

# The Grand Design

## by Stephen Hawking and Leonard Mlodinow

Review by Ian Kluge

### 1 . Introduction

Stephen Hawking's and Leonard Mlodinow's *The Grand Design* begins with a grand or rather, grandiose claim that "philosophy is dead" and goes on from there. The book proceeds to tell us that an infinite stack of multiverses – instead of turtles – explains our allegedly 'fine-tuned' existence on earth. For good measure, the authors throw in what they think is a new philosophy of science, model-dependent realism, and demolish free will. They also add elaborate faith-statements about M-Theory, which, as Nobel-Laureate Steven Weinberg points out, is not nearly so well established or useful as Hawking would have us believe. The book ends by asserting that gravity not God is the reason why there is something rather than nothing.

Hawking's claim that "philosophy is dead" (5) is such a sweeping over-generalization that it is hard to know what it actually means. He thinks, "Philosophy has not kept up with modern developments in science, particularly physics" (5). Does he mean philosophy of science? Or ontology? Or medical ethics? Philosophy of physics? Postmodernism? If so, then it is pretty clear he is one who is just catching up with philosophy. He needs to read a little more broadly in modern books on all these subjects. Given his claim, it is ironic that his supposedly 'new' model-dependent realism is a hash of warmed-over Kuhn (*The Structure of Scientific Revolutions*, 1962), postmodernist epistemology and, above all, 18th Century Kantian idealism. As we shall see below, this model makes science impossible.

The problems begin early in the book. (We'll pass over the history of science howlers, like the claim that Aristotle, the father of biology, rejected observation.) In trying to answer the question about the origin of natural law, Hawking conflates and confuses two issues: (1) the existence of God as the ground of being or origin of all that exists and (2) God's relationship to creation, such as making exceptions to the natural laws He established. In other words, Hawking confuses the question of God's existence as the source of natural law with the question about God's interference in His laws. These are two fundamentally different questions and can be answered independently of one another. It is quite possible – as deists like Hume did – to say that God exists as the author of all, including natural law, without subscribing to divine interference, or 'miracles' as understood by Hawking. Claiming that we cannot believe in God without believing in miracles is logical nonsense. There is no absolutely necessary connection between the two ideas. The Baha'i Writings recognize this fact: they do not deny the possibility of miracles but do

not make belief in God dependent on them, and, indeed, de-emphasize them.

According to Hawking, if we distinguish God's existence from His miraculous deeds, God becomes "no more than a definition of God as the embodiment of the laws of nature" (29). Even if this were true, why would it be a problem? Saying that the laws of nature are divine keeps divinity in our world-picture as surely as saying a transcendent God created all natural laws. Such a world-picture differs significantly from a purely naturalistic world-picture which denies the divine altogether and ascribes everything to chance or quantum fluctuations. The presence of divinity in whatever form – even as a pantheistic God Who embodies natural law –influences not only science vis-à-vis our understanding of causality, but also fundamental issues of ontic, social, legal and spiritual value. In one view, we are the 'children' of the divine, in the other a by-product of chance combinations of matter. On the other hand, if Hawking means more than a pantheistic God, i.e. God as the author of the laws, then it is clear that as creator, God transcends the laws He makes, just as any artist transcends his own work. Here, too, as the maker of laws that allow the formation of life God becomes a source of value as well as understanding vis-à-vis causality and cosmic order. Contrary to Hawking's claim, the subject of miracles has nothing to do with the differences in these two world-pictures.

Hawkin and Mlodinow follow the Humean view, that a miracle is necessarily an exception to the laws of nature. God breaks the rules He made. Hawking shows how this view is irrational. But this is not the only possible explanation. First, there is the explanation by secondary causes. In other words, God works through the laws of nature to achieve effects that contradict our expectations and usual experience. He uses natural laws in ways we have not yet discovered. Consequently, no break with natural law is required. Theoretically, if scientists could get enough knowledge, they might even be able to understand how some miracles 'work' – i.e. miracles could become quite 'scientific.' Furthermore, contrary to what Hawking claims, scientific determinism would not "exclude the possibility of miracles or an active role for God" (30) because God acts through not against natural laws. Such a conclusion fits in well with the Baha'i Writings which state "No thing have I perceived, except that I perceived God within it, God before it, or God after it." (Gleanings from the Writings of Baha'u'llah, p. 178). Since God is "in" things, S/he may act through or by means of them.

A second possible take on miracles comes from quantum physics. This view defines a miracle as an event of an extremely low order of probability. Quantum physics has established that in the last analysis, all laws are probabilistic i.e. do not operate with 100% guaranteed results in all cases (72). A genuine miracle then, is a highly unlikely – but not impossible – event. Coins can land on their edge. Not often. But they can. Philosophically speaking, this lets us doubt that miracles have occurred but does not allow us to prove they cannot – which is what Hawking seeks (unsuccessfully) to do.

In both of these theories about miracles, God can interfere in nature without breaking any physical laws though He can use them in ways we do not expect. In this case, however, the problem is with our knowledge and expectations and not with God even if Hawking would have it the other way around. Of course, this does not mean we must believe all miracle stories in all religions – indeed, we may choose to believe none – but it does mean that we cannot logically rule out the possibility of miracles a priori.

Multiverses are another source of logical difficulties for Hawking. The Grand Design claims that the existence of multiverses can explain why the universe we inhabit is fine-tuned for life without resorting to God as an explanation. In an infinite array of possible universes, one that contains life is likely or even inevitably bound to appear. Saying that a universe fit for humankind is likely to show up is, in fact, a covert appeal to the laws of probability – which raises the question of the origin of the law of probability. Are they ‘just there’? If so, Hawking has resurrected God – the only totally independent entity – under another name. Did these laws develop through the interaction of particles? If so, how did the particles get the capacity to develop natural laws? How did the particles develop the capacity to interact with one another? And how could we answer such questions by means of the scientific method which requires prediction and observation? Clearly, Hawking’s multiverse suggestion leaves science behind.

If, on the other hand, the appearance of multiverses were truly random, then we could not determine that any result was likely, unlikely, inevitable or impossible. This negates Hawking’s claim that countless multiverses can explain the origin of this fine-tuned universe. An explanation must tell us why something happened, must happen or is likely to happen – and if the appearance of universes is purely random, we cannot know any of these things. Simply claiming that because there are so many of these multiverses a world like ours must appear is like saying that sand-castles must appear on the beach because there are trillions of trillions of grains of sand. Well, no . . . For building sand-castles, sand-grains are necessary but not sufficient causes. Clearly, multiverses by themselves are not sufficient for explaining the existence of a fine-tuned universe.

## II. Model-Dependent Realism

One of Hawking’s and Mlodinow’s main contributions in The Grand Design is their theory of “model-dependent realism” (42) according to which a physical theory or world-picture is a model (generally of a mathematical nature) and a set of rules that connect the elements of the model to observations. This provides a framework with which to interpret modern science. (43)

In their view “to model-dependent realism it is pointless to ask whether a model is real, only whether it agrees with observation” (46); moreover, if two different models agree with observations, we cannot know which one is “more real than another” (46). This is inane wordplay – saying that a “model is real” means precisely that it agrees with observation. What else could it mean? How can a model “agree with observation” of nature and not be “real” i.e. not correspond to the reality it models? If a model makes testable predictions which are validated, the very fact of validation means something about the model is correct, i.e. corresponds to reality and, therefore, provides real information about nature. Clearly, Hawking and Mlodinow are trying to establish a distinction between ‘agreeing with observation’ and ‘being real’ – but what purpose can such a distinction serve in the pursuit of science? Imagine it being applied in virology: our model correctly predicts the nature and behavior of a deadly virus – but that’s no reason to make a vaccine, since the agreement with the model doesn’t tell us anything real about the virus. Who would accept such reasoning, let alone act on it?

The ultimate, and devastating consequence of accepting this line of thought is that it makes science impossible. Science is no longer a quest for knowledge about the world or nature and has turned into the quest for knowledge about our theories or models of the world – which is a very different thing. According to model-dependent realism, there is no such thing as scientific knowledge of nature but only knowledge of our own models. And even that is undermined by degeneration into an infinite regress. When we check a model against our observations, we must also have a model of what constitutes ‘an observation’ and that model requires further observations which in turn must be checked against our model and so on. Furthermore, we cannot even know our own models because to make a model we have to have a model of models, (and observe whether our model of models agrees with models we check) and then a model of the model of models and so on ad infinitum. This catches Hawking and Mlodinow in a logical tangle from which there is no escape: we cannot know nature (as they admit), but neither can we really know what a ‘model’ or an ‘observation’ is. The clear upshot is that science as the quest for knowledge about nature is impossible.

Hawking’s view covertly carries within it a profound and corrosive skepticism about the possibility of real knowledge about nature. All we can know are our models – and ultimately, as we have seen above, not even them. Moreover, if all knowledge is model-dependent, can we know anything about anything since all we can really know is whether or not our observations agree with our model? It is, after all, “pointless to ask whether a model is real” (46) i.e. whether a model gives knowledge about reality. This skepticism is precisely why Hawking and Mlodinow can undermine the whole concept of progress in science by claiming that the Copernican model is merely more convenient and not more correct than the Ptolemaic model of the solar system. There is no progress because there is no true model or knowledge about nature

– only more or less convenient models for whatever our purpose happens to be. That, of course, reduces ‘truth’ to whatever we want it to be.

The unadmitted source of model-dependent realism is Kant’s theory of perception. This is evident from their view that according to the idea of model-dependent realism . . . our brains interpret the input from our sensory organs by making a model of the outside world. We form mental concepts of our home, trees, other people, the electricity that flows from wall sockets, atoms molecules and other universes. These mental concepts are the only reality we can know (172; emphasis added).

For those who, unlike Hawking and Mlodinow, have “kept up” in philosophy, this is very old stuff indeed. Already in *The Critique of Pure Reason* published in 1781, Kant proposed the same idea: the mind builds our world-picture or model of reality by ordering raw sensory data according to categories such as time, space and causality in order to construct them into our perceptions and conceptions of the every day world – “homes, trees . . . atoms and other universes.” These are “the only reality we can know” (172). In other words, we never actually perceive reality as it is in-itself, i.e. Kant’s noumenal world but only the phenomenal world created by our minds. In effect, we are locked in a bubble world-picture, model created by the human brain. Moreover, there can be no ‘Archimedean viewpoint from which we can ‘objectively’ view the world; in the language of post-modern philosophy, there is no “privileged” viewpoint or model from which to judge the others. Science can do no more than test its hypotheses to see if its model matches the observations. Even if observation supports our model, we can only say that our world-picture or model is confirmed, but we cannot draw any conclusions about the noumenal, natural world as it is in-itself underlying our brained-generated phenomenal world. Therefore, in the last analysis, science is not about discovering reality – which we can never know – but about our models of reality. As Niels Bohr once said, “It is wrong to think the task of physics is to find out how Nature is. Physics concerns what we say about Nature.”

There are numerous problems with Hawking’s and Mlodinow’s neo-Kantian model-dependent realism, but as with all variations of Kantianism, one difficulty is paramount, i.e. the Darwin problem. How could humankind have survived through evolution with a perceptual mechanism which is not generally well-attuned to the world as it actually is? A creature whose perceptual system did not provide accurate information would not have lived long enough to produce viable off-spring over the last three million years. The same can be said about our conceptual systems which must interpret our perceptions in such a way as to match observation or at least, not contradict it. The survival value of a perceptual and conceptual mechanism that misled us about our environment would be null. Clearly, therefore, Kant and Hawking’s model-dependent realism grossly exaggerate the gap between our brain-built models and reality as it is. The models and reality are not always perfectly aligned, but this is a purely accidental, i.e. not

necessary situation. It may happen in some instances – and science must watch for this – but it does not necessarily happen all the time. Hawking and Mlodinow, of course, claim that this situation is necessary, i.e. inherent in the way the brain functions and makes models. Their view is contradicted by the fact that humans have been drawing correct conclusions about reality (and not just about their models) well enough to allow our species to survive for millions of years. There is no reason to think this has changed recently.

Therefore, contrary to Hawking and Mlodinow (and Kant), we can in fact learn something about reality as it really is and not just our theories and/or models. And, therefore, science as the discovery of reality, is really possible – which it is not in a view that limits science to determining whether our models fit observations. The view of science as the discovery of reality contradicts Hawking’s claim that “it is pointless to ask whether a model is real” (46). For example, on a busy highway, we will learn that large differentials in mass have a great deal to do with surviving a collision – and this is knowledge about reality, not just our theory. The same line of reasoning applies to Kant’s ur-version of model-dependent reality. Even if we accept Kant’s view that incoming sense data is shaped by categories such as time, space and causality, we also have to admit they are attuned to reality as it is or we would not survive as individuals or as a species. Imagine trying to cross a busy street if Kant’s category of time did not accurately reflect reality. The same principle also applies to Hawking’s statement that “There is no picture or theory independent concept of reality” (42). This may or may not be true – but it is irrelevant to the fact that some models are better attuned to reality than others especially when our survival is involved.

It is important to note that Hawking and Mlodinow are unable to express their own model-dependent realism consistently. For example, they discuss “the principles of quantum physics, which is an accurate description of reality” (44). If “it is pointless to ask whether a model is real, only whether it agrees with observation” (46) how can they make such a statement about what is real in nature? After all, our own percepts and concepts are all we can know. Here is another example of their inconsistency: “nature does not dictate the outcome of any process or experiment” (72). Given model-dependent realism, on what basis can they justify such a statement about nature? Do they mean nature in-itself or nature as our neurons have shaped it into certain models? A third example: Hawking says that Maxwell’s equations “apply to the entire universe” (93). On the basis of model-dependent realism, how could he make such a claim? This is not mere nit-picking. If a theory cannot be expressed consistently with its own principles, then its expression starts to undermine the principles – which indicates that something is amiss in the theory itself.

### III. God

Hawking and Mlodinow propose to do away with God as a necessary part of explaining the

existence of the universe. They believe that the three “why? questions” (171) can be answered “purely within the realm of science, and without invoking any divine beings” (172). These questions are (1) “Why is there something rather than nothing?” (2) “Why do we exist?” and (3) “Why this particular set of laws and not some other?” (171).

There are at least two major difficulties with the author’s attempts to answer these questions. The first is that they violate the principle of sufficient reason. In its Leibnizian formulation this principle asserts that no statement is true unless it contains a sufficient reason why it cannot be otherwise. Another variation states that no event X occurs unless there is a sufficient reason why X occurs and not something else, i.e. Y. A sufficient reason is one that makes other alternatives impossible. In concrete terms, the principle means that there must be a sufficient, i.e. necessary reason why cream warms up when I add it to hot coffee instead of turning to ice. Scientific research, of course, is the business of finding sufficient reasons for physical events. Therefore, when the search for sufficient reasons is abandoned science itself has been left behind.

The principle of sufficient reason quickly highlights the problems with Hawking’s and Mlodinow’s argument vis-à-vis God. In its most general terms the problem concerns explaining why the universe is a lawful place, i.e. one in which science can observe necessary regularities of behavior. Newton’s laws, for example, explain not only that things fall, and the manner in which they fall, but also why they necessarily fall in this way. This brings us to a question: what or who established the law? The law cannot establish itself since that involves the self-contradiction of having to exist before it exists. We can try to establish its existence by referring to other physical laws – but that only leads us to an infinite regress of references to still other laws, and, therefore, fails to give us any answer at all since an infinite regress by its nature gives no final answer. Nor does an infinite regress satisfy the principle of sufficient reason. A solution to this problem eludes Hawking and Mladinow again and again. They do not seem to realize that any purely immanent answer, i.e. answer that remains strictly within the realm of physical events and laws leads to an infinite regress and, thereby, ceases to be scientific. More succinctly, nature does not explain itself, i.e. no inherently material explanation of the universe is logically sustainable.

Any attempt to explain why physical laws and attributes exist by means of other physical laws and attributes fails one of the basic tests of rationality, namely, the principle of sufficient reason. Such an attempt does not provide a final explanation of why things must be the way they are, i.e. they fail to conclusively answer all three of the ontological questions the authors promise to resolve. ‘Why is there something rather than nothing?’ is not answered by referring to an infinite regress of laws. ‘Why do we exist?’ is not answered by telling us that the “universe creates itself” (181) because that still leaves open the question of the source of this capacity to create itself. Simply positing it is merely to stop asking questions – which is not a scientific procedure. ‘Why this particular set of laws and not others?’ is not answered by telling us that there are other laws that demand the existence of this particular law because this too merely starts an infinite

regress.

Here is a specific example. Hawking and Mlodinow write, “[o]ne requirement of any law of nature must satisfy is that it dictates that the energy of an isolated body surrounded by empty spaces is positive which means that one has to do work to assemble the body” (179). On this basis they explain why there is no reason “that bodies could not appear anywhere and everywhere” (179). The problem is obvious. Why “must” any law of nature satisfy this requirement? To say that other laws of nature require it, simply starts an infinite regress about explaining the attributes of the other laws and how these attributes arose. Consequently, Hawking and Mlodinow provide no final explanation at all if we remain within the confines of the material realm, i.e. within the limits of physical science.

This leads to two conclusions. First, any attempt to explain why physical laws and attributes exist by means of other physical laws and attributes fails one of the basic tests of rationality, namely, the principle of sufficient reason. Such attempts does not provide a final explanation of why things must be the way they are, i.e. they fail to conclusively answer all three of the ontological questions the authors promise to resolve. ‘Why is there something rather than nothing?’ is not answered by referring to an infinite regress of laws. ‘Why do we exist?’ is not answered by telling us that the “universe creates itself” (181) because that still leaves open the question of the source of this capacity to create itself. Simply positing this capacity is simply to stop asking questions – which is not a scientific procedure. ‘Why this particular set of laws and not others?’ is not answered by telling us that there are other laws that demand the existence of this particular law because this too merely starts an infinite regress.

The second conclusion is that if we want an ultimate explanation that does not degenerate into an infinite regress, we will have to accept that such an explanation will logically involve a non-physical factor, i.e. something that transcends matter and its intrinsic limitations. Anything that does not transcend matter inevitably involves infinite regress of physical laws. From this it follows that nature does not explain itself, i.e. no purely, inherent material explanation of the universe is logically sustainable. The problems mentioned by Hawking and Mlodinow at the beginning of Chapter 8 are intrinsically unsolvable by physical, i.e. scientific explanations alone.

Before continuing, there is another, albeit related problem with Hawking’s and Mlodinow’s argument. If the number of physical laws is infinite, then, of course, we get a linear infinite regress. However, if there is only a limited number of physical laws, the infinite regress becomes circular. Sooner or later we will arrive back at the very first law we are trying to explain – and off we go again, around and around forever in a circular variation of the infinite regress. Both possibilities clearly demonstrate the untenability of purely immanent, physical explanations of

the universe, its laws and its attributes.

The reference to something transcending matter is, of course, a reference to God in His ontological function i.e. God as the source and ground of being, not the personal God of Abraham, Isaac and Jacob. This “God of the philosophers” is independent of all physical entities; He transcends it, and is therefore, not subject to the limitations of time, space and causality that restrict material things. We now reach a crucial point in our argument. The ontological God is the only rational choice left to us in explaining the origin of the universe and its laws and attributes because as we have seen above, purely immanent, physical, scientific explanations lead to an infinite regress that violate the principle of sufficient reason and give no final answer. God is not arbitrarily chosen or shoe-horned into the discussion. He is recognized as the only remaining rational choice we have given the failure of the scientific explanations. In other words, a full explanation of the existence of the universe requires recognition of something transcendent, or conversely, no scientific explanation of the existence of the universe which ignores the transcendent is complete. Here science and religion have been unified or harmonized insofar as science and religion (belief in a God of some kind) need each other to complete their explanations in a logically viable way.

This leads to a scientific view of God. Until someone devises a viable, completely immanent physical argument showing how the universe arose the way it did without starting an infinite linear or circular regress, we will have to accept an ontological vision of God as our best available, i.e. most rational explanation. Call it ‘provisional theism’ if you like though I don’t think there is anything provisional about it since dismissing this argument requires making changes to the nature of matter and natural law – which is, to put it mildly, extremely unlikely.

Finally, Hawking and Mlodinow claim that theirs is “a model of a universe that creates itself” (181). For the reasons given above, this model is not logically viable, but that still leaves something to be clarified. As used by the authors, the phrase “creates itself” means “creates itself” literally out of nothing because of gravity. But, of course, they do not mean ‘nothing’ in the logical sense of absolute absence, but rather ‘nothing’ in the quantum sense of infinite potential energy which can have spontaneous fluctuations. Such fluctuations are not possible in absolute absence. If something fluctuates in absolute absence, we are obviously not dealing with absolute absence. This leads to a familiar problem for Hawking and Mlodinow: how did their nothing acquire the capacity to have spontaneous fluctuations? How did these fluctuations acquire their particular characteristics. Furthermore, claiming that the universe “creates itself” raises the question of the origins of this capacity as well as the laws by which it creates. As shown above, purely immanent, physical explanations are not logically viable.

Hawking and Mlodinow's also put far too much emphasis on M-theory as the basis of their radical conclusions. As Steven Weinberg puts it so gently, they "make this fundamental theory seem a little better understood than it actually is." (Steven Weinberg, "The Universes We Still Don't Know," NY Review of Books, Feb. 10, 2011). In other words, they exaggerate its explanatory power, scope and effectiveness. According to Weinberg, the basic problem with M-theory is that it is "not a fundamental theory itself" (ibid.) but only a series of proposed solutions to "an unknown fundamental theory" (ibid.). Whether or not this is a suitable foundation on which to base their far-reaching conclusions remains to be seen.

Intellectually speaking, *The Grand Design* is a weak book, worth reading only because Hawking is listed as the principle author. In other words, we read *The Grand Design* to find out what a great physicist is thinking – and come to realize that when he ventures from physics into philosophy, he is clearly out of his depth. He has, in his own words, "not kept up" (5) even as far as 18th century philosophy and shows little or no awareness of the derivation of his ideas – be it Kant or some forms of postmodernism – or of their philosophical implications. This is ultimately a book for enthusiasts, i.e. for new atheists wishing to magnify their claims by attaching them to a great name. It is not a book for those of serious philosophical bent who wish to explore their ideas seriously.

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