within science, it seems likely that the demand for rational compulsion will generally stultify interdisciplinary dialogue between theology and science.

Yet rational compulsion creates another impediment to productive interdisciplinary dialogue. In the logic of entailment, the direction of the logic and the direction of epistemic support move in the same direction. If A rationally compels B, then A strictly or partially entails B *and* A epistemically supports B. For a relation of epistemic support between A and B to obtain, the thing that does the supporting, in this case A, must be taken for granted—A must be given. But once A is given, any consequences strictly or partially entailed by A, say B, must be accepted as well —after all, A rationally compels B.

This creates a problem for interdisciplinary dialogue because presumably it is the implications of evidence from a given field that interest, for example, a theologian. Yet because the logic of entailment makes it irrational for anyone to doubt B given A, the theologian must either accept the implications of the scientific data without further discussion or challenge the evidential premise for the entailed conclusion (which the theologian, as a nonscientist, is in no position to do). Suppose, for example, that B follows from some evidential claim A from within a scientific discipline. And suppose, as is sometimes, though rarely, the case, that A happens to strictly or partially entail B. Suppose further that scientists generally are firmly committed to B, but the theologian finds B repugnant. For instance, we might imagine a dialogue between a member of the scientific establishment and a biblical scholar or theologian committed to a young earth. In this case, A is the claim that radiometric dating methods are sound, and B the claim that the earth is several billion years old. Here granting A does strictly entail B. But since the theologian is committed to an earth that is only a few thousand years old, B is utterly unacceptable. What then does the theologian do? The standard practice of the biblical scholar is to impugn A, that is, to reject the radiometric dating methods. Thus, the interdisciplinary dialogue between the biblical scholar or theologian and the scientific establishment does not even get off the ground. What is a fundamental assumption for the scientist, namely, A, entails a conclusion that is unacceptable to the theologian.

Of course, many theologians may adopt a less combative posture relative to scientific evidence or theory. Yet if the possible epistemic importance for theology of some evidence or theory A is confined to its logically entailed consequences B, even more scientifically sympathetic theologians may find little to contribute to an interdisciplinary dialogue —if for no other reason than it is irrational to doubt B given the logical exigencies of entailment. If, for the theologians, nothing is riding on some proposition B, then the theologians can graciously accept B, if A happens to entail B. Yet in this instance, the theologians do not learn anything genuinely new or significant about their discipline, nor do they contribute to understanding the science represented by A. In this case, B is irrelevant, or at best oblique, to the theologians' concerns; in the other, B so utterly contradicts the theologians' beliefs as to create irreconcilable conflict. Yet in neither case does fruitful dialogue ensue. Instead, presupposing that only the logic of entailment is relevant to the science and theology dialogue creates a conversation often characterized by either hostile accusation or polite chitchat.

EXPLANATORY POWER[5]

We believe an alternative understanding of epistemic support can foster a more productive interdisciplinary dialogue between science and theology. Fortunately such an alternative understanding is available. Although there are a number of ways to approach this alternative understanding of epistemic support, we approach it through the notion of *explanatory power*.[6]

A little history will help clarify what we mean by explanatory power. During the last century, C. S. Peirce devoted considerable energies to describing the modes of inference by which we derive conclusions from data. Because data are given and conclusions depend for their justification upon data, the relation of epistemic support is invariably directed from data to conclusion. Thus, if A comprises the data and B the conclusion, we say that A provides evidence for, serves to confirm, or epistemically supports B (where each of these expressions amounts to the same thing).

Now the thing Peirce observed is that the direction of the logic relating A and B need not go in the same direction as the relation of epistemic support between A and B. In the case of rational compulsion and entailment, as we saw in the last section, the directions are identical. Nevertheless, it can happen that the relation of epistemic support goes in one direction but the logic relating data and conclusion goes in the other. Peirce used the term *deduction* to characterize inference patterns whose logic and support relations were directed similarly, whereas he used the term *abduction* to characterize those where they were directed oppositely (Peirce 1931, 2:372–88).

The difference between these inference patterns becomes apparent from the following argument schemata (Meyer 1990, 25):

DEDUCTION SCHEMA

DATA: A is given and plainly true.

LOGIC: *But if A is true, then B is a matter of course.*

CONCLUSION: Hence, B must be true as well.

ABDUCTION SCHEMA

DATA: The surprising fact A is observed.

LOGIC: *But if B were true, then A would be a matter of course.*

CONCLUSION: Hence, there is reason to suspect that B is true.

Notice that the data and the conclusion of both schemata are identical, for in both instances we are given A and we conclude B. Yet the logic is entirely reversed. In the deduction schema the logic proceeds from A to B, whereas in the abduction schema the logic proceeds from B to A.

The logic of the deduction schema is the logic of entailment. Once A is given, anything logically entailed by A must be accepted as well. Within the deduction schema valid conclusions are therefore those entailed by A. The logic of the abduction schema, on the other hand, hinges on a quite different logic, one we shall call the *logic of explanation*. Once A is given, anything that neatly explains A becomes highly plausible. Within the abduction schema valid conclusions are therefore those which explain A.

Now it needs to be stressed that the logic of explanation is incompatible with the logic of deduction. As far as the logic of deduction is concerned, the logic of explanation commits the fallacy of affirming the consequent. The fallacy of affirming the consequent is essentially a failure to acknowledge that antecedent conditions can be underdetermined, that is, that more than one antecedent might explain the same evidence.

For instance, suppose we know that Frank was promoted, and suppose we know that if Frank behaves obsequiously toward his boss, he will be sure to be promoted. It does not follow as a logical deduction that Frank did in fact behave obsequiously toward his boss. Frank may just be incredibly competent so that his boss decided to promote him despite his not being obsequious. Alternatively, Frank's mother may be the head of the company, and so Frank's boss thought it wise to promote Frank even though Frank was at times downright rude. The point is that the explanation of Frank's promotion (whether it was on account of his obsequious behavior or on account of his mother being company president or whatever) is not governed by the logic of deduction. In particular, the logic of explanation involves no rational compulsion.

Peirce admitted as much when he noted, "As a general rule [abduction] is a weak kind of argument. It often inclines our judgment so slightly toward its conclusion that we cannot say that we believe the latter to be true; we only surmise that it may be so" (Peirce 1931, 2:375). Yet as a practical matter Peirce acknowledged that abduction often yields conclusions that are difficult to doubt even if they lack the airtight certainty that accompanies the logic of deduction. For instance, Peirce argued that skepticism about the existence of Napoleon Bonaparte was unjustified even though Napoleon's existence could be known only by abduction. As Peirce put it, "Numberless documents refer to a conqueror called Napoleon Bonaparte. Though we have not seen the man, yet we cannot explain what we have seen, namely, all these documents and monuments, without supposing that he really existed." To this Peirce added, "There is no difference except one of degree between such an [historical] inference and that by which we are led to believe that we remember the occurrences of yesterday from our feelings as if we did so" (Peirce 1931, 2:375).

To sum up, whereas in the logic of deduction, A epistemically supports B because A logically entails and therefore rationally compels B, in the logic of explanation, A epistemically supports B because B provides a good explanation of A. As Peirce showed, both logics provide legitimate inference patterns and underwrite robust relations of epistemic support. Yet although these logics often work in tandem, they are nevertheless distinct. Moreover, the logic of explanation suggests an important role for theology in enhancing our understanding of some scientific data, results, or theories. Unlike the logic of entailment, which left theology little to do beyond (in the most negative case) questioning the empirical findings of science, the logic of explanation suggests that theology might provide science with a source of (albeit in many cases metaphysical) hypotheses and explanations for its empirical findings and results. This logic further suggests a way that scientific data might provide epistemic support for theological propositions or doctrines. In particular, it suggests that scientific data can provide epistemic support for theological propositions just in case those propositions suggest a better explanation for the data than do the alternatives under consideration.

CONTEMPORARY DEVELOPMENTS

What has happened to the logic of explanation and its concomitant conception of epistemic support since Peirce's day? The key development has been a generalization of Peircean abduction via the notion of explanatory power. Even though Peirce clearly distinguished deduction from abduction, there is a sense in which deduction still plays a central role within Peircean abduction. Recall the Peircean abduction schema:

ABDUCTION SCHEMA

DATA: The surprising fact A is observed.

LOGIC: *But if B were true, then A would be a matter of course.*

CONCLUSION: Hence, there is reason to suspect that B is true.

Within the logic of this abduction schema, the prototypical example of B explaining A is the case in which A follows as a logical deduction from B (alternatively, B strictly entails or rationally compels A). Thus, as an elementary example of abduction, Peirce considered the case where A = *every bean observed from the bag is white* and B = *all the beans in the bag are white* (Peirce 1931, 2:374). Here B not only explains A but actually entails A (indeed, there is a one-step logical deduction leading from B to A).

Of course, Peirce also understood that such strict entailment relations were not necessary to provide an explanation. Nevertheless, he gave no account of how a rational agent might assess which of the many possible (abductively inferred) hypotheses might stand as the best explanation of some evidence A. In recent years, however, philosophers of science have clarified how such assessments are made. They have proposed three criteria that must be satisfied in order for B to constitute the best explanation of A. These are as follows:

First, B must be *consonant* with A.[7] Thus, instead of injecting discord or dissonance into our understanding of A, B must harmonize with A as well as the network of beliefs of which A is a part. In particular, if one were to take B as an (abductive) hypothesis, one would expect A to follow as a matter of course. To say that B is consonant with A implies that A confirms B, where B is taken as a hypothesis. Note that consonance is more than simply a coherentist requirement. Consonance involves both goodness of fit and aesthetic or theoretical judgment. A and B must not only be at peace with each other but one ought to have some reason to expect A given B.[8]

Second, B must *contribute* to A. Thus, B must perform some useful work in helping to explain A. B must solve problems or answer questions pertinent to A which could not be handled otherwise. This second requirement is a corollary of Occam's razor, ensuring that adding B to our stock of beliefs won't be superfluous. Increasingly this requirement has been explicated in terms of causal adequacy. Indeed, recent work on the method of "inference to the best explanation" (Lipton 1991) suggests that determining which among a set of competing possible explanations constitutes the best depends upon assessments of the causal powers of competing explanatory entities. Entities or events that have the capability to produce the evidence in question constitute better explanations of that evidence than those that do not.

Third, as the best explanation, B must have some comparative advantage over its principal rivals. Using hyperbole, we might say that it must be the *champion* among current competing explanations for A. B is therefore not the best explanation of A in any absolute sense. B must simply do a better job of explaining A than any of its current competitors. Explanation is therefore viewed as inherently competitive, contrastive, and fallible. Best explanations (champions) stand ever in need of critical reexamination. This third requirement therefore ensures that explanation is simultaneously progressive and self-critical.

Although this account gives only the barest sketch of what it means for B to be the best explanation of A, it will suffice for our purposes. Moreover, it accurately summarizes the development of Peirce's thinking in the hands of his modern-day successors. It is interesting to note that these modern-day successors are almost entirely philosophers of science. Imre Lakatos (1970), with his notions of competing "research programmes" and "heuristic power," Nancey Murphy (1990), with her application of Lakatosian philosophy of science to theology, Larry Laudan (1977), with his notions of competing "research traditions" and "problem solving ability," and Peter Lipton (1991), with his carefully nuanced notion of "inference to the best explanation," all incorporate the basic criteria we have enumerated in their programs for scientific rationality.

How does epistemic support look when explanatory power rather than rational compulsion serves as its basis? The answer will by now be obvious. Instead of A epistemically supporting B because A rationally compels the acceptance of B, A now epistemically supports B because B serves as the best currently available explanation of A. And this in turn means that B is consonant with A, a contributor to our understanding of A, and the current champion among competing explanations of A.

THE BIG BANG AND THE DIVINE CREATION

With explanatory power rather than rational compulsion characterizing epistemic support, the cosmological theory of the Big Bang and the Christian doctrine of divine Creation can now be brought into a relation of mutual epistemic support. To show this in detail far exceeds the scope of this modest essay. Still, a few brief observations will suggest how the Big Bang and the divine Creation might provide epistemic support for each other, once epistemic support is reconceptualized by reference to the logic of explanation.

Curiously, in the very passage in which he denies that relations of epistemic support obtain between the Big Bang model and the Christian doctrine of creation, Ernan Mc Mullin actually opens the door to such relations. In a passage already quoted, Mc Mullin remarks, "What one could say . . . is that if the universe began in time through the act of a

Creator, from our vantage point it would look something like the Big Bang that cosmologists are talking about. What one cannot say is, first, that the Christian doctrine of Creation 'supports' the Big Bang model, or, second, that the Big Bang model 'supports' the Christian doctrine of Creation" (Mc Mullin 1981, 39). Yet if we take explanatory power as our basis for epistemic support, it seems that what Mc Mullin denies in the second part of this quotation he actually affirms in the first.

For consider what it means to say, "If the universe began in time through the act of a Creator, from our vantage point it would look something like the Big Bang that cosmologists are talking about" (Mc Mullin 1981, 39). Doesn't this simply mean that if we assume the Christian doctrine of Creation as a kind of metaphysical hypothesis, then the Big Bang is the kind of cosmological theory we have reason to expect? Doesn't this also mean that the Christian doctrine of Creation is consonant with the Big Bang? We submit that the answer is yes to both questions.

Suppose now that we take the Big Bang as given (= data) and pose the question of how we might best explain the Big Bang in metaphysical terms. The playing field is potentially quite large. Metaphysics offers a multitude of competing explanations for the nature and origin of the material universe, everything from solipsism to idealism to naturalism to theism. Nevertheless, in practice we tend to consider only the competing explanations advocated by parties in a dispute. Since Mc Mullin's foil is the scientific naturalist, let us limit the competition to Christian theism and scientific naturalism.

If we limit our attention to these two choices, Christian theism and its doctrine of Creation may with some justification be regarded as providing a more causally adequate explanation of the Big Bang than any of the explanations offered to date by scientific naturalism. Since the naturalist assumes that, in Carl Sagan's formulation, "the Cosmos is all that is, or ever was or ever will be" (Sagan 1980, 4), naturalism denies the existence of any entity with the causal powers capable of explaining the origin of the universe as a whole. Since the Big Bang (in conjunction with general relativity) implies a singular beginning for matter, space, time, and energy (Hawking and Penrose 1970, 529–48), it follows that any entity capable of explaining this singular event must transcend these four dimensions or domains. Insofar as God as conceived by Christian theism possesses precisely such transcendent causal powers, theism provides a better explanation than naturalism for the putative singularity affirmed by the Big Bang cosmology.

This assessment will no doubt seem unacceptable to the inveterate naturalist. And, indeed, many ingenious naturalistic cosmologies have been devised to circumvent both the Big Bang singularity and its apparent metaphysical implications. To see this one needs only to recall the

contortions scientists have endured, not only in their metaphysical speculations but in their scientific theorizing, to avoid the dissonance created by the Big Bang cosmology for a naturalistic worldview. Einstein acknowledged this dissonance when he introduced his notorious cosmological constant to maintain a static universe—a decision he came to regret, calling it the biggest blunder of his career. Fred Hoyle acknowledged it when he proposed his steady state theory to retain an eternal universe—despite its flagrant violation of the conservation of energy. Of course, most committed naturalists now reject both these theoretical formulations. And many would also acknowledge that a rudimentary logic of explanation does create dissonance between the Big Bang and naturalism. Nevertheless, they would assert that coupling Big Bang cosmology with more speculative quantum cosmologies or many worlds hypotheses can eliminate dissonance. Yet, ironically, to the extent that even these cosmological ideas have validity, they may themselves have latent theistic implications. (Richards 1997, 224–26; Plantinga 1980, 213–17; Craig 1988, 389–95; 1996, 26–27).

In any case, the Christian doctrine of creation is consonant with a more standard Big Bang model and may well be regarded as a better explanation of it than its naturalistic competitors. Moreover, because the Big Bang is a putative scientific fact and because we are asking for a metaphysical account of that fact, it follows that the Christian doctrine of Creation is not a superfluous addition to our understanding of the Big Bang. The Christian doctrine of Creation actually contributes to our metaphysical understanding of the Big Bang by providing a causal explanation of it. Therefore, because Christian theism satisfies the first two criteria of best explanations enumerated above, it may (in a competition with naturalism) plausibly be regarded as a better explanation of the Big Bang. Hence, if we explicate epistemic support in terms of explanatory power rather than rational compulsion, it follows that the Big Bang provides epistemic supports for Christian theism and its doctrine of Creation.

To be sure, the argument that the Big Bang provides epistemic support for the Christian doctrine of Creation can be more fully developed and nuanced. Still, the general idea of how a fruitful interdisciplinary dialogue between theology and science may proceed should be clear. Note that in the example involving the Big Bang and the Christian doctrine of Creation, we only examined the case of a scientific claim (i.e., the Big Bang) providing epistemic support for a theological claim (the Christian doctrine of Creation). We could, of course, turn this around. Thus, we could fix the Christian doctrine of Creation as data and ask which cosmological theory of the origin of the universe is best supported by the Christian doctrine of Creation. The answer to this question is left as an exercise to the reader.

NOTES

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1. Cf. Wittgenstein's remark: "I am sitting with a philosopher in the garden; he says again and again, 'I know that that's a tree,' pointing to a tree that is near us. Someone else arrives and hears this, and I tell him: 'This fellow isn't insane. We are only doing philosophy'" (Wittgenstein 1969, 61e, no. 467).

2. Here we are thinking especially of the work of Imre Lakatos (1970), Larry Laudan (1977), Nancey Murphy (1990), and Peter Lipton (1991).

3. A detailed treatment of partial entailment may be found in Adams (1975).

4. Things become more complicated if in addition to probabilities we introduce utilities and thus have to balance the utility associated with a consequence against its probability (see Jeffrey 1983, chap. 1). Our discussion ignores utilities and focuses strictly on probabilities.

5. This section summarizes the second author's treatment of explanation in his doctoral dissertation (Meyer 1990).

6. Imre Lakatos, for instance, uses the phrase "heuristic power," whereas Larry Laudan speaks of "problem solving ability." See Lakatos (1970) and Laudan (1977).

7. Synonyms and close relatives for consonance abound in the philosophical literature. These include *coherence*, *consistency*, and *consilience* (to name just a few that begin with the letter *c*). We prefer *consonance*, in part because it evokes the psychological notion of cognitive dissonance. Among theologians concerned with theology-science interconnections, *consonance* seems to be gaining ground in recent days (see Peters 1989).

8. See Lipton (1991, 114–22), as well as John Leslie's (1989) notion of "neat explanations."

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