

CHAPTER 11

BRAVE NEW WORLDS

It was the best of times. It was the worst of times.

—CHARLES DICKENS

The central problem with the notion of creation is that it appears to require some externality, something outside of the system itself, to *preexist*, in order to create the conditions necessary for the system to come into being. This is usually where the notion of God—some external agency existing separate from space, time, and indeed from physical reality itself—comes in, because the buck seems to be required to stop somewhere. But in this sense *God* seems to me to be a rather facile semantic solution to the deep question of creation. I think this is best explained within the context of a slightly different example: the origin of morality, which I first learned from my friend Steven Pinker.

Is morality external and absolute, or is it derived solely within the context of our biology and our environment, and thus can it be determined by science? During a debate on this subject organized at Arizona State University, Pinker pointed out the following conundrum.

If one argues, as many deeply religious individuals do, that without God there can be no ultimate right and wrong—namely that God determines for us what is right and wrong—one can then ask the questions: What if God decreed that rape and murder were morally acceptable? Would that make them so?

While some might answer yes, I think most believers would say no, God would not make such a decree. But why not? Presumably because God would have some reason for not making such a decree. Again, presumably this is because reason suggests that rape and murder are not morally acceptable. But if God would have to appeal to reason, then why not eliminate the middleman entirely?

We may wish to apply similar reasoning to the creation of our universe. All of the examples I have provided thus far indeed involve creation of something from what one should be tempted to consider as nothing, but the *rules* for that creation, i.e., the laws of physics, were preordained. Where do the rules come from?

There are two possibilities. Either God, or some divine being who is not bound by the rules, who lives outside of them, determines them—either by whim or with malice aforethought—or they arise by some less supernatural mechanism.

The problem with God determining the rules is that you can at least ask what, or who, determined God's rules. Traditionally the response to this is to say that God is, among the Creator's many other spectacular attributes, the *cause of all causes*, in the language of the Roman Catholic Church, or the *First Cause* (as per Aquinas), or in the language of Aristotle, moving the *prime mover*.

Interestingly, Aristotle recognized the problem of a first cause, and decided that for this reason the universe must be eternal. Moreover, God himself, whom he identified as pure self-absorbed thought, the love of which motivated the prime mover to move, had to be eternal, not causing motion by creating it, but rather by establishing the end purpose of motion, which itself Aristotle deemed had to be eternal.

Aristotle felt that equating First Cause with God was less than satisfying, in fact that the Platonic notion of First Cause was flawed, specifically because Aristotle felt every cause must have a precursor—hence, the requirement that the universe be eternal. Alternatively, if one takes the view of God as the cause of all causes, and therefore eternal even if our universe is not, the *reductio ad absurdum* sequence of “why” questions does indeed terminate, but as I have stressed, only at the expense of

introducing a remarkable all-powerful entity for which there is simply no other evidence.

In this regard, there is another important point to stress here. The apparent logical necessity of First Cause is a real issue for any universe that has a beginning. Therefore, on the basis of logic alone one cannot rule out such a deistic view of nature. But even in this case it is vital to realize that this deity bears no logical connection to the personal deities of the world's great religions, in spite of the fact that it is often used to justify them. A deist who is compelled to search for some overarching intelligence to establish order in nature will not, in general, be driven to the personal God of the scriptures by the same logic.

These issues have been debated and discussed for millennia, by brilliant and not-so-brilliant minds, many of the latter making their current living by debating them. We can return to these issues now because we are simply better informed by our knowledge of the nature of physical reality. Neither Aristotle nor Aquinas knew about the existence of our galaxy, much less the Big Bang or quantum mechanics. Hence the issues they and later medieval philosophers grappled with must be interpreted and understood in the light of new knowledge.

Consider, in the light of our modern picture of cosmology, for example, Aristotle's suggestion that there are no First Causes, or rather that causes indeed go backward (and forward) infinitely far in all directions. There is no beginning, no creation, no end.

When I have thus far described how something almost always can come from "nothing," I have focused on either the creation of something from preexisting empty space or the creation of empty space from no space at all. Both initial conditions work for me when I think of the "absence of being" and therefore are possible candidates for nothingness. I have not addressed directly, however, the issues of what might have existed, if anything, before such creation, what laws governed the creation, or, put more generally, I have not discussed what some may view as the question of First Cause. A simple answer is of course that either empty space or the more fundamental nothingness from which empty space may have arisen, preexisted, and is eternal. However, to be fair, this does beg the possible question, which might of

course not be answerable, of what, if anything, fixed the rules that governed such creation.

One thing is certain, however. The metaphysical “rule,” which is held as an ironclad conviction by those with whom I have debated the issue of creation, namely that “*out of nothing nothing comes*,” has no foundation in science. Arguing that it is self-evident, unwavering, and unassailable is like arguing, as Darwin falsely did, when he made the suggestion that the origin of life was beyond the domain of science by building an analogy with the incorrect claim that matter cannot be created or destroyed. All it represents is an unwillingness to recognize the simple fact that nature may be cleverer than philosophers or theologians.

Moreover, those who argue that out of nothing nothing comes seem perfectly content with the quixotic notion that somehow God can get around this. But once again, if one requires that the notion of true nothingness requires not even the *potential* for existence, then surely God cannot work his wonders, because if he does cause existence from nonexistence, there must have been the potential for existence. To simply argue that God can do what nature cannot is to argue that *supernatural* potential for existence is somehow different from regular natural potential for existence. But this seems an arbitrary semantic distinction designed by those who have decided in advance (as theologians are wont to do) that the supernatural (i.e., God) must exist so they define their philosophical ideas (once again completely divorced from any empirical basis) to exclude anything but the possibility of a god.

In any case, to posit a god who could resolve this conundrum, as I have emphasized numerous times thus far, often is claimed to require that God exists outside the universe and is either timeless or eternal.

Our modern understanding of the universe provides another plausible and, I would argue, far more physical solution to this problem, however, which has some of the same features of an external creator—and moreover is logically more consistent.

I refer here to the multiverse. The possibility that our universe is one of a large, even possibly infinite set of distinct and causally separated universes, in each of which any number of fundamental

aspects of physical reality may be different, opens up a vast new possibility for understanding our existence.

As I have mentioned, one of the more distasteful but potentially true implications of these pictures is that physics, at some fundamental level, is merely an environmental science. (I find this distasteful because I was brought up on the idea that the goal of science was to explain why the universe had to be the way it is and how that came to be. If instead the laws of physics as we know them are merely accidents correlated to our existence, then that fundamental goal was misplaced. However, I will get over my prejudice if the idea turns out to be true.) In this case, the fundamental forces and constants of nature in this picture are no more fundamental than the Earth-Sun distance. We find ourselves living on Earth rather than Mars not because there is something profound and fundamental about the Earth-Sun distance, but rather simply if Earth were located at a different distance, then life as we know it could not have evolved on our planet.

These anthropic arguments are notoriously slippery, and it is almost impossible to make specific predictions based on them without knowing explicitly both the probability distribution among all possible universes of the various fundamental constants and forces—namely, which may vary and which don't, and what possible values and forms they may take—and also exactly how “typical” we are in our universe. If we are not “typical” life forms, then anthropic selection, if it occurs at all, may be based on different factors from those we would otherwise attribute it to.

Nevertheless, a multiverse, either in the form of a landscape of universes existing in a host of extra dimensions, or in the form of a possibly infinitely replicating set of universes in a three-dimensional space as in the case of eternal inflation, changes the playing field when we think about the creation of our own universe and the conditions that may be required for that to happen.

In the first place, the question of what determined the laws of nature that allowed our universe to form and evolve now becomes less significant. If the laws of nature are themselves stochastic and random, then there is no prescribed “cause” for our universe. Under the general principle that anything that is not forbidden is

allowed, then we would be guaranteed, in such a picture, that some universe would arise with the laws that we have discovered. No mechanism and no entity is required to fix the laws of nature to be what they are. They could be almost anything. Since we don't currently have a fundamental theory that explains the detailed character of the landscape of a multiverse, we cannot say. (Although to be fair, to make any scientific progress in calculating possibilities, we generally assume that certain properties, like quantum mechanics, permeate all possibilities. I have no idea if this notion can be usefully dispensed with, or at least I don't know of any productive work in this regard.)

In fact, there may be no fundamental theory at all. Although I became a physicist because I hoped that there was such a theory, and because I hoped that I might one day help contribute to discovering it, this hope may be misplaced, as I have already lamented. I take solace in the statement by Richard Feynman, which I summarized briefly before, but want to present in its entirety here:

People say to me, "Are you looking for the ultimate laws of physics?" No, I'm not. I'm just looking to find out more about the world, and if it turns out there is a simple ultimate law that explains everything, so be it. That would be very nice to discover. If it turns out it's like an onion with millions of layers, and we're sick and tired of looking at layers, then that's the way it is . . . My interest in science is to simply find out more about the world, and the more I find out, the better it is. I like to find out.

One can carry the argument further and in a different direction, which also has implications for the arguments at the core of this book. In a multiverse of any of the types that have been discussed, there could be an infinite number of regions, potentially infinitely big or infinitesimally small, in which there is simply "nothing," and there could be regions where there is "something." In this case, the response to why there is something rather than nothing

becomes almost trite: there is something simply because if there were nothing, we wouldn't find ourselves living there!

I recognize the frustration inherent in such a trivial response to what has seemed such a profound question throughout the ages. But science has told us that anything profound or trivial can be dramatically different from what we might suppose at first glance.

The universe is far stranger and far richer—more wondrously strange—than our meager human imaginations can anticipate. Modern cosmology has driven us to consider ideas that could not even have been formulated a century ago. The great discoveries of the twentieth and twenty-first centuries have not only changed the world in which we operate, they have revolutionized our understanding of the world—or worlds—that exist, or may exist, just under our noses: the reality that lies hidden until we are brave enough to search for it.

This is why philosophy and theology are ultimately incapable of addressing by themselves the truly fundamental questions that perplex us about our existence. Until we open our eyes and let nature call the shots, we are bound to wallow in myopia.

Why is there something rather than nothing? Ultimately, this question may be no more significant or profound than asking why some flowers are red and some are blue. “Something” may always come from nothing. It may be required, independent of the underlying nature of reality. Or perhaps “something” may not be very special or even very common in the multiverse. Either way, what is really useful is not pondering this question, but rather participating in the exciting voyage of discovery that may reveal specifically how the universe in which we live evolved and is evolving and the processes that ultimately operationally govern our existence. That is why we have science. We may supplement this understanding with reflection and call that philosophy. But only via continuing to probe every nook and cranny of the universe that is accessible to us will we truly build a useful appreciation of our own place in the cosmos.

Before concluding, I want to raise one more aspect of this question that I haven't touched upon, but which strikes me as

worth ending with. Implicit in the question of why there is something rather than nothing is the solipsistic expectation that “something” will persist—that somehow the universe has “progressed” to the point of our existence, as if we were the pinnacle of creation. Far more likely, based on everything we know about the universe, is the possibility that the future, perhaps the infinite future, is one in which nothingness will once again reign.

If we live in a universe whose energy is dominated by the energy of nothing, as I have described, the future is indeed bleak. The heavens will become cold and dark and empty. But the situation is actually worse. A universe dominated by the energy of empty space is the worst of all universes for the future of life. Any civilization is guaranteed to ultimately disappear in such a universe, starved of energy to survive. After an unfathomably long time, some quantum fluctuation or some thermal agitation may produce a local region where once again life can evolve and thrive. But that too will be ephemeral. The future will be dominated by a universe with nothing in it to appreciate its vast mystery.

Alternatively, if the matter that makes us up was created at the beginning of time by some quantum processes, as I have described, we are virtually guaranteed that it, too, will disappear once again. Physics is a two-way street, and beginnings and endings are linked. Far, far into the future, protons and neutrons will decay, matter will disappear, and the universe will approach a state of maximum simplicity and symmetry.

Mathematically beautiful perhaps, but devoid of substance. As Heraclitus of Ephesus wrote in a slightly different context, “Homer was wrong in saying: ‘Would that strife might perish from among gods and men!’ He did not see that he was praying for the destruction of the universe; for if his prayers were heard, all things would pass away.” Or, as Christopher Hitchens has restated it, “Nirvana *is* nothingness.”

A more extreme version of this eventual retreat into nothingness may be inevitable. Some string theorists have argued, on the basis of complex mathematics, that a universe like ours, with a positive energy in empty space, *cannot* be stable.

Eventually, it must decay to a state in which the energy associated with space will be negative. Our universe will then recollapse inward to a point, returning to the quantum haze from which our own existence may have begun. If these arguments are correct, our universe will then disappear as abruptly as it probably began.

In this case, the answer to the question, "Why is there something rather than nothing?" will then simply be: "There won't be for long."