FINE-TUNING, MULTIPLE UNIVERSES, AND THE "THIS UNIVERSE" OBJECTION

BY

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Abstract: When it is suggested that the fine-tuning of the universe for life provides evidence for a cosmic designer, the multiple-universe hypothesis is often presented as an alternative. Some philosophers object that the multiple-universe hypothesis fails to explain why *this* universe is fine-tuned for life. We suggest the "This Universe" objection is no better than the "This Planet" objection. We also fault proponents of the "This Universe" objection for presupposing that we could not have existed in any other universe and that the values of the free parameters of the Universe could have been different. Lastly, we reflect on why fine-tuning for life needs explaining.

Given the need for fine-tuning, the fact that the Universe does indeed permit life is said to support the hypothesis that the Universe is the product of intelligent design. In response, the hypothesis that there are many universes other than our own is often presented as an alternative. While this hypothesis is popular amongst physicists, some philosophers reject it as explanatorily unsatisfactory. The standard complaint is that the multiple-universe hypothesis violates Ockham's Razor, but an emerging objection is that the multiple-universe hypothesis fails to explain why *this* universe permits life. We dub the foregoing the "This Universe" objection (TU) and raise three objections to it. First, we challenge its proponents to explain how it differs from the "This Planet" objection (TP), which is clearly not a cogent objection to explanations of the fitness for life of the Earth that appeal to the vast number of planets in the Universe. Second and third, we fault it for presupposing two non-obvious metaphysical theses: that we could not have existed in any other

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universe, and that the values of the free parameters of the Universe could have been different. We also address why advocates of the multiple-universe hypothesis think fine-tuning needs explaining in the first place.

Terminological preliminaries

Before proceeding, some terminological points are in order. First, the term 'the Universe' (with a capital "u") will be used as a proper name that picks out a particular instance of the purported natural kind presupposed in the multiple-universe hypothesis. [As will be discussed below, it is not at all clear what this natural kind is supposed to be.] The terms 'universe' and 'universes' (with a lower-case "u") will be used to refer to other instances of this purported natural kind. Thus the Universe (in the sense provided) is not necessarily the totality of all (spatiotemporal) things. Furthermore, reference to the Universe is secured indexically, at least according to the participants in the debate, most of whom talk of "this universe," "our universe," "the universe that begat and nourished us," and so on.

Second, the following abbreviations will be used:

D: The hypothesis that there is a supernatural designer possessing power and knowledge sufficient to create a universe with life and a strong motive for doing so.

M: The hypothesis that there are vastly many universes.

E: The fact that the Universe is such as to permit the development of life in it at some stage.

E′: The fact that some universe is such as to permit the development of life in it at some stage.

K: The fact that many of the initial conditions and free parameters of a universe need to be fine-tuned in order for the development of life to be possible.

Fine-tuning, multiple universes, and TU: a brief review

Our universe follows the laws of general relativity and quantum mechanics. Contemporary cosmologists (rightly or wrongly) are not terribly concerned to explain why the universe follows these laws rather than other conceivable laws. Rather, they seek to explain why our universe has various particular features given that it does follow these laws. For the purposes of this discussion, we will go along with them. Thus when we talk of universes in this paper, we are to be understood as referring only to possible physical realities that follow general relativity and quantum mechanics. Whether there might be non-relativistic, non-quantum-mechanical universes, and whether such universes might be hospitable to life, are questions beyond the scope of this discussion.

To note that our universe follows general relativity and quantum mechanics is not to provide a full description of it. To do so we must also specify a list of values for a large number of free parameters, including quantities such as the mass density of the universe, the expansion rate of the early universe, the mass of the proton, and the strength of gravity. These parameters are "free" in that they are not deducible from currently accepted theory; they need to be "filled in by hand." To say a parameter P needs to be fine-tuned for life is, by most accounts, to say life could not arise in a universe in which P took a slightly different value (assuming the remaining free parameters keep their actual values). Although we find this definition inadequate, we will not contest it for the purposes of this paper.[1] It seems that very many free parameters need to be fine-tuned if there is to be life anywhere in the universe.[2] Thus something that we might have thought too obvious to mention, E, is supposed to be eye-popping given K. According to the contemporary design argument from fine-tuning, since E is phenomenally improbable given K, a better explanation for E is D. This argument may be laid out in terms of the probabilistic theory of confirmation, according to which a hypothesis is confirmed by evidence to the degree that the evidence together with the background knowledge renders the hypothesis more probable. In the case at hand, the claim is that:

$$(1) \quad P(D|E \,\&\, K) \gg P(D|K)$$

because:

$$(2) \quad P(E|D \,\&\, K) \gg P(E|{\sim}D \,\&\, K)$$

So D is confirmed by E. It is a short step from (1) to an argument for D if one grants that:

$$(3) \quad P(D) \gg P(E|{\sim}D \,\&\, K)$$

that is, if one grants that it is far more probable that there is a designer than that an undesigned Universe just so happens to permit life.

A rival to D is M. If M is true, say its proponents, then it is unsurprising that at least one universe in the multitude is life-permitting. As is called to our attention by the anthropic principle, the only sort of universe we can observe is a life-permitting one, and this observational selection effect, when coupled with M, is supposed to explain why we observe a fine-tuned universe. That is,

$$(4) \quad P(M|E \,\&\, K) \gg P(M|K)$$

because:

$$(5) \quad P(E|M \,\&\, K) \gg P(E|{\sim}M \,\&\, K)$$

So even if D raises the probability of E, M does so at least as well (according to M's proponents). Though M does not entail ~D (M says nothing about whether the universes in the ensemble are or can be the products of design), M is consistent with ~D. Thus the atheist seeking intellectual fulfillment can, according to proponents of M, account for E in terms of M plus the anthropic principle without having to appeal to design at all.

At this point proponents of the design argument typically object that D is vastly simpler than M, and so to choose M over D is to violate Ockham's Razor. Richard Swinburne is perhaps the most notable advocate of the claim that D bests M in the simplicity department,[3] but many others sing the same tune.[4] We shall not address the issue in this paper except to say that we think clarification is needed regarding how to rate M with respect to simplicity. Consider in comparison the Standard Model in particle physics. It postulates only a few types of elementary particles and so is rightly regarded as an elegant theory, even though the raw number of such elementary particles is vast. The case of the Standard Model suggests that simplicity is measured with respect to types rather than tokens, and furthermore that simplicity is but one criterion at work in Ockham's Economy Principle. Does M involve postulating too many types of entities? How does it fare with respect to other considerations like symmetry and beauty? The answers, surely, depend on the specific multiple-universe model on offer. We note that some authors think simplicity considerations actually favor M rather than disfavor it.[5]

In addition to the preceding objection to M, however, is the complaint that M does not explain E at all, where E is understood as the fact that *this* universe, *our* universe, permits life. The intuition is well-expressed by Alan Olding:

> . . . the 'world-ensemble' theory provides no explanatory comfort whatsoever. The situation is this. We have our own universe with planets occasionally, if not always, producing life; and, to escape explaining this fact, we surround it with a host of other universes, most limp and halting efforts and some, perhaps, bursting at the seam with creatures. But where is the comfort in such numbers? The logical situation is unchanged – *our* universe, the one that begat and nourished us, is put together with as unlikely a set of fine-tuned physical values whether it exists in isolation or lost in a dense scatter of worlds. So, then, by itself or surrounded by others, the existence of our universe still cries out for explanation.
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> . . . whatever the probability of finding our world among the one or the many, the probability of our world existing at all takes on its own value irrespective of whatever else independently exists. There is, then, something logically odd in conjuring up a dust of universes large and varied enough to ensure at least one world carries sentient life and we

are still left with the problem of accounting for the strange fact that that is precisely what our world does.[6]

Ian Hacking makes the same point, arguing that to think M explains E is to commit the "Inverse Gambler's Fallacy" of inferring a large number of trials (e.g. a long series of dice tosses) solely from observation of a single extreme outcome (e.g. the tossing of double-sixes). Since all the trials are independent, the existence of many prior tosses does not make double-sixes any more likely on the observed toss. Likewise, says Hacking, the existence of a vast temporal sequence of expanding and collapsing universes (as in the "oscillating universe" model of John Wheeler[7]) does not make it any more likely that the Universe will be one of the extreme cases in which life is possible.[8]

More recently TU has been pressed by Phil Dowe[9] and Roger White.[10] Since White's version of TU adds some new wrinkles, we will summarize it here. White concedes that if we were to accept M, then an inference to D would no longer be supported. However, he denies that this is because M explains E. Instead he claims that M merely "screens off" the probabilistic support that E lends to D. So:

$$(6) \quad P(E|D \,\&\, M \,\&\, K) = P(E|{\sim}D \,\&\, M \,\&\, K)$$

If there are many universes, White thinks, then the probability that *this* one is life-permitting is no greater on the supposition that there is a designer than on the supposition that there is no designer. This is because there is no reason why a designer would single out our universe to be the one that permits life. [Note that White presupposes here that a designer would only be concerned to create one life-permitting universe; if a designer would be expected to create many, (6) would not hold.] So conjoining M with D robs D of its power to explain E.

The situation as White envisions it is analogous to surviving a game of Russian Roulette. Suppose your captors tell you five bullets have been placed in the chamber of a six-shooter and then force you to put the gun to your head. You pull the trigger but find yourself still alive. This, you may think, is evidence that your captors intended for you to live and were simply lying about having loaded five bullets in the gun. But if you are one of six captives at the table, if the captors tell you five bullets have been loaded, if each of you fires, and if only you escape death, you have far less reason to think the captors intended for you to live. Given that many people were targets of the loaded gun, the hypothesis that the captors wanted *you* to survive is less attractive. Why should your captors have selected *you* for survival?

Despite M's ability to screen off the probabilistic support E lends to D, White thinks we have no reason to believe M, because M fails to raise the

probability of E and hence is not confirmed by E. To see why, suppose for the sake of argument that 1% of all possible universes are life-permitting. So:

$$(7) \quad P(E|{\sim}M \,\&\, K) = 1\%$$

Suppose also that according to M there are exactly 1,000 universes. On White's view, the probability that the Universe is life-permitting would still be 1%, because the features of a given universe are not in any way dependent on the features of the other 999 universes. To suppose otherwise would be to commit the Inverse Gambler's Fallacy. So:

$$(8) \quad P(E|M \,\&\, K) = 1\%$$

Since (7) and (8) are equal, E does not confirm M at all. Of course, M is confirmed by E′, the fact that *some universe or other* permits life, because the probability of E′ conditional on M and K is very high indeed.

$$(9) \quad P(E'|M \,\&\, K) = 1 - P({\sim}E'|M \,\&\, K) = 1 - (0.99)^{1000} = 99.99\%$$

However, M's making E′ more likely does not make E any more likely.

White is concerned to block the reply that since E entails E′, we have at least as much reason to believe E′ as E, and so E confirms M via E′ just as much as E confirms D directly. If we reason in this way, claims White, we fail to consider our total evidence. White does not define the "total evidence" principle precisely, but we can get an intuitive grasp of it through an example (of ours, not White's). Imagine that police have evidence that proves that one of the Smith twins, Bob or Bill, committed a murder. The police are justified in arresting Bob, because their evidence strongly confirms the hypothesis that Bob committed the murder (even though that evidence implicates Bill just as much). But suppose the police get additional evidence that strongly indicates that Bill in particular committed the murder. They keep Bob in jail. Bob learns the nature of the evidence and sues the police for wrongful imprisonment. The police justify their conduct by explaining that their evidence confirms the hypothesis that one of the Smith twins committed the murder, which in turn confirms the hypothesis that Bob committed the murder. Any reasonable judge would rightly rule against the police. Evidence proving Bill committed the murder cannot be used to justify arresting Bob for the same crime.

The moral White draws from such examples is that we cannot set aside a stronger piece of evidence in favor of a weaker one. We must consider our total evidence. Our total evidence is that the Universe – *this* universe – permits life, not that *some* universe permits life, and since M does not make it more likely that *this* universe permits life, M is not confirmed by E.

TU, TP, and the specialness of us

Proponents of TU demand that M explain why *this* universe permits life. This curious demand is not made in any comparable appeal to great replicational resources. For example, when it comes to explaining the fitness of the Earth for life, accounts that appeal to the vast number of planets in our universe (and hence the vast number of chances for conditions to be just right) surely are not to be faulted for failing to explain why *this* planet is the fit one. Clearly the "This Planet" objection (TP) is no good, though that objection is implicit in the criticisms of authors who defy naturalists to explain the origin of life *on Earth*. TP is not cogent because when we set aside all of the features of the Earth that are essential to its ability to produce living creatures (including relational properties such as distance from the right sort of star), there is otherwise nothing special about it. There *might* have been something special about the Earth. For example, it could have been that only from the vantage point of the Earth would one see that the constellations spell out "THIS UNIVERSE IS GOD'S HANDIWORK." But absent such a special feature, there is no motivation for the demand to explain why this particular planet, the Earth, is fit for life.

On hearing news reports that a lone family in a remote Armenian village survived a devastating earthquake in December 1988 (nearly 50,000 Armenians were killed by that earthquake), a friend of one of us deemed it a miracle. When it was noted that, given the size of the area, it wasn't unlikely that some family occupied a protected position in a fortified cellar at the time of the quake, she replied "Well, it was a miracle that *they* survived." When the problems with this tactic were noted, she responded glumly that philosophers "always want to ruin everything." Much as we hate to be wet blankets, we see no difference between being surprised that *they* survived (whoever the fortunate Armenian villagers were) and being surprised that *the Earth* is a suitable abode for life.

This, then, is a *prima facie* challenge to TU. How is TU any different from TP? We suspect proponents of TU think there is, indeed, something special about *this* universe – namely, that it is, as Olding says "*our* universe, the one that begat and nourished us." Straightaway this exposes proponents of TU to the allegation of anthropocentrism. What is so special about ourselves that our existence needs to be explained? Yet we hesitate to pursue the anthropocentrism allegation too vigorously in this paper. The whole project of explaining cosmic fine-tuning for something-or-other (life, intelligence, rationality, or the emergence of complex self-organizing systems) presupposes that the feature in question is especially in need of explanation. For example, M-advocate Lee Smolin argues that "the existence of stars is the key to the problem of why the cosmos is hospitable to life" and then maintains that "any philosophy according to

which the existence of stars and galaxies appears to be very unlikely, or rests on unexplained coincidence, cannot be satisfactory."[11] Yet why is the hospitability of the cosmos to life even something a physical cosmologist should seek to explain? And if constructing cosmological theories for the sake of rendering likely life's existence is methodologically sound, what is wrong with doing likewise for the sake of making our existence more likely?

The role in science and in design arguments of judgments about what is valuable or special is a vexing issue.[12] We do not wish to become sidetracked by it here. We will thus assume for the sake of argument that there is indeed something special about the fact that *this* universe permits life. The question we now wish to explore is whether M is incapable of raising the probability of this fact. Proponents of TU think so, but as we see it, their reasoning relies on two non-obvious metaphysical assumptions: that we could only exist in this universe and that a universe is a sort of thing such that the values of its free parameters could have been different.

Total evidence, preselection, and the possibility of our having existed in some other universe

Let us return to White's point about total evidence. It requires some qualification. Suppose that we are given a one-kilogram sample of matter and are told to determine how many uranium atoms it contains, if any. Unfortunately, our Geiger counter is broken. Luckily for us, however, we have at our disposal an amazing resource: a uranium oracle. This gifted individual knows the state of each and every uranium atom, and even has names for them. We leave the oracle in a room with the sample and come back an hour later. The oracle tells us that just one uranium atom decayed: Fred. From the fact that Fred decayed we deduce that one uranium atom decayed. Can we proceed to use half-life calculations to estimate the number of uranium atoms in the sample?

Not if we are required to reason from the fact that Fred decayed rather than the fact that some uranium atom or other decayed. Since the presence of other uranium atoms makes it no more likely that Fred should have decayed, the fact that Fred decayed doesn't confirm the hypothesis that the sample contains the calculated number of uranium atoms. Indeed, we are not even entitled to conclude that there is more than one uranium atom in the sample. The extra information that it was Fred who decayed blocks such inferences, even though the extra information itself is quite compatible with the conclusion that there are many uranium atoms. Whatever the obligation to consider our total evidence amounts to, it should not block inferences of the above sort. Otherwise

epidemiologists would destroy the validity of their studies simply by knowing the names of their subjects, ecologists would be forbidden from using the "tag and recapture" technique, and so on.

Perhaps we are allowed to confirm a hypothesis with claims that are entailed by our total evidence provided that nothing in the total evidence disconfirms the hypothesis. In the case of the uranium oracle, identification of the particular atom that decayed (Fred) does not disconfirm the hypothesis that the sample contains the expected number of uranium atoms. Yet this rule of reasoning, too, is inadequate. For suppose from the beginning of our experiment the oracle tracked only Fred's progress. In that case, we would err in inferring that there are other uranium atoms nearby, because the presence of other uranium atoms would not make Fred's decay any more likely. The proposition that Fred decayed would not disconfirm the hypothesis that there are many uranium atoms, but we would be wrong in taking Fred's decay as confirming the hypothesis that there are many uranium atoms. The problem is that in our modified story the oracle preselects Fred, whereas in our original story the oracle is open to any decay event. This suggests that we may confirm a hypothesis with claims that are entailed by our total evidence so long as nothing in the total evidence disconfirms the hypothesis and so long as our evidence is not preselected.

With this qualification of the total evidence requirement in mind, and remembering that E entails E′, we are in a better position to assess whether E′ confirms M. It seems that it does, so long as E does not disconfirm M and so long as the Universe was not preselected. We see no reason to think E disconfirms M, so the crucial question is whether the Universe is preselected for observation. If so, then we cannot reason from E′ to M. If not, then we can.

Could we have observed that the universe we inhabit permits life in some universe other than the Universe? Proponents of TU take for granted that we couldn't. Dowe gets at this issue when he says "The observational selection reasoning seems to suppose either something like Leibniz's identity of indiscernibles, or else that 'we' are disembodied souls floating over universes, waiting for a fine-tuned one to appear so that we can find a home."[13] Though we take no stand on the possibility of disembodied souls floating over universes (interestingly, it seems dualists are in a position to reject TU out of hand), we fail to see why we couldn't have observed in some other universe that the universe we inhabit permits life. Suppose, for example, that as a teenager in Texas George W. Bush observed that the conditions in his surroundings were such as to permit life. Could he have made the same observation in Louisiana? Certainly, for the Bushes could have moved to Louisiana rather than having stayed in Texas. Why can we not extend this picture to include some other solar system, some distant part of the Universe, or, indeed, some other universe?

The picture of possibility space gets fuzzy here. For the sake of argument let us assume, in accordance with the doctrine of Kripke regarding the necessity of material origins,[14] that no individual counts as George W. Bush whose biological parents are not George H. W. and Barbara Bush. Likewise, George H. W. and Barbara have their immediate biological ancestry essentially, and so on. Might origin essentialism serve to restrict George W. Bush's observation to locations within (at the very most) the light cone of Earth at the time life originated on it four billion years ago? Perhaps, if it is not possible for the very same tree of life of which Bush's family is a branch to have arisen on some other planet. But it seems possible that the Earth itself could have occupied some region of spacetime other than the one it actually occupies. Contemporary cosmology clearly shows that planets, solar systems, and even galaxies are small potatoes in the grand scheme of things. This suggests any particular planet, solar system, or galaxy could have occupied a different location in spacetime, just as a particular grain of sand could have washed up on some other stretch of a beach. So although one way proponents of TU might restrict us to the Universe when we observe that the universe we inhabit permits life is by restricting our observation to some proper part of the Universe (e.g. the Earth), good arguments for placing such restrictions have yet to be produced.

The identity conditions of universes

How about universes? Could we have occupied a different universe? This depends on what we make of this alleged natural kind "universe." Unfortunately, contemporary cosmology is not very good at helping the lay metaphysician understand its object of study. Some basics are agreed. "Quantum cosmology" is nowadays the favored approach to explaining the Big Bang.[15] On it, the Universe is the product of inflation from a preexisting quantum field. M, in turn, is the hypothesis that the primordial quantum field produces more than one universe (undergoes more than one "vacuum fluctuation"). The universe-generating field is not a deterministic system, so if M is true, there is no explanation of why specific universes come to be rather than others.

Within this general picture, however, there is no agreed account of the nature and identity conditions of a universe. On some models, universes are causally and temporally disconnected. On others they are not – for example, in Smolin's model in which "baby" universes are produced out of the black holes that form in "mother" universes.[16] In yet other models, M is simply the hypothesis that the Universe is vastly larger than the observable universe and that the free parameters take different values in

different spacetime regions. Whether there would be physical interactions at the boundaries of the different regions is not clear. These competing models indicate that there is no agreed answer to the question of what makes a thing a universe and what makes it the particular universe it is rather than some other.

One intriguing metaphysical option is that each set of possible parameter values defines a cosmic essence. If M is true, a random subset of these essences is instantiated, yielding many universes. For any universe in the vast array, there would be no possible world in which its free parameters take different values (although there would be possible worlds in which M is true and yet that universe does not exist). One reason in favor of this view is that, assuming the universes all adhere to basic nomic structures like general relativity, there are no other candidates (except haecceities) for that which individuates them. On this supposition, M would indeed make it more likely that the Universe exists, because the cosmic essence possessed by the Universe would have a great number of chances of getting instantiated. This picture might become unwieldy if individual cosmic essences can be instantiated more than once.

Other metaphysical pictures could be drawn. For example, with cosmogenic models whereby universes grow out of inflating "bubbles" in a pre-existing hyperspace, perhaps the bubbles can be distinguished in terms of their positions in this hyperspace. Again, in Wheeler's oscillating-universe model whereby big bangs occur as the result of "rebounding" from prior big crunches, perhaps universes can be individuated in terms of their positions in the sequence of bangs and crunches. Of course, these metaphysical pictures themselves raise questions – for example, regarding what distinguishes locations in the hyperspace and what serves to order the universes in an oscillating sequence of bangs and crunches.

Given the number of possible metaphysical pictures of M and given that no winner has emerged in contemporary cosmology, there appears to be no reason to assume, as do proponents of TU, that (a) the free parameters of *this* universe could have been different, and that (b) no version of M could raise the probability of E. Perhaps on some understandings of 'universe' and 'the Universe' M makes E more probable, whereas on others it doesn't. On top of this, an assumption implicitly at work in TU – that material origins are necessary – may be false.[17] Until the metaphysical waters concerning universes and our possibilities for being located in them become less muddied, we are not in a strong position to say M makes E more or less probable. Of course, this point cuts both ways. Proponents of both M and of TU must first figure out what they mean by 'universe' and what, precisely, M amounts to before they deem M capable, or incapable, of raising the probability of E.

Why does the existence of a life-permitting universe need explanation?

The critics of M question why its advocates even think the existence of a life-permitting universe needs explanation. M is indiscriminate; if true, it would raise the probability of the existence of any given universe, whether it permitted life or forbade it. Why, then, should an advocate of M be surprised by the existence of a life-permitting universe in particular? White says that D is the *only* hypothesis relative to which E stands in need of explanation. Those who reject D as either impossible or wildly implausible should dismiss E as the way things just happen to be – "in which case," White says, "the current motivation for multiple universes loses its force."[18]

If we construe this last claim as a sociological one we are led to ask what the "current motivation" is for M. The answer will depend on who gets surveyed. There are individuals who reject D and dismiss E as happenstance and yet who support M for other reasons – say, that their favorite model of quantum cosmology predicts the existence of many other universes. Such individuals would believe M even though they are not motivated by a desire to block the design-inclined from taking E as evidence of D (though they might regard such a result as a pleasant side effect). Critics of M often portray it as *ad hoc*, but this need not be the case; independent theoretical considerations might very well motivate the advocates of M.

Nonetheless it is true that some prominent advocates of M talk as if a felt need to explain E is what motivates them to support M. Consider, again, multiple-universe maven Smolin, who develops a theory the express purpose of which is to render more likely the existence of stars and galaxies; that is, what motivates his cosmological theory is a desire to explain E. Yet why *not* dismiss E as unexplained coincidence? The debate about fine-tuning and the anthropic principle certainly does not suffer from a lack of people who share the attitude of Stephen Jay Gould:

> . . . something has to happen, even if any particular "something" must stun us by its improbability. We could look at any outcome and say, "Ain't it amazing. If the laws of nature had been set up just a tad differently, we wouldn't have this kind of universe at all."[19]

In response, might those surprised by E appeal to Leibniz's Principle of Sufficient Reason (PSR)? This principle has often been invoked by those who demand an explanation for the existence and nature of the Universe.

> Assuming this principle, the first question we have the right to ask will be, *why is there something rather than nothing?* For nothing is simpler and easier than something.

Furthermore, assuming that things must exist, we must be able to give a reason for *why they must exist in this way*, and not otherwise.[20]

Plenty of philosophers think these are good questions. For example, regarding any one of the most general causal laws governing the universe, Peter Unger says we can ask of it the following question.

Why is it that just *that* very general phenomenon, or law, should be so fundamental, or indeed obtain at all, in the world in which we have our being? Within the usual framework of explanation, law and causation, there seems no place for such curiosity to come to rest. There seems no way for us to deal adequately with the brute and ultimate *specificity* of the ways in which almost everything appears to happen.[21]

In response to this question, Unger proposes a multiple-universe theory of his own, though this theory is not constrained by contemporary physics and so includes "universes" which, unlike the ones we consider in this paper, follow neither general relativity nor quantum mechanics.

The PSR, however, does not render life-permittingness *particularly* in need of explanation. The sorts of questions Leibniz asked about the universe can be asked of any universe whether or not it permits life and regardless of the ease or difficulty with which it does so. It would be highly misleading to cite the PSR in demanding an explanation for E, since the PSR would lead one to demand an explanation of the universe *whether or not it permitted life*. To bring home this point, it is useful to describe a universe that is just as specific and arbitrary as this one but in which "surprising" contents such as stars, galaxies, and living beings are absent.

Imagine that the n free cosmic parameters are listed in a table and consider the decimal expression of π out to the nth decimal place. We can describe a different possible value for each of the n parameters simply by multiplying the actual value of the ith parameter in the table by the ith digit in the decimal expression of π. Let us call the universe that results from performing this operation "the π universe." For example, if the first three entries in the table describing our universe are for the masses of the proton, the neutron, and the electron respectively, then in the π universe the proton will be three times as massive, the neutron will have the same mass, and the electron will be four times as massive ($\pi = 3.14.....$). If the literature on fine-tuning and the anthropic principle is correct, the π universe will almost certainly fail to contain stars and galaxies, or at least the right sort for life to have a chance of evolving.

Let us follow Dowe and suppose (fancifully) that Leibniz and Smolin are disembodied souls endowed with awareness of the nature of physical reality. Let us also suppose that the π universe is the only universe in existence. In that case, there would exist a universe rather than nothing;

according to Leibniz, this would demand explanation. Furthermore, the universe would be some particular, specific way rather than another; according to Leibniz (and Unger), this, too, would demand explanation. Yet remember that Smolin says "any philosophy according to which the existence *of stars and galaxies* appears to be very unlikely, or rests on unexplained coincidence, cannot be satisfactory." He says "stars and galaxies," not "any particular form of matter whatsoever." Presumably, then, he regards the existence of a universe containing stars and galaxies as particularly significant in a way in which the existence of the π universe would not be.

Why think stars, galaxies, and life are surprising? In trying to answer this question, it will prove helpful to take a look at the literature on "surprising" or "puzzling" phenomena – phenomena that we do not dismiss as the result of chance, but rather regard as in need of explanation. One key point emerging from this literature is noted by Gould: mere improbability is insufficient grounds for surprise. Paul Horwich states the matter clearly.

> Unlikely things are happening constantly, which don't surprise us – things which have as minute a probability as those which do. Suppose I fish a coin from my pocket and begin tossing it. I would be astonished if it landed heads 100 times in a row; but that outcome is no less probable than any other particular sequence of heads and tails; yet certainly not every outcome would surprise me, for example an irregular sequence of about 50 heads and 50 tails.[22]

Improbability, then, seems to be only a necessary condition for an event's being surprising. What further conditions must an event meet in order to count as surprising?

F. P. Ramsey suggested that what distinguishes surprising phenomena from run-of-the-mill improbable occurrences is that the former cause us to modify our probability assessments while the latter do not.

> What we mean by an event not being a coincidence, or not being due to chance, is that if we came to know it, it would make us no longer regard our system as satisfactory, although on our system the event may be no more improbable than any alternative. Thus 1,000 heads running would not be due to chance; i.e. if we observed it we should change our system of chances for that penny.[23]

Clearly Ramsey is onto something. However, he does not tell us what it is about such phenomena that compels us to modify our probability assignments.

One approach to surprising phenomena provides a natural answer to this question. According to the proponents of what we will call the "tidy explanation" account of surprise, the reason that we do not dismiss as mere happenstance phenomena such as the flipping of 1,000 heads in a

row is that there is a better ("tidier") explanation of the event – better, that is, than the account according to which the coins all just happened to turn up heads. In this case, the alternative hypothesis is that the coin is somehow rigged (say, by being two-headed). While initially improbable, we regard this hypothesis as not terribly so, especially when compared to the flipping of 1,000 heads in a row using a fair coin. If true, the hypothesis makes far more likely the flipping of 1,000 heads consecutively. Note that there is no such simple alternative hypothesis in the case of a random 1,000-long string of heads and tails.

Horwich advances just such a view of what it is in virtue of which surprising phenomena are surprising.

> . . . the truth of E [the proposition that a certain event occurred] is surprising only if the supposed circumstances C, which made E seem improbable, are themselves substantially diminished in probability by the truth of E . . . and if there is some initially implausible (but not wildly implausible) alternative view K about the circumstances, relative to which E would be highly probable.[24]

Similar views are endorsed by Richard von Mises,[25] D. J. Bartholomew,[26] John Leslie,[27] and Peter van Inwagen.[28] The common thread is that an event that is improbable conditional on the chance hypothesis is surprising if substantially more probable conditional on some not-too-implausible non-chance hypothesis.

If these accounts of surprising phenomena are correct, it suggests we ask what tidy explanation of E is glimpsed by those surprised by E. It cannot be M. M would be an explanation (tidy or untidy) of *any* universe, whether or not it permitted life. If M rendered the existence of *our* universe surprising and in need of explanation, it would do the same for the existence of *any* universe. Leibniz and Unger might be pleased by that result, but the other authors we discuss would not. So we are inclined to agree with White here. It does appear that what motivates some advocates of M is a sense that D is a plausible explanation of E.

It is a common view that religion and science are completely different domains of knowledge and discourse – that science is about facts and religion is about values.[29] Because this view is poorly defined and because the distinctions on which it rests (e.g. between fact and value) are (in our humble opinions) so shaky philosophically, we hesitate to attribute specific doctrines to those who believe in religion/science separation. But our guess is that most religion-science separationists would affirm that the framing of scientific hypotheses should be a religiously neutral enterprise. If so, shouldn't religion-science separationists find it scandalous that prominent physicists are developing multiple-universe theories for the unstated purpose of blocking an inference to a designer? Assuming they are not Leibniz-style rationalists, shouldn't religion-science separationists adopt

the attitude of Gould that E is "just one of those things"? It is a matter for further discussion whether these questions tell against M or, rather, against popular conceptions about the relationship between science and religion.[30]

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NOTES

[1] For more on the problems with such a definition, see Neil A. Manson (2000) "There Is No Adequate Definition of 'Fine-tuned for Life'," *Inquiry* vol. 43, pp. 341–52, as well as Timothy McGrew, Lydia McGrew, and Eric Vestrup (2001) "Probabilities and the Fine-tuning Argument: A Skeptical View," *Mind* 110, pp. 1027–38.

[2] For thorough presentations of the data of fine-tuning, see John D. Barrow and Frank J. Tipler (1986) *The Anthropic Cosmological Principle*, New York: Oxford University Press, chapter 6, and John Leslie (1989) *Universes*, New York: Routledge, chapter 2.

[3] Richard Swinburne (1998) "Argument from the Fine-Tuning of the Universe," in *Modern Cosmology and Philosophy*, John Leslie (ed.) Amherst, New York: Prometheus Books, pp. 172–8.

[4] See, for example, Robert C. Koons (1997) "A New Look at the Cosmological Argument," *American Philosophical Quarterly* 34, pp. 207–8.

[5] For example, Leslie, *Universes*, p. 69.

[6] Alan Olding (1991) *Modern Biology and Natural Theology*. New York: Routledge, p. 123.

[7] John Archibald Wheeler (1998) "Beyond the End of Time," in J. Leslie (ed.) *Modern Cosmology*, pp. 213–21.

[8] Ian Hacking (1987) "The Inverse Gambler's Fallacy: the Argument from Design. The Anthropic Principle Applied to Wheeler Universes," *Mind* 96, pp. 331–40.

[9] Phil Dowe (1999) "Response to Holder: Multiple Universe Explanations are not Explanations," *Science and Christian Belief* 11, pp. 67–8.

[10] Roger White (2000) "Fine-Tuning and Multiple Universes," *Nous* 34, pp. 260–76.

[11] Lee Smolin (1997) *The Life of the Cosmos*. New York: Oxford University Press, pp. 29, 35.

[12] See Neil A. Manson (2000) "Anthropocentrism and the Design Argument," *Religious Studies* 36, pp. 163–76.

[13] Dowe, "Response to Holder," p. 68.

[14] See Saul Kripke (1972) *Naming and Necessity*, Cambridge, Massachusetts: Harvard University Press, notes 56–7. For a further explication of origin essentialism, see Graeme Forbes (1985) *The Metaphysics of Modality*, New York: Clarendon Press, ch. 6.

[15] For an accessible survey of the field, see C. J. Isham (1988) "Creation of the Universe as a Quantum Process," in *Physics, Philosophy, and Theology: A Common Quest for*

Understanding, Robert J. Russell, William R. Stoeger, S. J., and George V. Coyne, S. J. (eds.) Vatican City State: Vatican Observatory, pp. 375–408.

[16] Smolin, *Life of the Cosmos*.

[17] For a strong recent criticism of origin essentialism, see Teresa Robertson (1998) "Possibilities and the Arguments for Origin Essentialism," *Mind* 107, pp. 729–49.

[18] White, "Fine-tuning and Multiple Universes," note 14.

[19] Stephen Jay Gould (1998) "Mind and Supermind," in J. Leslie (ed.) *Modern Cosmology*, p. 189.

[20] G. W. Leibniz, "Principles of Nature and Grace, Based on Reason," in *G. W. Leibniz: Philosophical Essays*, transl. Roger Ariew and Daniel Garber, Indianapolis: Hackett, 1989, pp. 209–10.

[21] Peter Unger (1984) "Minimizing Arbitrariness: Toward a Metaphysics of Infinitely Many Isolated Concrete Worlds," in *Midwest Studies in Philosophy, IX*, P. A. French, T. E. Uehling, and H. K. Wettstein (eds.) Minneapolis: University of Minnesota Press, p. 29.

[22] Paul Horwich (1982) *Probability and Evidence*. New York: Cambridge University Press, p. 101.

[23] F. P. Ramsey, "Chance," in D. H. Mellor (ed.) *Philosophical Papers*, New York: Cambridge University Press, p. 106.

[24] Horwich, *Probability and Evidence*, pp. 101–2.

[25] Richard von Mises (1957) *Probability, Statistics, and Truth*, 2nd revised English edition, prepared by Hilda Geiringer, New York: The Macmillan Company, pp. 19–20.

[26] D. J. Bartholomew (1984) *God of Chance*. London: SCM Press Ltd., p. 46.

[27] Leslie, *Universes*, p. 10.

[28] Peter van Inwagen (1993) *Metaphysics*. Boulder, Colorado: Westview Press, p. 135.

[29] For a vigorous recent statement of this view, see Stephen Jay Gould (1999) *Rocks of Ages: Science and Religion in the Fullness of Life*. London: Jonathan Cape.

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