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THE ANTHROPIC PRINCIPLE

I

In the last few decades a large number of tantalizingly rare coincidences, vital for the existence of a minimally stable universe, have been discovered. One example of an astonishingly felicitous concurrence: there is a marvelously delicate balance—as Paul Davies explains in *Superforce* in one of his masterful expositions of the latest achievements in physics and cosmology—between the forces of gravity and those of electromagnetism inside all stars. It has been shown, Davies writes, that changes in the strength of either force by only one part of ten followed by forty zeros (!) would spell catastrophe for every star including our own sun, and the universe could not sustain any planets fit to live in. Another fascinating fortuity has been discussed by Brandon Carter and concerns the ratio between the product of the speed of light and the size of the quanta, and the square of the charge of the electron. He denotes that ratio by R_1 and shows it to be equal to 137. Carter argues that if R_1 were just slightly more than 137 then all stars would be blue giants and there could exist no planets anywhere in the universe, let alone living creatures. If on the other hand R_1 were a little smaller, all stars would be red dwarfs and the planets orbiting them far too cold to sustain any kind of organism.

Many have interpreted these startlingly fortunate facts as indication of the existence of a very powerful being with a special interest in the emergence and survival of human-like creatures. Some writers have recently explicitly stated that nature seems to them far too harmonized for it to be just a heedless hap, and thus have tended to agree with Fred Hoyle that the “universe is a put-up job.”

The argument from the profusion of well-fitted congruent conditions to the claim that they are the manifestations of an underlying purposeful fine-tuning is fairly impressive. It has also caused a certain amount of astonishment. After all, in the last few

centuries it has become an almost established rule that every major step in the progress of science creates a new source of embarrassment to the believer. The Copernican revolution that displaced Man from the center of the universe; Laplace's work on astronomy which, he claimed, showed that the planetary system is self-sustaining and can function perfectly well without any Divine assistance; and the Darwinian naturalistic account of the emergence of complex life forms and later the naturalistic account of stellar and planetary evolution, were the major landmarks along the road leading to the adoption by more and more people of a secular view of reality. It seemed that at each stage of this development the theist was forced either to withdraw some of his claims or to continue to cling to them only at the cost of retreating into obscurantism. It is understandable that some should be taken aback at witnessing what looks like a turnabout by contemporary cosmology, which instead of producing yet another problem, seems to provide support for religious belief. Thus we are presented, for a change, with a scientific result that puts the atheist on the defensive.

Naturally the recent advances in astrophysics have not proven an insurmountable obstacle to those who are resolute in their opposition to the idea of a Divine being. No sooner had the theistic inferences become known than a variety of arguments, devised to show that the evidence fails to support a belief in a purposefully created universe, were put forward. One of these arguments stands out as being far more popular than any other and I propose to devote most of this discussion to it.

II

The most widely voiced objection to the theistic inference from contemporary cosmology is that the believer overlooks the fact that exceedingly improbable events happen all the time and no special significance is to be assigned to them. For example, I have just pulled a \$1 note from my wallet and observe its serial number to be G65538608D. The prior probability of the note I was looking at having this serial number was less than one in ten billion. Thus, undeniably, I am faced here with an extremely rare occurrence. But is it also the case that I am confronted with a genuinely astonishing event, an event so baffling that it calls for an investigation into the question of what extraordinary circumstances could have given rise to this event? Surely the answer is no. It was after all quite certain all the time that should I pick a banknote, it will have some serial number printed on it, and whatever it will be, it will be an equally

improbable number. It was thus certain from the very beginning that I was going to come across a very unlikely situation, which therefore implies nothing of significance.

The secularists have claimed that the existence of the incredibly improbable coincidences discovered by present-day scientists is in the same category as the observation of a rare serial number. The far-reaching inferences theists have been trying to make from these discoveries are therefore entirely unwarranted. Just as in the case of my banknote, so in the scientific context, before ascertaining the actual value of the ratio between the electromagnetic and the gravitational forces, and indeed even before a physical universe came into being, it was certain that the ratio must have some value, and furthermore, whatever that value would turn out to be, it would have an exceedingly low prior probability. Thus, given that the ratio in question is bound to have some highly improbable value, there is no justification for trying to attach any significance to the fact that it turns out to have this or that particular value.

A science writer, Michael Lemonick, is one of many who makes essentially this point. In a short article he discusses what has become known as the anthropic principle, which asserts that all the constants of nature are precisely the way they are required to be to ensure conditions necessary to sustain human life. The inference from the existence of those favorable conditions that someone is likely to have planned and willed “isn’t all that compelling” according to Lemonick. He writes:

We can always, after the fact, find examples of highly improbable events that happened anyway. If you close your eyes and throw a dart, for instance, it will stick *somewhere* in the wall. Before the throw, chances were overwhelmingly against hitting that particular point. You hit it anyway, but so what? (*Science Digest*, Aug. 1986)

In a widely discussed, lively and lucid essay appearing in the *New Scientist* (2 June, 1983), Ralph Estling expresses similar sentiments. He charges that the believer’s reasoning is based on the discredited practice of using the concepts of probability on an *a posteriori* basis. It is silly, he claims, to get excited over the discovery that the universe is precisely the way it is when it is inevitable that the universe should be the way it is. He reminds his readers that

every human being (and everything else) has truly enormous odds against his being precisely he, and nobody else, but once he *is* he and nobody else, the matter rests and no seeking retrospectively over fantastic odds is called for.

Estling uses several examples to deride the habit of “reason[ing] backward, from presumed effect to ostensible cause.” He also cites

the famous scientist Jacques Monod who in his influential *Chance and Necessity* has said:

Among all the events possible in the Universe the *a priori* probability of any particular one of them occurring is next to zero. Yet the Universe exists; particular events must occur in it, the probability of which (before the event) was infinitesimal. . . . Destiny is written as and while, not before, it happens.

It is worth mentioning that John Updike has devoted a considerable amount of the narrative in his *Roger's Version* to a description of the discussions among the characters of the various recent results in cosmology which seem to support the theistic hypothesis. In the course of these arguments the point that it is a very common feature of reality to bring forth exceedingly improbable phenomena which call for no explanation, is made once by a theologian and once by a biologist. In both cases they happen to use essentially the same illustration as Estling, namely, that the rare combination of genes of any given individual is of very low prior probability and yet provides no grounds for astonishment or speculation.

It should be pointed out that while Updike is a very gifted writer, he is not a professional philosopher. He presents his arguments rather sketchily, and many of the points made by the principal characters may not withstand logical scrutiny, at least not in the form they are presented in the book. But he is very skillful in painting an authentic picture of the way highly intelligent people, who have not been trained in formal philosophical analysis, talk about issues that are of great concern to them. Updike is known to be a meticulous observer and an accurate reporter of contemporary middle-class American life. One of the merits of his book is that it contains a powerful, realistic rendering of the mental struggle thinking people undergo in trying to acquire, come to terms with, and defend beliefs about religion. I believe his narrative properly reflects the fact that even among academicians the majority fail to exert sufficiently their mental resources to think through the arguments required to support their religious attitudes.

What is essential to a conceptual clarification of the issue before us is the ability to make the crucial distinction between improbable events that are genuinely surprising and those which are not. This distinction hinges on the difference between two types of rare events. Sometimes we observe an event which may be a rare instance of a certain kind of event but not of a rare kind of event. In that case we are not confronted with a truly surprising observation and need not search for a hypothesis to explain it. However when we observe an instance of rare *kind* of event we are justified in regarding our observation as being surprising and rationality requires us to look for

some plausible, explanatory hypothesis on the adoption of which we shall no longer be confronted with an astonishing situation. As long as no such hypothesis is forthcoming it is rational to view the situation as puzzling. Let me illustrate this point with some concrete examples.

III

Suppose we placed an electric typewriter in the cage of our pet woodpecker. I do not think we should find it extraordinary if the bird, for lack of anything better to do, kept pecking at the various keys. But we should certainly be dumbstruck if as a result of its continued tapping of the keys it correctly reproduced the poem "The Owl and the Pussycat." No one would be willing to entertain the hypothesis that the woodpecker had intentionally printed Lear's poem. Birds are of relatively low intelligence among animals and even among humans there are only a few who know the whole poem by heart. At the same time, however, we would want to resist the suggestion that we are confronted with an unbelievably improbable phenomenon; and that what we see is simply the almost impossibly unlikely result of a purely random process. No, we should prefer any other hypothesis that was not utterly absurd, for instance that someone has been playing a very clever trick on us by remote control.

But of course, if the probability that random pecking at the keys of a typewriter should produce a sequence of symbols which amount to "The Owl and the Pussycat" is one in many trillions, so is also the probability of any completely jumbled sequence of as many symbols. And of course it would stir no emotions in any of us if we were to observe that our woodpecker had filled a whole page with a meaningless succession of signs. Given that the page is going to be filled up, it is certain right from the beginning that it will display this or that exceedingly improbable configuration. Why then does the observation of the poem produce such a shock?

The answer seems to be that while the production of some sequence is definitely to be expected, the production of a special and significant kind of a sequence is not. In the story of our bird we are faced not with just any sequence; we are confronted by one that is but a tiny subset of the set of long succession of symbols that constitutes a set of interconnected, meaningful sentences. The surprise is to find the page to be filled with a special *kind* of sequence, a kind that had very small prior probability to be materialized.

It might of course be pointed out that the members of any finite set of symbols will inevitably have something in common and in

consequence of which they are unique in some sense. What is however relevant for our purposes is the significant interconnectedness by virtue of which the members may be said to form a natural kind because all of them are associated with the same causes or subject to the same regularities, or share some unique physical properties. Meaningful texts such as poems may certainly be said to belong to a significant natural kind. Such texts are regularly produced by people eager to communicate with others; they are often printed in large quantities; copies of them are kept in libraries and bookshops. Thus the woodpecker's efforts resulted not just in an instance of a printed page, but of a page filled with especially significant print, the kind of which constitutes a very small fraction among all the possible printed pages. Its appearance, therefore, cries out for an explanation that would show it not belonging to a rare sort of event. As long as it is not forthcoming we shall be tantalized by the text we are observing.

IV

For further illustration we may return briefly to our example concerning the \$1 note I have pulled out of my wallet, where my observing it to display an exceedingly improbable serial number causes absolutely no surprise. Imagine however that the next thing I do is to phone a friend who lives hundreds of miles away and ask him to try and guess the serial number of the note I have just looked at. Suppose my friend mentions without hesitation G65538608D, which is precisely the number appearing on the banknote. Unquestionably we would find my friend's achievement quite awe-inspiring and begin to wonder what kind of paranormal powers he may possess. The reason, of course, would be that our friend could have mentioned any one of over ten billion legitimate serial numbers; his mentioning the particular number at which I happen to be looking at seems too improbable for us not to regard it as an extraordinary and astounding event.

Suppose, however, someone asks: what basis is there for astonishment? After all, no matter how small the prior probability of my friend mentioning the "correct" serial number, precisely as small was the prior probability of that number actually appearing on my bill in the first place. Why is it then that given two events of identically low probability, one is regarded as a routine event and the other as an occasion for amazement?

In the light of what we have said earlier there seems to be no real problem. In the first situation the event of my bill having the

particular number we observe it to have was of course a highly improbable event; nevertheless it did not constitute a surprise since it was an instance of the kind of event that was bound to take place. Every banknote has some serial number consisting of two letters and eight digits and one of these combinations of ten characters is bound to be printed on the bill in front of us. On the other hand, my friend, in naming the number he did name, did something of a very rare kind: he named the number identical with the one in front of me. This kind of occurrence was of course not bound to take place; in fact the prior probability of this kind of occurrence taking place is less than one in ten billion. I should point out that we are entitled to view the set of event-pairs in which a printed number and the number uttered by someone are identical, as forming a naturally connected class. There is very often a causal connection between such pairs; for example, frequently a number appearing in print is the cause of someone (who sees it) mentioning it.

V

Now it should not be hard to see the central error of Lemonick, Estling, and Monod as well as others who have charged that the use of the anthropic principle for the purposes of the theist is based on a misunderstanding of the nature of probability. What these writers have overlooked is the vital distinction to be made between improbable events that are genuinely surprising and those which are not. These critics are of course right in saying that given any possible universe with the same sort of physics as ours, it inevitably will exemplify one of the indefinitely many and exceedingly rare combinations of physical magnitudes. And indeed if we were confronted with nothing more than a universe containing one of the many equally rare combinations, we would have nothing to be astounded about and puzzled about. In fact however the actual universe exhibits something much more; it exhibits also a very rare *kind* of combination. Our universe is a member of that tiny subset of universes where all the conditions that are indispensable for sustaining life are present. As we have pointed out earlier, the prior probability of concurrence of the combination with the large number of the precise conditions we require is exceedingly small. Thus seeing that in fact they do obtain is genuinely surprising. The theist's enterprise is therefore a legitimate one. He is trying to advance a hypothesis that will explain why a felicitous combination of factors—whose coincidence would otherwise be inexplicable—was destined to come about.

Of course we cannot conclude that upon exposing the error in one of the objections—even if it is the major objection—to the

theist's argument based on the anthropic principle one has shown the complete validity of that argument. There are other objections that might be raised. Indeed it is hard to imagine that it should ever be possible to advance a conclusive proof for theism so that no reasonable person, regardless how intent he may be on resisting it, will be able to do so. The main point of this discussion is to draw attention to a phenomenon that, it might be said, was required by Divine fairness; over an extended period science has kept providing results that the adversaries of religion have been able to use as their ammunition. The anthropic principle seems to redress the imbalance, since for a change it offers at least a *prima facie* argument supporting the theist.