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Cosmological Fecundity[1]

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This paper characterizes various responses to the question, 'Why does our universe exist?' Some responses – that the question is senseless, that the existence of our universe is logically necessary – are implausible. Adjudication between more plausible responses requires us to evaluate the argument from the 'fine-tuning' of the universe, a refurbished version of the argument from design that appeals to cosmology rather than biology. The evidence of fine-tuning should lead us to adopt, albeit provisionally, cosmological fecundity, the hypothesis that there exist many universes of varying characters. The existence of our universe is thereby rendered less surprising. This is to be preferred both to the theistic hypothesis and to the view that the existence of our universe requires no explanation.

I

Why is there something rather than nothing? Why this something rather than some other? In natural theology the first question is tackled by the cosmological argument, the second by the teleological, or argument from design. The separability of these two questions – one about the existence, the other about the character of the world – embodies what Robert Nozick calls an inegalitarian assumption: that existence requires explanation in a way that non-existence does not.[2] On the inegalitarian view, 'nothing' is a natural state, in need of no explanation, whereas 'something' is a deviation from the natural state and so demands some account of the reasons for the deviation. The use of the term 'natural' here is potentially misleading. Nozick cites as examples of natural states the Aristotelian notion of rest and the Newtonian conception of rest or uniform rectilinear motion, but both of these presume some deeper account of nature against which they are to be understood. In Aristotle's case this is teleological, in Newton's it is theological. A more neutral way of expressing the inegalitarian assumption might be to say that 'nothing' is the *default* state of reality.

Nozick suggests that, by accepting inegalitarianism, we betray a bias that lacks any clear justification. Why should 'nothing' need less explanation than 'something'? Why should reality have a default state? But there is much to be said for the view that 'nothing' is a simpler state of affairs than the existence of any particular something. When we ask, 'Why is there something rather

than nothing?' we are led on to ask, 'Why this something rather than some other?' Were there nothing, but nevertheless someone around to wonder why, there would be no equivalent follow-up question. Nothings are all alike, or, put another way, there is only one of them. This suggests that inegalitarianism, although unjustified in strong form, might be acceptable when weakened to the claim that 'nothing' stands in less need of explanation than the existence of any particular something. Of course, if David Lewis is right and every logically possible world exists, then even weak inegalitarianism is unjustified, for what exists is not any particular something but all of them.[3] Perhaps, like 'nothing', the existence of 'everything' is extremely simple, and hence stands in less need of explanation than the existence of any particular something. And unlike 'nothing', 'everything' is a possibility that might in fact obtain. On the other hand, we might think that the existence of every logically possible thing is a very special possibility that cries out for explanation in a way that the existence of just some logically possible things does not.[4]

If we reject strong inegalitarianism, then reality has no default state and the distinction between the question about the existence of the world and the question about its character blurs. We can choose instead to ask 'Why does this possibility obtain rather than some other?' The other possibilities include there not being anything at all, there being everything that there could possibly be, and countlessly many cases in between. The great disadvantage of this way of formulating the question is that we may not know which possibility in fact obtains; at least with the question 'Why is there something rather than nothing?' we were clear as to which of these two possibilities was actual. But the egalitarianism of the reformulated question has its own advantages, for so long as we assume that 'nothing' is the default state of reality, we are forced to admit a deviation from that state that invites explanation. If there is no default state, then perhaps we can take an explanatory shortcut: things had to be some way or other; this is how they are; end of short and uninteresting story.

Is this shortcut open to us? It would be convenient if it were, but unfortunately the absorption of the question about why there is something rather than nothing into the wider question about why there is this something rather than some other does little to diminish the force of the latter even if it succeeds in evading the former. As I noted above, this latter question was traditionally addressed by the argument from design, and, as this argument has been undergoing something of a revival, we need to pay attention to it before we can hope to assess the adequacy of the proposed shortcut to explanatory completeness. If, as the argument from design claims, there is something very special about the universe that we inhabit, then the fact that things are the way they are can no longer be regarded as uninteresting. Perhaps there is a longer story to be told.

II

How should we classify the various types of answers that might be given to the question, 'Why does this possibility obtain rather than some other?' Here it is useful to borrow a distinction made by Derek Parfit between a narrow scope for the term 'possibility' and the far wider scope employed when 'possibility' is used to refer to the way reality as a whole might be. Parfit distinguishes *local* from *global* possibilities.[5] One local possibility is that a universe of the kind that we inhabit exists; another is that a world consisting only of an iron sphere with the London Telephone Directory inscribed upon it exists. We know the former local possibility obtains; we do not know whether or not the latter one does, though it seems unlikely. The obtaining of any particular local possibility leaves open the question whether other local possibilities also obtain: perhaps there is, besides our universe, another that is spatially, temporally, and causally isolated from ours that consists only of an iron sphere inscribed with the London Telephone Directory.

Global possibilities, by contrast, cover the whole of reality; they are exclusive as well as inclusive, telling us what doesn't exist as well as what does. One global possibility is that the only local possibility that obtains is the one involving the existence of a universe like ours. Another is that our local possibility obtains, and so does the one involving the iron sphere inscribed with the London Telephone Directory, but no others. There are two notable global possibilities: the Null Possibility, in which nothing exists, and the Maximal Possibility, in which every conceivable world exists. We know from our own existence that the Null Possibility does not obtain, but the same grounds do not tell us whether or not the Maximal Possibility obtains.

Armed with this distinction between local and global possibilities, we can see that the question, 'Why does this possibility obtain rather than some other?' is unstable. If it asks, 'Why does the local possibility that consists in the existence of a universe like ours obtain?' it may receive an answer that appeals to something outside the universe and hence outside the scope of the question. But if the question asks, 'Why does this global possibility obtain rather than some other?', the opportunity for appealing to one part of reality to explain the rest is lost. The significance of this global question is difficult to grasp precisely because everything that might function as an answer is included in the reality about which it asks. For example, a theist might answer the local question about why a universe like ours exists by saying that God created it. The global question cannot receive a similar answer because God is now part of the possibility whose obtaining we wish to explain.

We should not conclude from the instability of the question, 'Why does this possibility obtain rather than some other?' that the only question ever worth asking is about the obtaining of the local possibility that consists in the existence of a universe like ours. This is the question with which we should

start, but at least some kinds of answers to this question will suggest follow-up questions that are also worth asking, and some of these follow-up questions will begin to converge on the question about global possibilities that seems at first so difficult to grasp. This is because at least some answers to the original, local question invoke the obtaining of other local possibilities as well, and so provide clues to the global possibility of which our own local possibility is a part. In what follows, I shall mostly be concerned with the question, 'Why does the local possibility that consists in the existence of a universe like ours obtain?' I shall return to the issue of global possibilities in the last section.

In general, questions of the form, 'Why does this possibility obtain rather than some other?' meet with three kinds of response. The question may be rejected as posed, either because it is nonsensical, or because there are no other possibilities, or because some, many or all other possibilities obtain alongside the one asked about. The question may be accepted but then answered by claiming that there is no explanation, because the obtaining of that possibility is sheer coincidence. Finally, coincidence can be rejected as implausible and then perhaps a candidate explanation will be offered. Applied to our start-up question, 'Why does the possibility that consists in the existence of a universe like our own obtain rather than some other?', this general classification gives us the following kinds of view:

(1) *Local rejectionism*. It makes no sense to ask why just our universe exists.
(2) *Local necessitarianism*. The existence of just our universe is logically necessary.
(3) *Fecundity*. Some, many or all other local possibilities also obtain.
(4) *Local coincidence*. The existence of just our universe is sheer coincidence.
(5) *No-coincidence*. It is no coincidence that our universe exists, but rather due to . . .

Of these five kinds of view, (1), (2), and (4) accept the presupposition that the existence of our universe is the only local possibility that obtains. (3) explicitly rejects that presupposition. What about (5)? One obvious no-coincidence view is theistic: besides our universe there exists also a God who created it, and this God is neither part of the universe nor identical with it. This no-coincidence view denies the claim that the global possibility that obtains consists only in a universe like our own, but unlike (3) it supposes that something else exists which explains why our universe exists. This is not implied by (3); if local possibilities are spatially, temporally, and causally isolated one from another it is unclear how the obtaining of any one local possibility could explain the obtaining of any other. In a much looser sense, however, (3) can be explanatory, because the obtaining of any particular local

possibility may be surprising on its own, but not so surprising given that many other local possibilities also obtain.

What can we say about these five kinds of view? Local rejectionism puts an end to questioning before the process begins; it denies that (2)–(5) are coherent answers to a coherent question. This is highly implausible. The claim that the universe is as it is because God made it that way makes sense, even if we have no good reason to believe it. Equally, the claim made by the local coincidence view seems intelligible, even if we find it difficult to credit. Local necessitarianism is also highly implausible: surely there are countless ways things might have been, including there being nothing at all. The existence of just our universe can hardly be logically necessary. But this is not the end of the line either for rejectionism or for necessitarianism; these responses may be more plausible when we try to answer follow-up questions prompted by other kinds of view. For example, suppose that an extreme version of (3) (fecundity) is true and all possibilities obtain. Someone might believe that this Maximal Possibility obtained by logical necessity. Or suppose a particular theistic version of (5) (no-coincidence) is true and there exists, besides our own universe, a God who exists necessarily and who necessarily creates just a universe like ours. Both these views are forms of global rather than local necessitarianism: whatever exists exists necessarily, but it is more than just a universe like ours. David Lewis holds the former view: he claims that it is necessarily true that there is everything rather than nothing.[6] As the Null Possibility seems to be a real possibility I think this form of global necessitarianism is implausible.[7] With qualifications, the latter view can be attributed to Leibniz, who holds that God exists necessarily and is constrained by the demands of perfect goodness to create the best possible world.[8] As the Null Possibility excludes the existence of God, this theological necessitarianism is open to the same criticism as Lewis's atheological version. God seems better suited to the role of necessary existent than Lewis's maximal mereological sums of spatio-temporally interrelated things, but if necessary existence is an incoherent notion, theological necessitarianism is in as poor shape as any other kind. Not everyone who believes that God exists necessarily is a thoroughgoing necessitarian, however. Someone might believe that there are countless global possibilities but that God exists in all of them. Here the appeal to the intuition that the Null Possibility is a real one loses much of its force, for it can be conceded that there really could have been nothing except God, and that goes a long way towards satisfying our sense that the existence of everything that we experience is contingent.

Global rejectionism is also more plausible than its local counterpart: as a matter of logic alone, some global possibility must obtain. If no global possibility is privileged over any other, and if many include a universe like ours, it is unsurprising that such a universe exists. This global rejectionism trades upon the suggestion that there are many universes besides our own, for

there is only one global possibility in which our universe is the only local possibility that obtains, whereas there are countlessly many global possibilities in which our universe exists alongside others.

The local coincidence view claims that the existence of a universe like ours is a brute fact, incapable of explanation. This is the short and uninteresting story outlined above: things had to be some way or other; this is the way things are. The credibility of this view depends upon how surprising it is that of all the global possibilities it is the one that consists in just the existence of a universe like ours that obtains. Both the no-coincidence theorist and the fan of fecundity find this view incredible: given the nature of our universe, its existence must either be explained by something beyond it or rendered unsurprising by the postulation of many other universes besides our own. In most of what follows, I shall attempt to adjudicate this three-sided dispute among coincidence, no-coincidence, and fecundity.

No-coincidence views claim that the obtaining of whichever possibility does in fact obtain is neither a matter of sheer accident nor a matter of logical necessity. One subdivision in the category is theological: God brought it about that this possibility obtained. Even if God exists necessarily, this view can differ from the theological variant of global necessitarianism set out above if God is not constrained as a matter of necessity to create one particular possible world. For example, if there is no best possible world, or if God is not constrained by perfect goodness to create the best possible world even if there is one, then an element of free choice enters into God's act of creation, and this choice plays a role in explaining why this possibility obtains rather than any other.[9] Alternatively, it might be claimed that God's existence is a brute fact, incapable of explanation, and this could combine with a libertarian view of God's creative act to yield a different version of a theological no-coincidence view.[10]

Another type of no-coincidence view is axiarchic: some creative principle brought it about that this possibility obtained.[11] Parfit distinguishes between axiarchic explanations, which involve the ascription of value to the obtaining of certain possibilities, and the broader claim that it is no coincidence that some possibility obtains, even though it is of no greater value than some other.[12] Thus the claim that this possibility obtains because it is best, or most elegant, or possesses some other valuable feature, is an axiarchic claim; the claim that it is no accident that this possibility obtains, although also requiring that this possibility possess some feature that explains why it was selected, need not imply that the feature is in any way valuable. As an example of such a view, we might believe that every possible world exists not by necessity, as Lewis claims, but because possibility implies actuality in some weaker fashion. The inclusiveness possessed by the existence of everything, which maximizes the number of possibilities that are realized, functions as an explanation of the obtaining of the Maximal Possibility through an appeal to

a creative principle which selects possibilities for creation on the basis of mere possibility. But this does not involve any claim to the effect that it is better for reality to be maximal in this way. Parfit thinks it would be terrible if it was.[13]

The fan of fecundity, unable to deny that it would be extremely surprising or unpleasantly arbitrary if the existence of a world like ours was the only possibility that obtained, but unwilling to countenance a resort to theological or axiarchic explanations, suggests that enough other possibilities also obtain to render the obtaining of this one unsurprising or unarbitrary. How much is enough? That depends upon how surprising or arbitrary this world seems. An extreme rationalist like Peter Unger, bent on squeezing the last bit of arbitrariness out of the metaphysical tube, opts for infinitely many isolated concrete worlds, a Lewis-like position, and is happy to have modal realism along for the ride.[14] But others are driven shorter distances in the same direction by the desire to explain certain facts about our universe which they think are highly unlikely to obtain unless it is but one amongst many. The only intellectually satisfying alternative, as they see it, is to adopt theology or axiarchy.

If local variants of rejectionism and necessitarianism are implausible, then the question, 'Why does the possibility that consists in the existence of a universe like our own obtain?' must receive an answer in terms of local coincidence, no-coincidence, or fecundity. If the existence of a universe like ours is unsurprising, we should opt for the former; otherwise, we should reject coincidence in favour of a theory that reduces our surprise to an acceptable level. But how surprising is it that a universe like ours exists? This brings us to the argument from design.

III

Although dealt a body-blow by the publication of *The Origin of Species* in 1859, the design argument has since recovered much of its former glory by an appeal to cosmological rather than biological evidence. The human eye, once the favourite example of the intricacy and complexity of the world, has been replaced by the fine-tuning of the various physical constants. Instead of the abundance of plant and animal life available for humans as food, providence is now manifested in the delicacy of the atomic resonances that make possible the production of carbon atoms in stars. The hospitality of the earth's temperate climes is no longer cited as proof of divine purpose; rather, we are told about symmetry-breakings in the early history of the universe which gave us the present structure of space and time and without which it seems that life of any kind would be inconceivable. Richard Dawkins claims that it was impossible to be an intellectually fulfilled atheist before Darwin;[15] if the newly refurbished argument from design is valid, perhaps it was only possible

to be an intellectually fulfilled atheist after Darwin but before Hubble and the development of the theory of the Big Bang.

The evidence appealed to in recent versions of the argument from design derives mainly from physical and cosmological theories developed in the last thirty years or so, and in particular the Big Bang theory of the origin of the universe. Many details of this theory are still vague, but its general outlines are well established. Big Bang theory itself offered considerable consolation to some theists: Pope Pius XII publicly welcomed it as lending support to the Biblical view of creation. In the other camp, Fred Hoyle persisted in his defence of the steady-state theory partly because he believed it fitted much better with atheism than any theory postulating a universe with a beginning in time.[16] But the re-vamped argument from design is not a simple inference from the fact that the universe had a beginning to the necessity for some cause of the universe as a whole. That would be dull and unconvincing. Rather, appeal is made to the apparently extraordinary 'fine-tuning' of the visible universe: if things had been only a little different at the start, the subsequent history of the universe would have been radically altered, and life as we know it, or even life as we might speculate about it, would have been impossible.

At the heart of the 'argument from fine-tuning' are a series of astronomical (in both senses of the word) improbabilities, the occurrence of which is essential if the universe is to be life-permitting, as it indubitably is. Here are three examples:

(i) A change of 1 part in 10^{100} in gravity or the nuclear weak force would disrupt the cosmological constant that drives inflation in the early universe, causing either runaway inflation or massive and sudden deflation.[17]

(ii) A 1 percent increase in the strong nuclear force would burn all carbon to oxygen, and there could be no carbon-based life. A 2 percent increase would stop quarks forming into protons and there could be no atoms.[18]

(iii) Were the electromagnetic force slightly stronger, all stars would be red, unable to explode, and very cold; were it slightly weaker, all stars would be blue, short-lived, and very hot. Changes of only one part in 10^{40} in either electromagnetism or gravity would spell catastrophe for stars like the sun.[19]

How should we react to these extraordinary facts and their accompanying improbabilities? We can immediately dispose of the knee-jerk response that we shouldn't be surprised that the universe is the way it is because if it wasn't that way we wouldn't be here to be surprised about it. It is reasonable to seek an explanation of the fact that you survived the firing-squad even though if you hadn't you would be in no position to wonder about it.[20] Another response is to think that science will some day provide explanations that minimize the cosmological improbabilities by relating various apparently independent facts to one another. Maybe the strengths and ranges of the

various forces are connected in such a way that none can vary without the others also doing so.[21] Or maybe some law governs initial conditions as well as the processes by which subsequent states develop out of those conditions. But such 'Theories of Everything', in which this turns out to be the only physically possible universe, face huge obstacles: even the much more limited Grand Unified Theory, uniting the electro-weak and strong forces, fails in its simplest form, for the proton does not decay at the predicted rate.[22] More ambitious TOEs, championed by some physicists, are regarded as dangerous myths by others. John Barrow, for example, regards the role of initial conditions as ineliminable and the subsequent history of the universe as characterized by random symmetry breakings that could have happened very differently.[23] On this view, it is sheer luck that the visible universe has but four dimensions, the others having been compactified soon after the Big Bang; that the universe has not wound down long ago into a single blob; that the universe is made up of matter rather than anti-matter; that the sky is dark at night instead of being hot enough to fry us, and so on.

Theism offers a neat explanation of the fine-tuning of the universe: God made it that way. However improbable the existence of God, it cannot be less probable than, say, the probability of bare lambda and quantum lambda cancelling each other out with an accuracy of one part in 10^{120}, as some inflationary theories require.[24] If we think that God is unsatisfactory as an explanation, perhaps because we think that our universe, with its attendant evils, is highly improbable on the standard theistic hypothesis, then we can modify the hypothesis by making God less than perfectly good or less than infinitely powerful. But perhaps God is conceived too anthropocentrically here. Leibniz, for example, insists that we must not think that God designed the universe with just us in mind: many aspects of the world have little or nothing to do with us and everything to do with the metaphysical perfection of God's handiwork.[25] In fact, Leibniz typically subsumes the moral aspects of the world's goodness into its metaphysical perfection, and his position often threatens to collapse into the axiarchic claim that perfection is itself creatively effective.[26] Leibniz needs God as an intelligence exercising choice between possible worlds because he thinks that possible worlds cannot co-exist; he needs God as a solution to the problem of contingency because no possible world can exist necessarily. So a necessary being is needed to explain why there is something rather than nothing; a perfect being is needed to explain why there is this something rather than some other.

Theism is one kind of no-coincidence view. Others are axiarchic, claiming that the possibility that obtains does so because of some valuable feature that it possesses. As Parfit points out, the claim that the universe exists and is the way it is because it is good faces the problem of evil in much the same manner as does theism.[27] But, just as theism can be modified to cope with this, so can axiarchy. Some versions of axiarchy ignore evil

altogether: if the universe is the way it is because that is most elegant, then suffering is just an unfortunate by-product of that elegance. Non-axiarchic no-coincidence views, because they do not impute any value to the feature or features on the basis of which this possibility is selected, also evade the problem of evil.

If we set these other no-coincidence views aside, the main rival to theism is some version of fecundity. If our universe with its very special features is simply one amongst countless universes, and if these other universes have other, typically less special features, then there is no longer any fine-tuning to be explained. Although ontologically lavish, this hypothesis has a lot going for it: it postulates entities of a familiar kind – universes – and assumes that these other universes diverge from our own in ways suggested by the history of the only universe to which we have direct access. Thus, if it is true that random symmetry breakings gave us three dimensions of space and one of time, other universes may have many more dimensions, or fewer; if the expansion-rate of the universe was crucially dependent upon initial conditions in the region that inflated to form our corner of reality, elsewhere the inflation may never have got going, or ended abruptly, or proceeded more rapidly, and so on. These are relatively modest ways of generating universes other than and different from our own.

There are less modest versions of cosmological fecundity. One is Wheeler's 'oscillating universe' scenario, in which successive Big Bangs generate universes which end in successive Big Crunches.[28] Another is Everett's many-worlds interpretation of quantum theory, which suggests that every possibility permitted by the theory occurs: worlds split off from each other continually, and the indeterminacy of our own world is compensated for by the realization of all other possibilities elsewhere.[29] Branching occurs in other theories, for example, 'child' universes generated out of false vacuums within the 'mother' universe, or Markov's 'daughter', 'grand-daughter', and 'great grand-daughter' universes born during successive Big Bangs and Crunches.[30] Or we could appeal to the size of the capital 'U' Universe: if the cosmos is open and infinitely large, then it contains infinitely many universes invisible to others because they lie beyond their horizons. If one or other, or perhaps some mixture of these suggestions is correct, then reality is unimaginably more vast and varied than even our own unimaginably vast little bit of it. Given such vastness and variety, it is unsurprising that one small corner of reality has the character of the region that we inhabit.

It is precisely this ontological over-abundance that is cited by the critics of fecundity as a reason for rejecting it in favour either of coincidence or no-coincidence: fecundity violates in spectacular fashion the prohibition on multiplying entities beyond necessity.[31] But if, as both no-coincidence and fecundity claim, the astronomical improbabilities cited in the argument from

fine-tuning are intolerable as they stand, then something must be done to render them tolerable.

IV

Could the improbabilities involved in the fine-tuning be coincidences and nothing more? If so, the existence of the universe is a brute fact, and the fact that it is the way it is is equally brutish. Here we could distinguish brute facts from random occurrences. It is easy to assign probabilities to the outcomes of random procedures, either by gathering statistical information about past outcomes or by constructing a frequency model. As an example of the latter, consider Paley's remarks on the inverse square law:

> [C]oncerning this law of variation we have three things to observe: First; that attraction, for anything we know about it, was just as capable of one law of variation, as of another: Secondly; that, out of an infinite number of possible laws, those which were admissible for the purpose of supporting the heavenly motions, lay within certain narrow limits: Thirdly; that of the admissible laws, or those which come within the limits prescribed, the law that actually prevails is the most beneficial. So far as these propositions can be made out, we may be said, I think, to prove choice and regulation: choice, out of boundless variety; and regulation of that which, by its own nature, was in respect of the property regulated, indifferent and indefinite.[32]

Paley here begins by supposing that the law of attraction might have taken any number of forms. Of these forms, few would have yielded stable orbits for planets, and only one of these stable solutions would have been as simple, orderly, elegant, and providential as the one that obtains. In the absence of any deeper explanation for the inverse square law, then, it is obvious that some non-random procedure must have produced the law which we experience, for the chances of this law being selected randomly are vanishingly small.

If we succumb to the temptation of thinking that the universe is the result of some universe-generating process which has no bias towards life-permitting solutions, and is hence random in this respect, then the fact that the universe actually is life-permitting is likely to amaze us. Generalizing Paley's argument, we can construct a frequency model in which possible initial conditions, particle masses, force strengths, etc., vary independently of one another. As the number of combinations that yield universes capable of supporting life is a tiny fraction of all the possible combinations, we are forced either to admit choice out of boundless variety (no-coincidence) or suppose that the boundless variety really exists (fecundity).

Can we evade this dilemma by refusing to admit the appropriateness of any frequency model whatsoever? As an analogy, think of thousands of books arranged alphabetically by author on someone's shelves; the probability that this arrangement came about randomly is vanishingly small. But what is the

probability of this arrangement if the books are there as the result of no process of any kind, not even a random one? Probabilities can be coherently ascribed to cases only when we can construct a model for assessing the frequency of various other possible outcomes. If we deny the appropriateness of every model, we deny the appropriateness of assigning probabilities.

One problem with this strategy is that physicists and cosmologists themselves like nothing more than entertaining speculations about the process by which the universe acquired its fundamental characteristics. The story of random symmetry breakings yielding values for the various cosmological constants, force strengths, and particle masses or energy levels naturally suggests a frequency model in which probabilities are assigned to the various outcomes compatible with the overall theory. It then turns out that the probability of a life-permitting set of values is incredibly small. The primary motivation for seeking the Holy Grail of a Theory of Everything is in order to raise this probability to the kind of level that physical theory finds acceptable. Nor is it consoling to be told of the alphabetically arranged books that the question why they are so arranged is empty because they have always been there and always been that way.[33] It is true, as a matter of logic alone, that some global possibility must obtain. That the global possibility that obtains includes a universe like ours, characterized by the apparent coincidences involved in the fine-tuning, is not a matter of logic, even if it is, given fecundity, unsurprising. Calling the universe a brute fact and then refusing to admit that brute facts can coherently be described either as probable or as improbable is simply dodging the issue.

Once we concede that the universe might have taken any number of other forms, the vast majority of which would have been entirely unsuitable for the development of life, it is appropriate to ask why the universe takes one of the few forms which permit such development. If the probability of a life-permitting universe arising by chance is incredibly small, we should conclude either that the universe must have been selected because it is life-permitting or that there are countless other universes, not life-permitting, which make the presence of this life-permitting one unsurprising. If coincidence can be ruled out, then we are left with a choice between no-coincidence or fecundity.

V

Perhaps the best way of approaching this choice is by asking whether we have to make a choice at all. Theism and fecundity are not incompatible: if God has reason to make one universe, God may have reason to make many. But the thinking behind the recourse to many worlds is analogous to that behind the appeal to the vastness of the visible universe in explaining the origin of life on earth. Even in a life-permitting universe, it is unlikely that life will develop in some particular place at some particular time.[34] But the fact that there are

countless galaxies containing countless stars, many of which are presumably circled by planets like our own, renders the origin of life somewhere in the universe at some time or another unsurprising. It is obviously open to someone to appeal to this kind of explanation for the origin of life within the universe while rejecting a similar kind of explanation for the origin of the life-permitting universe itself, but it seems odd to endorse the reasoning in one case and not in the other. God might well have reason for creating more than one universe, so the theistic hypothesis does not exclude the existence of many universes. But in terms of explaining the fine-tuning, fecundity can get along perfectly well on its own.

The analogy between the origin of life on Earth and the origin of the life-permitting universe containing the Earth can be pressed further, and again to the advantage of fecundity. Although the Earth is such as to permit the origin of life and its subsequent development into varied forms, it is not a particularly hospitable environment. Whole orders of creatures are now extinct, and the history of life is characterized throughout by massive and sudden decimation of species. But this is hardly surprising: of the few planets that are life-permitting, they are not all equally so, and we inhabit one of the more challenging ones. There may be others that are more comfortable and some that are even less so.[35] Similarly, given the existence of many universes, it is unsurprising that the one that we inhabit is such as to permit the development of life, but also unsurprising that the universe places considerable obstacles in our path. The problem of evil vanishes once we recognize that our existence is a consequence of the fact that the universe is life-permitting, but not in any sense the reason why it is so. On the theistic hypothesis, the universe is consciously selected by an agent who possesses a considerable degree of foresight. On the hypothesis of fecundity, the only selection that goes on is the unsurprising and automatic selection that ensures that we inhabit a universe that is such as to permit, if only barely, the existence of inhabitants like us.

Unlike theism, then, fecundity is non-teleological; there is no reason why this universe is life-permitting. Although the recourse to many-worlds is motivated by the improbability of an arbitrarily selected universe being life-permitting, fecundity does not claim that there is anything special about a life-permitting universe beyond this improbability: had the universe we inhabit been a little denser, it would have collapsed billions of years ago; a little hotter, and our evolutionary ancestors would have long since fried; tweak the particle masses and atoms are impossible; tinker a bit with the nuclear forces and there are no complex molecules. But equivalent things could presumably be said about some other improbable universes that happen not to permit the development of life. On the many-worlds hypothesis, the improbability of a life-permitting universe is compensated for by the fact that most of the other worlds are life-denying. But fecundity can concede that at least a few of those

other worlds will also be members of small and exclusive clubs; say, the club of universes whose matter-distribution is perfectly homogenous, or the club of universes in which matter and anti-matter balance so precisely that everything vanishes in a massive burst of radiation. From the perspective of these necessarily unobserved universes we can run a version of the many-worlds hypothesis to explain the extraordinarily fortunate fine-tuning of the constants, masses, and forces that prevented the formation of galactic clumps, or which preserved the perfect equilibrium between each particle and its oppositely charged cousin. For fecundity these other finely-tuned universes are on a par with our own, despite the fact that they are life-denying.[36] For theism, by contrast, it is not mere fine-tuning, but fine-tuning interpreted teleologically, that is required. Life-denying universes, no matter how improbable, are no evidence for the standard theistic hypothesis.

Because of the incredible intricacy of the chemical basis of life, it seems clear that very few life-denying universes will be as complex as our own, even if some of them are quite as improbable. Does this complexity constitute a specialness of a different order, one that might be appealed to by the theist in order to ground the teleology to which fecundity need not aspire? It is necessary to proceed rather carefully here. What is required is a demonstration of the special nature of those universes that are life-permitting, not those that, like the actual universe, happen to contain life. That a universe which permits life to develop also contains life which has developed is completely explained by whatever explains the origin of life together with the Darwinian explanation of the development of more complex life-forms out of simpler ones. If we have a complete explanation of life given that the universe is life-permitting, we cannot count the fact that there actually is life as something which makes the universe special.[37] That would be to double-count the intricacy and complexity of life, once at the level of its chemical basis and again at the level of the organisms which develop on the basis of that chemistry.

This means that it is not life itself, but only the possibility of life, which must constitute the explanandum crying out for an explanans. This fact might in itself give fecundity some advantage over theism, for if it is highly improbable that life will develop even in a life-permitting universe like ours then God was taking quite a risk in merely creating a suitable universe and leaving it to generate life by itself. Perhaps it is not improbable that life will develop somewhere in a universe of the size of our own, though the fact that we have never been visited by or detected the presence of any extra-terrestrial life does suggest that life is extremely uncommon. Or perhaps God is not risk-averse. At any rate, the set of life-permitting universes is probably larger than the set of life-containing ones. But it is still extremely small when compared with the set of all possible universes.

Might there be universes which have chemistries as intricate and complex as our own but which are life-denying? On the face of it, that seems unlikely.

The complexity of even the crudest forms of life is staggering: a DNA molecule is a million times longer than it is wide, and the information it contains would fill thousands of volumes of incredibly tiny print. We know much less about DNA than we know about the Sun, despite the fact that the Sun is much further away than our own genome. The simple reason for this is that there is much less to know about the Sun; it is a simple object compared to our own chromosones.[38] But measuring complexity is a complex business. Paley's famous contrast between the stone and the watch clearly involves a judgement about the relative complexity of the two items, and yet the stone is in fact remarkably complex internally, composed almost entirely of empty space in which are whirling countless numbers of particles with their distinctive charges, masses, spins, orbits, and so on. This is true of the watch as well, though the purity of the alloys in the watch represents one way in which its composition is less complex than that of the stone. For Paley, of course, it is the mechanical contrivance of the watch which is so striking: all those cogs fitted together to transmit the elasticity of the spring precisely and regularly to the hands, and so on. Paley would not be impressed by a digital watch in this regard, but once he had overcome the unfamiliarity of the object, he would recognize that his argument was untouched because the crucial difference between the watch and the stone is preserved: one tells the time and the other doesn't. But the issue of complexity has then dropped out of the picture and teleology is doing the work instead.

The claim that life is special is built into the theistic hypothesis through the postulation of a God who has reason to create a universe that permits the development of life. So it is hardly surprising that the existence of a life-permitting universe raises the probability of the theistic hypothesis. But the improbabilities appealed to in the argument from fine-tuning are independent of the claim that life is special and require explanation even if the possibility of life is judged to be bad or neutral rather than good. It is, of course, open to someone to claim that life is special independently of any theological underpinning for such a claim, and then the fact that the universe is finely-tuned in a life-permitting rather than a life-denying way will appear significant. But as the specialness of life is one of the things that theists and atheists often disagree about, it represents a contentious basis upon which to prefer a theistic explanation for the fine-tuning.

Theism and fecundity agree that, like the majority of bridge hands, the majority of universes are much of a muchness: there is no description under which they can reasonably be said to belong to a small and hence improbable set. The theist identifies this universe as a winning hand, and concludes that the cosmological deck has been stacked by the dealer. Fecundity, in the absence of a teleology that picks out some universes as 'winners' rather than 'losers', has to fall back upon the improbabilities cited in the argument from fine-tuning in order to justify the postulation of universes other than our own.

Is there a problem here? If fecundity conceded that every universe is, relative to some suitably tailored criterion of specialness, a member of a special set, and hence is characterized by improbabilities as astronomical as those that characterize this one, then it would saw through the branch on which it sits. But although universes differently-tuned from our own are not all exactly alike, and so are life-denying in countlessly many and varied ways, it does not follow that each of these other universes is, relative to any plausible criterion of specialness, a member of a special set. The specialness of the set of life-permitting universes can differ in kind from other, arbitrary sets even if it is argued, against the theist, that there is nothing special about life itself.

Consider again the firing-squad, each of whose twelve markspersons fires twelve live rounds at a small target fixed over my heart. One possible outcome is that 34 bullets hit the target, 53 enter surrounding areas of my ribcage, 22 hit my abdominal region and groin, 21 penetrate my arms, legs, and head and the remaining 14 miss altogether. In another outcome, the figures are respectively 43, 62, 29, 7, and 3. These two outcomes are quite distinct, and yet neither is special or surprising. But some outcomes are special: the one in which all bullets enter the upper left chamber of my heart, the one in which all enter the lower right chamber, and the one in which all miss altogether are good examples. Perhaps the fairest comparison to the universe that we inhabit would be an outcome in which, although sustaining a few flesh-wounds, I nevertheless survive. If I have no reason to believe that my life is of any value to the markspersons or anyone who has influence over them, and so can discount a teleological account of my survival, still this does nothing to diminish the specialness of the outcome, for something immensely improbable has occurred, namely, that none of the bullets hit their intended target or the immediately surrounding region, and that the rest of them were sufficiently wayward either to miss me altogether or to do me no serious and lasting harm. By analogy, fecundity will not be deprived of its springboard merely because we cannot ground the teleological claim that there is something special about life.

The refurbished argument from design that appeals to cosmological improbabilities is modelled on the pre-Darwinian argument, now fossilized in the apologetic literature, that appealed to biological adaptation. But the fine-tuning of the universe cannot simply be substituted for biological adaptation in an otherwise unaltered argument, because no amount of improbability by itself generates teleology.[39] By the same token, the cosmological improbabilities will not go away just because we do not appeal to God to dispel them. Even if Paley's watch has no discernible function, but is merely an intricate and nicely contrived executive toy, it is still a most unusual object compared to a stone.

From a physical point of view, the most obvious distinction between the watch and the stone is that the former has a very low entropy when compared

to the latter. The visible universe as a whole is also low in entropy. Of course, the universe will probably end up having a very high entropy, and might be in such a state for indefinitely longer than it was in a state of lower entropy. But that does not alter the fact that it could always have had a much higher entropy than it now does, or than it had at earlier points in its history. Penrose calculates the improbability of the initial configuration of the universe as one in $10^{10^{123}}$, and remarks that he 'cannot recall anything else in physics whose accuracy is known to approach, even remotely, a figure like . . . [this]'.[40] The inflationary hypothesis disposes of the need for a large region of low entropy in the early stages of the Big Bang by proposing that the whole of the visible universe is inflated out of a tiny region which just happened to be in a low entropy state. Even if all the difficulties surrounding the inflationary hypothesis can be satisfactorily solved, and even if the force-strengths, particle masses and other physical constants can all be tied together in a Very Grand Unified Theory, the existence of an initial state of low entropy will still be puzzling. But if we suppose that this is a low entropy region within a much larger state that is characterized nearly everywhere else by high entropy then this puzzlement will disappear. But that will just be because we have endorsed a form of fecundity, here in relation to initial conditions. The inflationary hypothesis itself pushes in this direction, for the inflating universe of contemporary cosmological models is typically a domain within a larger space.[41] Alan Guth, the pioneer of inflation, described the universe as the only example of a 'free lunch' in physics;[42] subsequent developments of the theory have led Andreas Linde to remark that 'the inflationary universe is the only free lunch at which all possible dishes are available'.[43]

VI

Fecundity is not much of an explanation, whatever form it takes. In particular, it is not a causal explanation. It does not tell us much about why our universe has the character it does to be told that there are lots of other universes with quite different characters elsewhere. The appeal to fecundity, like the appeal to God's direct creative act, assumes that causal explanations terminate in facts that admit of no such explanation. Paley, in the remarks about the inverse square law quoted above, insists that the providential character of the law proves 'choice and regulation: choice, out of boundless variety; and regulation of that which, by its own nature, was in respect of the property regulated, indifferent and indefinite'. Fecundity opts for boundless variety instead of choice, postulating an ensemble of universes in which indifferent and indefinite nature throws up the occasional appearance of regulation. But just as the appeal to divine choice sometimes served to close off avenues of scientific enquiry, so an over-hasty resort to fecundity might seem likely to discourage the attempt to come up with more conventional explanations of

what now appear to be fundamental facts about the universe that we inhabit.[44] There must, then, be something provisional in any endorsement of the hypothesis of cosmological fecundity as an explanation of the fine-tuning of the universe. Taking its cue from the present state of our knowledge, it is a hostage to theoretical and experimental advances that may alter the state of that knowledge.

Precisely because it is provisional the hypothesis of cosmological fecundity is also philosophically unsatisfying. Answering the question, 'Why does this possibility obtain rather than some other?' by saying that lots of other possibilities also obtain merely shifts our attention away from the local and towards the global level. Why do lots of possibilities obtain? The most fundamental facts about the whole ensemble of universes remain obstinately brutish. If we want to eliminate these brute facts then we need a different and deeper kind of explanation, one that mimics at the global level the kind of explanatory completeness that the evidence of fine-tuning denies us locally.

What might such an explanation be like? Global necessitarianism faces the objection, discussed above, that the Null Possibility appears to be a genuine possibility. Global theological necessitarianism, in which God exists necessarily and then realizes whichever local possibilities there is good reason to realize, fares little better unless the ontological argument can be made to work. No-coincidence views, unless they offer explanations that trace back to something necessary, are unlikely to satisfy the demand for explanatory completeness either. Any non-arbitrary selection between global possibilities must involve some selective principle, and we will then want to ask why this principle operates rather than some other.[45]

Given the plausibility of the appeal to fecundity in explaining the obtaining of this local possibility, it is tempting to press it to the limit. If the Maximal Possibility obtains, then there is no arbitrariness within reality as a whole. Suppose existence were the default state of reality, rather than non-existence; then everything that could exist would exist, including a universe like ours. But this reverse inegalitarianism lacks justification in just the same way as its more traditional enantiomorph. Why should reality have a default state? The Maximal Possibility is a very special possibility. Of all the global possibilities, it can hardly be coincidence that this is the one that obtains.[46] The reasoning that works in favour of a moderate and cosmologically inspired fecundity works against an immoderate and logically exhaustive fecundity; the obtaining of all logical possibilities is at least as special as the obtaining of just this finely-tuned one.

Having disposed of the appearance of fine-tuning locally, need we worry about explanations at the global level? Recall the short and uninteresting story: things had to be some way or other; this is how they are. At the local level this is unsatisfactory because there appears to be something very special about the way things are; a universe like ours is highly improbable,

suggesting either selection or fecundity. If we opt for the latter, then the tunefulness of our universe is swamped by the background noise of many, varied universes. Is multiplicity and variety a surprising way for things to be? Logic ensures that some global possibility obtain. In the absence of any non-arbitrary selection the global possibility that does obtain is likely to be messy and complicated, inhabiting the vast spectrum between the highly specialized global possibilities that are Maximal or Null. We know that the Null Possibility does not obtain, but the fact that it is a possibility deprives us of our best opportunity for claiming that the Maximal Possibility obtains instead. Because there could have been nothing we have little reason to believe that there is everything. Instead, there is just something. How much something? Enough to reduce the probability of a universe like ours to something more manageable than one in $10^{10^{123}}$.

NOTES

1 For comments on earlier versions of this paper, I am indebted to Wolfgang Mann, Derek Parfit, and audiences at the CUNY Graduate Center and Yale. Work on this paper was funded, in part, by the PSC-CUNY Research Foundation.

2 Nozick (1981), pp. 121 ff.

3 Lewis (1986).

4 Parfit (1992).

5 Parfit (1992).

6 Lewis (1986), pp. 73, 130.

7 There are other implausibilities that Lewis is willing to swallow. But unlike the claim that a world might consist of two or more disconnected spacetimes, which Lewis regards as 'negotiable' because 'it is no central part of our modal thinking, and not a consequence of any interesting general principle about what is possible' (1986, p. 71), the claim that there could have been nothing at all is among the most venerable of our modal intuitions. It would be odd to deny a central place in our modal thinking to this claim, and odd to assert that it is unconnected with any interesting general principles about what is possible.

8 Leibniz denies that God created the best possible world by necessity; God's choice is free and other worlds are possible even if God will not create them. It is a matter of dispute how successful this attempt to preserve contingency is: see, e.g., Blumenfeld (1973, 1975); Rescher (1979), pp. 23–53; Adams (1972, 1982).

9 Many contemporary philosophical theists deny coherence to the notion of a best possible world; see, e.g., Plantinga (1974), Morris (1984), Schlesinger (1988), Mann (1991). Plantinga defends a modal version of the ontological argument, and so might be regarded as holding the position outlined here.

10 Swinburne (1979).

11 Major champions of contemporary axiarchy are Nicholas Rescher and John Leslie; see Rescher (1984), Leslie (1979, 1989).

12 Parfit (1992).

13 Parfit thinks that if all possible worlds existed, 'the evil of the worst worlds could hardly be outweighed'. But perhaps the good of the best worlds could hardly be outweighed either. If maximality itself has value, this might tip the balance in favour of a positive evaluation of the Maximal Possibility. See Parfit (1992).

14 Unger (1984). If our world was metaphysically perfect, we would have little reason to believe that infinitely many worlds exist. Unger thinks it obvious that our world is highly arbitrary and hence far from perfect. Denis Sciama has suggested to me that some versions of fecundity are capable of a kind of confirmation: if we discovered that the fundamental laws of this universe were inelegant, this would undermine the axiarchic claim that our

universe exists because its fundamental laws are most elegant, and hence deprive us of one reason for believing that ours is the only universe that exists.

15 Dawkins (1986), p. 6.

16 Hoyle (1982), pp. 2 ff.

17 Davies (1983b), p. 28.

18 Barrow & Silk (1980), pp. 127–8; Hoyle (1954), p. 121; Salpeter (1957), p. 516.

19 Davies (1984), p. 242.

20 Swinburne (1989), p. 165.

21 This is the hope of Heinz Pagels: 'Only two decades ago, the equations of particle physics included dozens of unexplained parameters. . . . Today, there are only about nineteen arbitrary constants in the physical laws that describe nature at the microscopic level'; see Pagels (1985), p. 37.

22 Davies (1984), pp. 137–8.

23 Barrow (1990), passim.

24 Leslie (1989), p. 31.

25 See, e.g., the analogy between creation and architecture in *Theodicy* s. 215 (Leibniz, 1956): 'one will justifiably prefer beauty of construction in a palace to the convenience of a few domestics.'

26 In his 1676 essay, 'On the secrets of the sublime, or on the supreme being', Leibniz states the 'principle of the harmony of things' as: 'that the greatest amount of essence that can exist, does exist'. The more essence a thing has, the more perfect it is. Because all possibilities cannot co-exist, 'it follows that those things exist which contain the most essence . . . Therefore there exists first of all the being which is the most perfect of all possibles' (Leibniz, 1992, p. 20). A similar argument appears in 'On the ultimate origination of things' (Leibniz [1989], p. 150).

27 Parfit (1992).

28 Misner, Thorne & Wheeler (1973), ch. 44. Wheeler no longer holds this theory. His later view involves the 'Participatory Anthropic Principle' which claims that, just as observation collapses the wave function describing all possible states in quantum mechanics, so the evolution of conscious observers was needed to collapse the wave function of the universe as a whole (Patton & Wheeler [1975], Wheeler [1977]). In response, Bell asks the pointed question: 'Was the world wave function waiting for millions of years until a single-celled creature appeared? Or did it have to wait a little longer for some more highly qualified measurer – with a Ph.D.?' (Bell [1981], p. 610).

29 Everett & De Witt, in De Witt & Graham (eds). (1973).

30 Markov (1985), pp. 3–7.

31 This is the complaint of Richard Swinburne, though the only version of fecundity that he considers at any length is Everett's 'many-worlds' interpretation of quantum mechanics; see Swinburne (1989), pp. 166–72.

32 William Paley, *Natural Theology,* pp. 390–1.

33 In the case of the alphabetized books, other arrangements suggest themselves; so do appropriate frequency models. What about the expansion rate of the universe? This too suggests other possibilities (faster or slower expansion rates) and a frequency model in which no rate is more likely than any other. Why is it surprising that the universe is expanding at some particular rate? It isn't. What is surprising is that the universe is expanding at that rate given that the initial conditions were as they were, the force strengths as they are, the particle masses as they are, and so on. If everything except the expansion rate is fixed, then an arrangement of books is no analogy: with one book it makes no sense to speak of arrangement. But in the absence of a Very Grand Unified Theory of Absolutely Everything it is difficult to reduce the contingent facts to just one.

34 Hart puts the chances of life developing even on an ideally habitable planet as only one in 10^{3000}; there are perhaps 10^{7} such planets in our galaxy, and 10^{11} galaxies inside our horizon. See Hart (1982).

35 If mass-extinctions are sometimes caused by asteroid impacts, this is one way that the earth is inhospitable. On earth-type planets set far from asteroid belts life is presumably much calmer than here.

36 Finely-tuned life-denying universes are necessarily unobserved. Unless one accords observation a special status, perhaps along the lines of Wheeler's 'Participatory Anthropic Principle' (see n. 28), this fact cannot be appealed to in order to establish a special status for life-permitting universes. Here, the knee-jerk response has some force: that an improbable event had to occur if you were to be around to observe it does not make the event any less improbable, but nor does it make it any more so.

37 The distinction between life-permitting and life-containing universes may be problematic. Consider a lifeless planet. If there is an explanation for the absence of life, the planet is not life-permitting. If there is no explanation, we are not in danger of double-counting by explaining the same thing twice. This argument can be run at the level of universes rather than planets. But it seems reasonable to call our account of the origin and development of life on earth an explanation even if it involves random occurrences. We are double-counting if we appeal to the specialness of a life-containing universe as something over and above the specialness of a merely life-permitting one. This difficulty was pointed out to me by Arthur Collins.

38 Leslie (1989), p. 118.

39 Teleology persists in biology because adaptations are functional: populations exhibiting variety and heredity develop beneficial characteristics because better-adapted organisms survive to reproduce at higher rates than worse-adapted, and then transmit these adaptations through inheritance. Functional explanations are permitted because adaptations accumulate over time. There is no heredity in cosmology, and hence no functional explanation.

40 Penrose (1981), p. 249. Penrose calculates the observed entropy per baryon (proton, neutron) as around 10^{8}. There are about 10^{80} baryons in the visible universe, giving a total entropy of 10^{88}. A universe of solar-size black holes would have an entropy per baryon of 10^{20}; one immense black hole would have an entropy per baryon of 10^{123}.

41 Gale (1989), p. 197.

42 Guth (1982).

43 Linde (1982). Linde's most recent statement of 'chaotic inflation', which involves the postulation of many universes, is Linde (1998).

44 Pagels (1985), p. 38.

45 For detailed discussion of these issues, see Parfit (1992, 1998).

46 Parfit (1992).

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