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SCIENCE AND SUPERNATURALISM

Clement Dore

In the first section of this paper, I discuss a quantum mechanical account, which is endorsed by the MIT physicist, Alan Guth, of the origin of what Guth believes to have been an absolutely first universe. I argue that, though his explanation is unsound, there is no reason to think that it needs to be replaced by a supernaturalist one. In the second section, I argue that though Professor Steven Weinberg's tentative explanation of the apparent fine-tuning of the cosmological constant is unacceptable, we need not accept a supernaturalist account of the coming about of intelligent life.

1.

The United States has more religious citizens than any other industrialised nation. Roughly half of Americans are Biblical literalists; and, though most college-educated Americans have learned that people like Galileo and Darwin have discredited a literal reading of the Bible, many of them continue to believe that the empirical universe as a whole must have a non-empirical, supernatural cause who resembles the God of Genesis. It is very likely that these people either accept, or are disposed to accept, what Immanuel Kant called 'the Cosmological Argument', an argument from the fact that the empirical universe might not have existed to the conclusion that it must have a supernatural creator who could not have failed to exist – an argument, that is to say, from the essential fragility of observable things to a non-fragile creator. If these relatively enlightened believers are right, then scientific explanations

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of the origin of things – most recently, inflation theory – need to be supplemented, or replaced, by a supernaturalist account. Though I will express reservations about the claim that inflation theorists have given an adequate account of cosmic origins, I will give reasons for thinking that the relatively enlightened believers whom I have mentioned are mistaken in believing that scientific explanations of origins need to be supplemented by a supernaturalist one.

In the second part of my paper, I will consider another alternative to supernaturalism, namely, the theory that there are a very large number of universes, other than the one which we intelligent beings inhabit, in most of which the emergence of intelligent life is scientifically impossible. I will argue in effect that we do not need multiverse theory in order to avoid supernaturalism. I will give reasons for thinking that, although it is an alternative to supernaturalism, multiverse theory multiplies explanatory entities beyond necessity, and is not, for that reason, good science.

2.

The MIT physicist, Alan Guth, believes that there was an absolutely first universe, and that it gave rise to other universes, one of which, after aeons, gave rise to the one we inhabit. If Guth is right, then defenders of the Cosmological Argument can get at least a tentative foothold by maintaining that Guth's quantum mechanical account of how the first universe began needs to be supplemented by a supernaturalist explanation.

Guth undertakes to explain the origin of the first universe by citing quantum tunnelling. On page 273 of his book, *The Inflationary Universe* (Perseus Books, 1997), Guth discusses a theory of the start of the first universe which was propounded by the physicist Edward Tyron, in an article entitled, 'Is the Universe a Vacuum Fluctuation?' which appeared in *Physical Review Letters* in 1973. In that article, Tyron, utilizing the well-substantiated quantum-theoretical claim that

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positron-electron pairs constantly bubble up from tiny regions of space and instantly annihilate one another, maintained that it might well be that the universe started out that way, except that the envisaged annihilation, for a reason which is compatible with the laws of quantum physics, failed to occur. But Guth says this about Tyron's theory:

> If our universe was born from empty space, then where did the empty space come from[?]... a proposal that the universe was created from empty space seems no more fundamental than the proposal that the universe was spawned by a piece of rubber... One would... want to ask where the piece of rubber came from.

On page 237, Guth answers this question as follows:

> ...Alexander Vilenkin... (proposed) that the universe was created by a quantum process starting from 'literally nothing', meaning not only the absence of matter, but the absence of space and time as well... From quantum theory, Vilenkin took the notion of quantum tunnelling. A quantum system can suddenly and discontinuously make a transition from one configuration to another, as long no conservation law makes the transition impossible. Putting these ideas together, one can imagine that the universe started [with]... absolute nothingness... and then made a quantum tunnelling transition to a non-empty state [a so-called 'false vacuum', which, because of entropy, is a highly unstable region of space-time, the sudden, exponential expansion of which gave rise to the observable universe]. Calculation shows that a universe created this way would typically be subatomic in size, but that is no problem... Vilenkin was able to invoke inflation to enlarge the universe to its current size.

But there is a problem. The first quote makes it clear that Guth thinks that the claim that the universe emerged from

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empty space is unsatisfactory, because it raises, but does not answer, the question, 'Where does empty space come from?' Hence, Guth must think that *nothingness* is not such that it is appropriate to raise the question, 'Where does *it* come from?' But it is surely true that, in sentences of the form, 'X made a transition from one configuration to another', 'X' refers to a *stuff* which made that transition. Hence, when he says that 'Nothingness made a transition from one configuration to another', Guth is unwittingly referring to something about which it is perfectly appropriate to ask, as Guth asks about empty space, 'Where did *it* come from?'

It would not do for Vilenkin and Guth to reply at this point that by 'nothingness' they mean simply 'nothing', and that there can be no question of the *latter* word referring to a kind of stuff about which it is appropriate to ask the contemplated question. For if they substituted the word 'nothing' for the word 'nothingness' in their explanation, they would be saying 'Nothing underwent a transition from one configuration to another.' And *that* sentence is surely as poor a candidate for being an adequate explanation of origins as can be imagined.

This is not a case of a philosopher flying in the face of science. I don't wish to deny that inflation theories (there are by now several versions) are superior to standard Big Bang theory in terms of explanatory power. And, of course, I don't wish to deny that quantum theory makes enormously precise and accurate predictions. My only intention here is to point out that Vilenkin and Guth have been doing bad philosophy, and that it follows that they have not given us a good reason to deny that there is an opening for at least a tentative supernaturalist explanation of how things got started.

3.

But the supernaturalist may think that he can do better. He may want to argue as follows: Scientists have answered such general questions as 'Why are there human beings?'

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by referring to things which are different from human beings, in particular, to natural selection acting on random molecular mutations in other kinds of organisms. And scientists have answered similar questions – questions like 'Why are there galaxies?' 'Why are there stars?' and 'Why are there planets?' – by referring to things *other* than what the questions are about – to gravity, for example. Now, galaxies, stars and planets are all observable things. So it is reasonable to believe that, just as there are true answers to the more specific questions, 'Why are there galaxies?' 'Why are there stars?' and 'Why are there planets?' there is a true answer to the more general question, 'Why are there observable things?' And it is also reasonable to suppose that, just as the answer to the former questions refer to things *other* than galaxies, stars and planets, the answer to the latter question refers to one or more things which are *other* than observable things, namely, to one or more *unobservable* things, which are the cause of the collection of observable things of which the universe is composed. But, in order to avoid multiplying explanatory entities beyond necessity, we ought to postulate just one such unobservable cause of the empirical universe, an individual who is very like the God of orthodox theism.

This argument is unacceptable, however. For the question, 'Why are there observable things?' – unlike the questions 'Why are there galaxies (stars, planets, etc.)?' – is too broad in scope to have the same kind of answer as do the latter questions. Some observable things are simultaneous with one another (within a limited range of Einsteinian space-time). But all of them are members of sequences of macroscopic causes and effects which stretch back into the past. And if, unlike the human beings, galaxies, stars and planets which exist within the empirical universe, they stretch back into an *infinite* past – if they have no beginning – then, since there is no item within any one of these sequences which does not have a cause, asking for a cause of any one of these sequences is like asking me for a cause of a group of twenty items after I have assigned

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a cause to each member of the group. On page 67 of Hume's *Dialogues Concerning Natural Religion*, Hume, speaking through the mouth of the character, Cleanthes, says this about the matter:

> . . .in a [causal sequence with no beginning] each part is caused by that which preceded it, and causes that which succeeds it. Where, then, is the difficulty? But the WHOLE, you say, wants a cause. I answer that the uniting of these parts into a whole, like the uniting of . . . several distinct parts into one body, is performed merely by an arbitrary act of the mind, and has no influence on the nature of things. Did I show you the particular causes of each individual in a collection of twenty particles of matter, I should think it very unreasonable, should you afterward ask me, what was the cause of the whole twenty. This is sufficiently explained by explaining the cause of the parts. [David Hume, *Dialogues Concerning Natural Religion* (ed., Norman Kemp Smith, 2nd edition — New York, 1947.)]

Supernaturalists sometimes add the words 'at all' to questions of the form, 'Why are there any X's?' and maintain that questions of the form 'Why are there any X's at all?' cannot have as a proper answer an assertion which refers to what 'X's' refers to. These philosophers would say of the question, 'Why are there any observable things at all?' that it cannot have as a correct answer an assertion which refers to observable things, since the question would arise all over again with respect to *those* observable things. But, if it really is the case that questions of the form, 'Why are there any X's at all?' cannot be adequately answered by an assertion which refers to what 'X's refers to, then the opponent of the Cosmological Argument can reply that to presuppose that the question, 'Why are there any observable things at all?' has an answer is to assume without argument that there is no self-explanatory regress of

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observable things into an infinite past. (The more general question, 'Why is there *anything* at all?' is inappropriate, since it entails the in principle unanswerable question, 'Why do numbers – the numbers 9 and 10, for example – exist?' has an answer. And the question, 'Why are there any contingent things at all?' presupposes, once again, that *contingent* things are not part of a causal regress which has no beginning.)

In a book entitled *Why Does The World Exist?* (New York: W. W. Norton & Co., Inc., 2012) the *New Yorker* writer, Jim Holt, points out that, in answer to the question, 'Why does (even) a causal sequence, which has no beginning in time, exist?' Cleanthes replies in effect that in such a series there is nothing to which a cause cannot be assigned; hence nothing which cannot be explained. Holt puts it this way: 'Once all the parts are explained, [Cleanthes] submits, it's unreasonable to demand a further explanation (85). But,' Holt adds, 'there's something missing here. This infinite world is like a railroad train with an infinite number of carriages, each pulling the one behind it – and no locomotive.' (86)

But Holt's analogy (and other, similar analogies which he proposes) are unacceptable, if each event in the envisaged infinite causal sequence is *causally efficacious*, that is to say, such that it constrains the event which comes after it to occur. If that were the case, then the sequence would be similar to a railroad train each of whose carriages was driven by a power-generating engine which caused the carriage to move. (The engine must have enough power to push the carriage in front of it, but not *all* of the forward carriages.)

It may well be that Hume's constant conjunction analysis of causation (in the *Enquiry Concerning Human Understanding*)[1] – his contention that 'A-type events are causes of B-type events' means roughly that A-type events are constantly conjoined with B-type events – disallows this interpretation of Cleanthes's objection. For it looks very much as if that analysis leaves out *causal necessitation*. The constant

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conjunction analysis is incompatible with the obvious truth that it is not impossible that a constant conjunction between A-type things and B-type things is a mere coincidence – albeit a gigantic one – just as it is not impossible that every time I turn a page of a book which I am reading, a bird warbles in a tree outside the window of my study. Hall's reply to Cleanthes's objection is acceptable only if – what is not the case – Hume was right about the concept of causation. (It is ironic that Cleanthes, a character in Hume's *Dialogues Concerning Natural Religion*, is right only if Hume was mistaken.)

Causal necessitation is not, of course, *logical* necessitation. When A-type events cause B-type events to occur, the former do not stand to the latter as, say, the assertion that Socrates is a man and all men are mortal stands to the conclusion that Socrates is mortal. Nor do those A-type events stand to those B-type events as, according to Kant, $7 + 5$ stands for the number 12. The connection is not what Kant called synthetic *a priori*. But, since there obviously *is* such a thing as causation, and since Hume was mistaken about its nature, we must simply accept that this third kind of necessitation exists.

4.

'The Cosmological Argument' has its origins in ancient Greece. But there is another argument for the existence of supernatural agency which is of much more recent vintage. It has come to be known as 'the argument from fine-tuning' (which I shall call 'the AFT'). If that argument is sound, then we can validly infer the existence of a supernatural designer from a certain scientifically discernable fact, namely, that at least one of the constants of physics has a value which is such that it was highly antecedently improbable that it had that value, and which has accommodated the emergence of intelligent life (after billions of years of cosmic evolution and then biological evolution on our

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planet, and, probably, on other planets in other star systems).

It would be a mistake to believe that the AFT can be refuted by the simple expedient of pointing out that science is able to explain how intelligent life came about on the planet Earth. As educated people know, once an original, self-replicating molecule formed, natural selection, acting on random molecular mutations, took over, and led to the emergence of intelligent life on Earth. But the fact that science can explain how intelligent life came about on our planet – and, perhaps, on other Earth-like planets in the vast universe which we inhabit – does not entail that there is not a problem about the surprising fact that the cosmological constant has a value which is *compatible with the coming about of Earth-like planets – the coming about, that is to say, of life-accommodating environments, in which intelligent life would eventually emerge as a result of evolutionary pressures*. If it is improbable that planets like Earth would ever come about in the first place, we can't eliminate the improbability of intelligent life having come about in the empirical universe by arguing that, once our intelligent life-conducive planet came to be, it became likely that a purely scientific (non-supernaturalist) explanation of how we came to exist on it was sure to become available. Though it is very likely that there is a non-supernaturalist explanation of how living things came about on Earth-like planets, on some of which they evolved into intelligent individuals, it doesn't follow that it is also very likely that there is a non-supernaturalist explanation of the surprising fact that the value of the cosmological constant accommodated the emergence of intelligent life-conducive environments like the planet Earth.

On pages 137–138 of his book, *The God Delusion* (New York: Houghton Mifflin, 2006.), Richard Dawkins writes as follows:

> . . .suppose the origin of life, the spontaneous arising of something equivalent to DNA, really was a quite

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> staggeringly improbable event. Suppose it was so improbable as to occur on only one in a billion planets... even a chemical model with odds of success as low as one in a billion would *still* predict that life would arise on a billion planets in the universe... a chemical model need only predict that life will arise on one planet in a billion to give us a good and entirely satisfying explanation of the presence of life here.

What Dawkins asserts in this quote is undoubtedly true. But, once again, it doesn't follow from the fact that science can explain how intelligent life came about on Earth-like planets that science can also explain why the laws of physics in the empirical universe are compatible with the coming about of Earth-like planets in the first place.

On page 237 of his Harvard University Press book, *Looking Up* (Cambridge, Mass.: Harvard University Press, 2001.), the Nobel Laureate, Steven Weinberg, has this to say about the AFT:

> ...there is one constant whose value does seem remarkably well adjusted in our favour. It is the energy density of empty space, also known as the cosmological constant. It could have any value, but from the first principles one would guess that this constant should be very large, and could be positive or negative. If large and positive, the cosmological constant would act as a repulsive force that increases with distance, a force that would prevent matter from clumping together in the early universe, the process that was the first step in forming galaxies and stars and planets and people. If large and negative, the cosmological constant would act as an attractive force increasing with distance, a force that would almost immediately reverse the expansion of the universe and cause it to re-collapse, leaving no time for the evolution of life. In fact, astronomical observations

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> show that the cosmological constant is quite small, very much smaller than would have been guessed from first principles.

But on pages 237–238 of *Looking Up*, Professor Weinberg goes on to consider the following argument that we don't need to postulate an intelligent designer to explain the value of the cosmological constant:

> According to the 'chaotic inflation' theories of Andre Linde and others, the expanding cloud of billions of galaxies that we call the Big Bang may be just one fragment of a much larger universe in which Big Bangs go off all the time, each one with different values for the fundamental constants. In any such picture... there would be a vast number of Big Bangs in which the constants of nature take values unfavourable for life, and many fewer where life is possible... If any theory of this general type turns out to be correct, then to conclude that the constants of nature have been fine-tuned by a benevolent designer would be like saying, 'Isn't it wonderful that God put us here on Earth, where there's water and air... rather than some horrid place, like Mercury or Pluto?'

Weinberg concludes, however, that 'we don't know enough about physics to tell whether there are different parts of the universe in which... the constants of physics really do take different values'. And he rejects the argument from fine-tuning, not on scientific grounds, but on the ground that suffering makes it very unlikely that there is a *benevolent* designer. But this objection would be relevant only if the proponent of the AFT intends to prove not just that there is an individual who is in many respects similar to the God of orthodox theism, but that orthodox theism is true without qualification. If the proponent of the AFT is – as he should be – less ambitious than that, then Weinberg's objection is

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irrelevant. Moreover, if, as appears to be the case, Weinberg believes that, in view of the surprisingly intelligent life-accommodating value of the cosmological constant, multiverse theory is the best alternative to a non-scientific, supernaturalist explanation of those values, Weinberg's reluctance to endorse multiverse theory is arguably overly-scrupulous.

The second quote from Professor Weinberg makes it look as though he thinks that if physicists eventually find independent evidence for a multitude of sub-universes in which the values of the constants of physics are not conducive to the eventual coming about of intelligent life, then there will be only one question which the opponent of the AFT will need to answer, namely, 'Why do we live in a universe in which the values of the constants of physics make intelligent life possible, rather than one in which they don't?' This question entails the simpler question, 'Why don't we (intelligent beings) live in a universe in which the values of the constants of physics make intelligent life impossible?' And, since the general question, 'Why aren't there some things which are not possible?' needs no answer, neither does the former question.

Now it may look, at first glance, as though Weinberg's analogy is entirely appropriate. For it may look as though the best definition of the expression, 'the empirical universe', is 'the universe which can be observed and/or reached by highly warranted inferences from what can be observed', and (2) that it follows that the question, 'Why do the constants of physics in the empirical universe take values which are compatible with the emergence of intelligent life?' entails the question, 'Why do the constants of physics in a universe which intelligent individuals (scientists) can observe and/or reach by highly warranted inferences take values which are compatible with the existence of those intelligent individuals?' And that question entails the self-answering question, 'Why do intelligent individuals live in a universe in which intelligent life is possible rather than one in which it isn't?' Moreover, it may appear as

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though the question, 'Why do the values of the constants of physics in the empirical universe accommodate intelligent life?' couldn't be asked except by an intelligent individual, and that, since the question presupposes the existence of intelligent life, it is – like Professor Weinberg's question – self-answering.

But this is mere appearance. For, if there really are universes other than the empirical one then the question, 'Why do the constants of physics in the empirical universe accommodate the emergence of intelligent life?' could be raised by an intelligent individual who exists in a universe other than the empirical one. And, anyway, there are individuating descriptions of the empirical universe which do not refer to intelligent individuals. I have in mind such descriptions as, 'the universe which contains naturally occurring microwave radiation which has a temperature which is roughly 2 degrees above absolute zero', and, closer to home, 'the universe in which the value of the cosmological constant is very close to zero'. (To guarantee uniqueness of reference, we would have to replace 'roughly 2 degrees' and 'close to zero' with exact numerical values – something which only physicists know how to do. But those more precise descriptions would be purely numerical. They would not refer to the intelligent physicists who know how to formulate them.)

5.

But there is another, more serious objection. Professor Weinberg believes, at least tentatively, that the fact that it is surprising that the value of the cosmological constant has turned out to be compatible with the emergence of intelligent life makes it rational to try to explain that fact (away) by postulating a multitude of sub-universes in most of which the laws of nature do *not* accommodate the coming about of intelligent life. But Weinberg needs to tell us why consistency does not constrain him to draw the same conclusion with

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respect to *any* surprising phenomenon. He needs to tell us, for example, why, if – what is scientifically possible but highly antecedently improbable – 1000 flips of a normal coin yield 1000 heads in a row, it would not be rational to conclude that, since there are a multitude of other universes in which quadrillions of flips of a normal coin yield roughly one-half heads and one-half tails, the envisaged 1000 heads in a row is a mere statistical irregularity, not a highly antecedently improbable event. Would Weinberg reply that it is highly unlikely that there are such other universes? Then he needs to tell us why, though the apparent improbability of 1000 random heads in a row can't be explained away in the envisaged manner, it is rational to believe that the scientifically surprising intelligent life-accommodating value of the cosmological constant *can* be explained away by postulating a multitude of other sub-universes in which the laws of nature are not compatible with anything like the biological evolution which took place on planet Earth.

It may well be that the yielding of 1000 heads in a row by 1000 flips of a normal coin would not occur within the time span of the empirical universe, from the hot Big Bang to the heat death which awaits the universe billions of years hence. But it is surely *conceivable* that the envisaged, enormously improbable event will occur some time before the universe ends. And it is conceivable as well that the universe did not have a beginning, and that the contemplated highly improbable event has already occurred. But, as I have said, it is impossible to understand why Professor Weinberg should think that it is rational to fall back on sub-universes to explain (away) the surprising value of the cosmological constant, but refuse to postulate sub-universes in an attempt to accommodate *other* surprising events – like the coming about of 1000 random heads in a row. And, of course, it is not open to Weinberg to conclude that it could never even *conceivably* be rational to believe that conclusion. That is surely strongly counter-intuitive.

If someone insists at this point that it is not even conceivable that a rational person could conclude that 1000 heads

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in a row could occur randomly (even after having carefully inspected the coin and found it to have a normal centre of gravity), then my reply is to invite him to consider not 1000 heads in a row, but, say, 95. The random occurrence of 95 heads in a row is an antecedently highly improbable occurrence, and it is surely *conceivable* that a rational person could recognise that fact instead of trying to explain the improbability away by postulating sub-universes in which quadrillions of coin flips have results which entail that the 95 heads in a row is a mere statistical irregularity.

6.

Here someone may undertake to defend Weinberg in the following manner:

Quantum mechanics predicts that, even in a vacuum which comes as close to having zero (Einsteinian) mass-cum-energy as is physically possible, two kinds of elementary particles – electrons and positrons, for example – whose energies tend to cancel one another out, appear and then instantaneously disappear, yielding an amount of energy which, though not quite zero, comes close to zero. But there is an indefinitely large number of different kinds of possible cancellations which yield an indefinitely large number of possible numerical values of the vacuum energy, other than the one which it in fact possesses – a unique value which is compatible with the emergence of intelligent life. Of all the different kinds of energy-yielding cancellation processes which might have occurred, the process which in fact occurred yielded a very tiny vacuum energy – a cosmological constant, the numerical value of which accommodated our eventual coming about. Though it was highly antecedently improbable that the cosmological constant took a value which is compatible with that consequence, we can be certain that it did, since we can be certain that we exist. But it is surely implausible that our existence puts constraints on the value of the cosmological constant. And Professor Weinberg has in effect provided us

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with a way of avoiding that conclusion by inviting us to consider the possibility that the empirical universe is just one of a vast number of sub-universes, in most of which the constants, and consequent laws, of physics are not compatible with the emergence of intelligent life. If that is the case, then the question, 'Why are the constants and laws of physics in the empirical universe compatible with the emergence of intelligent life?' is, as Professor Weinberg says, like the self-answering question, 'Why do we live on Earth, where intelligent life is scientifically possible, rather than on a planet like Mercury or Pluto, where it isn't?'

But the objection to which multiverse theory is an apparent response is unconvincing. Let us consider it again: 'There is an indefinitely large number of values of the constants of physics, other than those values which accommodated the eventual coming about of intelligent life in the empirical universe, which those constants *might* have taken. And we need an *explanation* of why those constants take precisely the intelligent life-accommodating values which they in fact take, rather than the myriad of *other* values which they *might* have taken. Since there is an enormous number of numerical values other than the ones which the constants of physics in fact take, it is highly antecedently improbable that they took precisely *those* values. And what is highly antecedently improbable cries out for a causal explanation. 100 heads in a row, for example, calls for a causal explanation, namely, that the coin which yields that result did not have a normal centre of gravity.' The trouble here is that this objection refers to only one kind of improbability – the kind of improbability which is embodied in 100 flips of a normal coin yielding many more than one half heads (or many more than one half tails). And there is another kind of improbability. Suppose that I flip a normal coin, say, 100 times and get a certain pattern of heads and tails (starting, say, with Heads, Heads, Tails, Heads, Tails, Tails). The number of *other* patterns which *might* have come about – the number of *possible* patterns – is enormous. (The relevant formula here is 2^{nth} power, where 'n' is

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the number of flips. Hence, the number of possible patterns in the case which we are imagining is 2^{100th} – a gigantic number of patterns.) But if the 100 coin flips yielded roughly one-half heads and one-half tails, no rational person would believe that there must be a causal explanation of the fact that the *pattern* which came about did, in fact, occur, instead of one of the vast number of different patterns which might have come about. It's just that things in fact turned out that way. That is simply a brute fact, which doesn't need – or have – an explanation, other than the sum of the individual explanations of the individual results of the individual flips (in terms of the mass of the coin, the force of the flips and gravity). We would not, if we were rational, try to explain the pattern which did, in fact, occur by postulating a myriad of sub-universes in which trillions of coin-flips randomly yield other patterns. And Professor Weinberg needs to tell us why the kind of improbability which is exhibited by the constants of physics having intelligent life-accommodating values is not this second kind of improbability. If it is, then, just as we will not, if we are rational, seek an explanation of the fact that 100 coin-flips yields just the pattern that it does yield rather than some other one of the immense number of patterns which it might have yielded by postulating a myriad of sub-universes in which a myriad of other coin-flips yields different patterns, we will not, if we are rational, seek an explanation of the fact that the values of the constants of physics are as they are. We will recognize that that is simply a brute fact. Our knowing that there are a vast number of other values which the constants of physics might have taken does not entail that there must be an explanation of their having the values they do have. Professor Weinberg's multiverse explanation is superfluous – as is, of course, a supernaturalist account of the matter.

It may be objected here that one pattern being yielded by 100 coin-flips, rather than some one of the multitude of other possible patterns, does not exhibit either the first or the second kind of improbability. It may be said that the envisaged pattern would not be, strictly speaking, improbable.

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But I submit that this objection is undermined by the fact that it would be highly irrational for someone to bet on the emergence of *that* pattern, even though he knew that his bet wouldn't yield an enormous payoff. And, in any case, if it really isn't improbable that the cosmological constant has the precise value which it possesses, then there is no need to try to explain that value away, as Professor Weinberg does.

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Note

[1] On page 76 of *An Enquiry Concerning Human Understanding*, (3rd Edition, Oxford, England: Oxford University Press, 1974) Hume says: '. . .we may define a cause to be an object followed by another and where all the objects similar to the first one are followed by objects similar to the second.'

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