The Fire Each Time: Dark Energy and the Breath of Creation

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Cosmology, Ecology, and the Energy of God
CHAPTER 2

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Dark Energy and the Breath of Creation

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In the Beginning

The hot big bang hypothesis can be traced back to 1929, when Edwin Hubble discovered that the universe is expanding. While Hubble observed this phenomenon directly, the possibility of an expanding universe had already been opened by Einstein's theory of general relativity, which he completed in 1915. According to general relativity, space and time are neither independent nor static substances; rather, they compose a dynamic "space-time" that can grow, shrink, bend, and warp in relation to matter and energy. Prior to Hubble's observational confirmation, then, Einstein's own theory suggested that the universe might either be expanding or contracting—that space-time itself could either be racing outward or retreating inward.

His own calculations notwithstanding, this possibility was notoriously difficult for Einstein to abide. He believed—partially out of adherence to the law of conservation of mass-energy and partially out of what one might call an ontotheological yearning—that the universe must be static. Something must be regulating the elasticity of space-time, or else gravity left to its own devices would cause the universe to collapse. Einstein therefore posited a counter-balancing negative pressure (Lambda), which he called the "cosmological constant," to offer an equal and opposite push to gravity's pull. With gravity and lambda in perfect proportion, Einstein was able— theoretically, at least—to keep the universe from stretching out or caving in.

Upon hearing the news of Hubble's discovery—that space-time was in fact expanding outward—Einstein immediately retracted his cosmological constant, calling it his "biggest blunder." In the meantime, the work of a young Belgian physicist and priest named Georges Lemaître was vindicated. Two years before Hubble's discovery, Lemaître had posited an expanding universe based on Einstein's equations, provoking Einstein to tell him, "your math is correct, but your physics is abominable." Encouraged by his colleagues' sudden interest in his work after 1929, Lemaître went on to suggest that if the universe is expanding now, then it must always have been expanding—from the beginning of things. The scientist-priest, soon to be made monsignor, went further: the whole universe, in all its multiplicity, must have exploded forth from one point, which he called the "Primeval Atom."

The story goes like this: one day—although words fail us here, as there were no days—14 billion years ago, this Primeval Atom of infinite density issued forth a searing white light (and lo, there was light). The light radiated from an ultra-hot, ultra-dense plasma and formed "vast quantities of energy in the form of a dense particle soup." This particle soup—a roiling, undifferentiated, dare one say tehomic gloop"—of quarks and gluons took 380,000 years to cool down sufficiently for matter to emerge. This cooling is attributable to a regime change that took place 75,000 years after the big bang, when the fires of radiation gave way to the gentler tug of gravity. Out of the plasma, gravity began to draw atoms and molecules to itself, coagulating galaxies, planets, and stars into being. Out and back: the universe flung into flaming infinity and then gradually attracted and assembled by the power of gravity. From Hubble's shocking discovery through the last few years of the twentieth century, this was the operative theory: the universe was born in a moment of insanely rapid and infernally hot expansion and was gradually given over to the demiurgic force of gravity, which has slowed down the expansion of the universe ever since—a benevolent cosmic girdle.

And then the whole thing came ungirdled. In 1998 two independent research teams each discovered that the universe's expansion is not slowing down; it is speeding up. Using type Ia supernovae to measure the brightness—and therefore the distance—of cosmic bodies, teams led by Saul Perlmutter and Brian Schmidt both found that faraway galaxies are
not only moving farther away; they are moving farther away faster than they used to.\textsuperscript{10} NASA's Wilkinson Microwave Anisotropy Probe (WMAP), launched in 2001 to gather light from the outer edge of the cosmic sphere, confirmed as much: the universe immediately after the big bang was 13.7 million light-years in radius. It is now 13.7 billion light-years in radius. At this rate the universe will double in size every 10 billion years.\textsuperscript{11}

So Einstein was not entirely wrong. There is a counter-gravitational force, but it does not exist in a happy homeostasis with gravity. Rather, it won its cosmic tug-of-war against gravity 9 billion years after the big bang, which is to say 5 billion years ago. Since then it has been pushing space-time itself outward with increasing velocity. Of course, as Dan Hooper of the Fermi National Accelerator Laboratory reminds us, it is strange that anything should be expanding the space of the universe itself, because "by definition, there is no space outside of the Universe for it to expand into."\textsuperscript{12} So something is pushing the world out into nothing at all. Shortly after its discovery in 1998, Michael Turner of the University of Chicago named this strange force "dark energy."\textsuperscript{13}

\textit{All Things Invisible}

Particularly for the apothetically inclined, "dark energy" is a captivating name, and indeed, like all the names for the "divine darkness" of Pseudo-Dionysius, this one doesn't quite name what it names.\textsuperscript{14} The "dark" of \textit{dark energy} means two rather simple things: cosmologists can't see it, and they don't understand it. Hooper claims it is "the biggest mystery in all of physics," and Turner has called it "the most profound problem in all of science."\textsuperscript{15} Like the depths of darkness perhaps more familiar to theologians, dark energy is unfathomable.

In addition to marking its inscrutability, calling this energy "dark" also connects it to the stubbornly elusive "dark matter" discovered in the mid-twentieth century. In the early 1950s a twenty-two-year-old graduate student named Vera Rubin realized that galaxies seem to be spinning too quickly to stay in orbit. They must, she suggested, be more massive than we think they are; there must be some invisible substance that weighs them down and prevents them from spinning into oblivion. A similar idea had been posited by the Swiss astronomer Fritz Zwicky in 1933, but Zwicky was notoriously crotchety; Rubin was young, and a woman, and the idea was odd. It was not until the 1970s that the mainstream scientific community realized that however odd, dark matter exists; moreover, it surrounds most galaxies in thick, invisible rings called \textit{halos}. But unlike ordinary halos, these do not shine. The "dark matter" composing them neither absorbs nor releases light, nor does it interact with electricity or magnetism. It is hoped that some particles of dark matter might eventually be generated by the Large Hadron Collider in Geneva, but for the moment, scientists have never seen, felt, or heard dark matter, nor do they know what it is. And yet, to draw upon an old scholastic distinction, they know \textit{that} it is.

As for dark energy, it has proven even more recalcitrant. Michael Turner has ventured the explanation that dark energy is kind of like dark matter, except "more energylike."\textsuperscript{16} The iniquity of this qualification seems deliberate; scientists simply do not know what the stuff is. In the words of David Schlegel of the Lawrence Berkeley National Laboratory, "the term doesn't mean anything. It might not be dark. It might not be energy. The whole name is a placeholder for the description that there's something funny that was discovered [twelve] years ago now that we don't understand."\textsuperscript{17}

As is evident from Schlegel's mild perverseness, "not understanding" dark energy is particularly troubling to physicists. This is primarily because, whatever it "is," dark energy seems to compose the majority of "is-ness" itself. According to NASA, of all the universe's mass-energy, approximately 70 percent is dark energy, about 25 percent is dark matter, and less than 5 percent is visible matter.\textsuperscript{18} That is to say that all we can see—tables, puppies, pencils, planets, and stars—everything that seems to \textit{be}, is on balance almost nothing.\textsuperscript{19} Lawrence Krauss of Case Western Reserve University has therefore called the discovery of dark energy "the ultimate Copernican Revolution." We will recall that Copernicus unsettled Christendom's fantasy that the earth was the center of the solar system. Subsequent centuries of astronomy have shown that our solar system is not the center of the galaxy, nor is our galaxy the center of the universe. Far from being the center of anything at all, Krauss says, "we're just a bit of pollution," nowhere in particular.\textsuperscript{20}

Now, any student of European history knows what a difficult time the Church has had with Copernican Revolutions—from Galileo to Darwin to Freud (who believed his Copernican Revolution to be the last and greatest). Dogma has been on the defensive since the birth of modern science. What is surprising, however, is the extent to which dark energy's Copernican Revolution has unsettled cosmologists themselves. There are a number of reasons for this, most of which amount to dark energy's multifarious obstruction of a Theory of Everything—that is, an account of the four
forces of the universe that would harmonize quantum theory with general relativity.\textsuperscript{21} Infamously, when quantum mechanics calculates the value of dark energy, it produces a number $10^{120}$ times larger than the amount of dark energy there actually seems to be (for comparison, there are only about $10^{86}$ atoms in the entire visible universe).\textsuperscript{22} This has been a massive embarrassment to the cosmological community. "It's been so hard," Perlmutter has confessed, "that we're even willing to consider listening to string theorists. They're at least providing a language in which you can talk about [quantum mechanics and general relativity] at the same time."\textsuperscript{23}

What is troubling about string theory is that it can end up positing anywhere between $10^{500}$ and $10^{1000}$ types of potential universes. "Listening to string theorists," in other words, opens the possibility that the universe is not one. It might well be a multiverse. As Mark Livio of the Space Telescope Science Institute (STSI) has admitted, the idea of "a zillion universes" "raises the blood pressure of many physicists seriously."\textsuperscript{24}

Dark energy's ability to provoke such anxiety is rooted, it seems, in the possibility that the incomprehensible part of the universe might not only dwarf but also ultimately swallow what is a comprehensible whole. At this point in space-time, dark energy constitutes a bit more than 70 percent of the universe. If the dominant hypothesis is correct, dark energy will cause the universe to stretch outward until, a few trillion years from now, "every individual galaxy, star, and planet will be ripped apart" or gradually dissolved and nothing but dark energy will remain.\textsuperscript{25} So the invisible might overrun the visible; darkness might, in fact, overcome the light that shines in it. Yet it is for this very reason that Michael Turner insists, "we can't understand the universe until we discover what dark energy is."\textsuperscript{26} Another familiar theologeme: we cannot understand it, but we have to understand it. And so it is that Lawrence Krauss told a group of physicists and astronomers at a recent meeting at STSI: "in spite of the fact that you are liable to spend the rest of your lives measuring stuff that won't tell us what we want to know, you should keep doing it."\textsuperscript{27}

**Energy and Unknowing**

When faced with the problem of knowing something that "won't tell us what we want to know," the Eastern Orthodox tradition has recourse to a term with which the Western tradition is largely unfamiliar: the energy of God. This line of thinking was most clearly set forth by Gregory Palamas in the thirteenth century and revived by Vladimir Lossky in the twentieth, but it can be found in the fourth-century Cappadocians as well: God is unknowable in essence (ousia), but knowable in energy (energeia).\textsuperscript{28} The divine energies are said to be the Pseudo-Dionysian prodoii—the emanations of God—or as he often puts it, "the ray" issuing forth from the divine darkness. The unknowable divinity makes itself known in the energies yet remains hidden in essence. The essence is dark, but the energy is light.\textsuperscript{29}

As Lossky explains it, this distinction between essence and energy emerged as a corollary to the doctrine of theosis, or deification. According to Orthodox teaching, the soul can participate through grace in the very life of God. Now, considering God's radical transcendence of creation, this teaching seems puzzling. How can the soul gain access to the life of a wholly inaccessible God? How can it take part in a God whose simplicity renders God indivisible into parts? As Lossky explains it, humans cannot, in fact, participate in the essence of God, for that would effectively divide God among the participants. Nor can humans participate in the persons of the Trinity (hypostaseis), for the hypostatic union belongs to the Son alone. And yet 2 Peter assures us that we shall become "partakers of the divine nature."\textsuperscript{30} Lossky concludes, "We are therefore compelled to recognize in God an ineffable distinction . . . between the essence of God, or His nature, properly so-called, which is inaccessible, unknowable, and incommunicable; and the energies or divine operations, forces proper to and inseparable from God's essence, in which He goes forth from Himself, manifests, communicates, and gives Himself."\textsuperscript{31} God therefore exists in two modes: en ousia (in essence), God is known only to Godself, while en energeia (as energy), God communicates Godself outside Godself.

At this juncture one might be tempted to map the distinction between essence and energy onto the distinction between the "immanent" Trinity (which expresses God eternally within the Godhead) and the "economic" Trinity (which expresses God temporally out to creation). But this would not be quite right: the energies are eternal and therefore independent of creation. And the energies must be eternal because, as Lossky maintains—although it is unclear how he knows—God would manifest Godself beyond Godself even if there were no creation.\textsuperscript{32} Yet here one might ask: what would "beyond Godself" mean if there were no creation? In an effort to circumvent this problem, Lossky has recourse to Palamas's rather hasty distinction between energies that are tied to time (creation, redemption, providence, etc.) and those that are eternal (wisdom, power, goodness, etc.).\textsuperscript{33} But this dichotomy risks compromising the unity of the energes and introducing an unorthodox shift from potentiality to actuality within
the Godhead, which from eternity is held to be fully actualized. In short, the energies occupy a rather fuzzy ontological position. Lossky claims this fuzziness for orthodoxy by dubbing it “antinomic”; just as Christ is both fully human and fully divine, the energies are both free from creation and bound up with it. On the one hand, Lossky explains, “they belong to theology [the immanent trinity], as eternal and inseparable forces of the Trinity existing independently of the creative act; on the other, they also belong to the domain of ‘economy,’ for it is in His energies that God manifests Himself to creatures.”

Leaving aside for a moment their categorical instability, the “energies” designate all the divine attributes: Wisdom, Life, Power, Justice, Love, Being, Goodness—all of the terms Pseudo-Dionysius enumerates in his treatise on the Divine Names—including, one imagines, “worm,” “drunk with a hangover,” and far more problematically, “essence” (I shall return to this momentarily). All of the names of God are energies—even “God,” according to Gregory of Nyssa, insofar as it names the faculty of governance. “We name Him from each of them,” Palamas says of the energeiai, “although it is clear that He transcends all of them.” And indeed, this is in keeping with Pseudo-Dionysius’s conviction that as Creator, God can and must be named by all creation, but that as Creator, God also exceeds creation. Having named God with every name, Dionysius therefore entreats us to unsay them, denying the names from the lowest (worm, drunk, rock) to the highest (Father, Son, Holy Spirit) until, unknowing, we “may see above being that darkness concealed from all the light among beings.”

For Dionysius, the divine names, or energies, both reveal God to creation and conceal God from it. This is the reason they must both be affirmed and denied. So in ascending past the “ray” of the names to the Darkness of God, do we thereby move beyond energy to essence? In this passage from the Mystical Theology at least, Dionysius seems to indicate as much; once we have denied the highest of revealed names, we will contemplate the concealed God. Yet Palamas and Lossky expressly deny this possibility, asserting that the deified soul in Dionysius finds its end not in the Darkness of God but rather in the uninterrupted light of energy. In short, Palamas and Lossky reverse the apophatic privilege of darkness, relegating it to a fleeting moment on the way to light. Furthermore, they lose sight of Dionysius’s insistence that the divine exceeds both darkness and light, and that the soul is only united to God once it is carried beyond this opposition. This puzzling light-supremacy can perhaps be most clearly seen in Palamas’s and Lossky’s conviction that, just as the dark revelation of the Mystical Theology purportedly gives way to the uninterrupted light of the

Divine Names, the darkness of Sinai has been overcome by the Light of the Transfiguration. While it is beyond the scope of this exploration to perform a systematic deconstruction of the distinction between essence and energy, we have thus stumbled upon a number of places in which it trembles. In order to align essence with darkness and energy with light, Lossky and Palamas must reconfigure the apophatic journey so that it ends, not in darkness, nor in neither-light-nor-darkness, but in uninterrupted light. Second, their designation of Mt. Sinai and Tabor as indexes of this progression requires not only a healthy dose of Christian supercessionism but also a rather flat-footed reading of the Transfiguration (after all, the voice of God comes not from unending brightness but from a “bright cloud” that “overshadows” them). Third, to call upon Pseudo-Dionysius in support of the ousia/energeia distinction is questionable at best, insofar as he names ousia among the divine names that Palamas and Lossky equate with the energeia. Surely, if essence is an energy, it is not entirely distinct from energy. And finally, insofar as some of Dionysius’s divine names are tied to creation (creator, redeemer, sustainer, etc.), Palamas is forced to admit that some energies are not eternal, even though most of them are. And again, “most of them are,” or must be, because of the speculation we saw earlier in Lossky: God would have revealed Godself outside Godself—even independently of an “outside” to which God might communicate—because it is in God’s nature to exceed Godself. What all of these faltering moments seem to indicate is that the divine essence is some sort of energy. Certainly such a divine essential energy would exceed the human capacity to discern it, but insofar as any discernment or participation is possible, it would be by virtue of an outpouring of this energetic essence. This is nothing more than what Plotinus ventured in synthesizing the Platonic One with the Aristotelian Intellec: energy flows forth from God (energeia ek tês ousias) out of the energy of God (energeia tês ousias). Like fire, God gives energy because God is energy.

Along this reading, the divine energy would be the very stuff of God, pouring outward and flowing back. Just as the divine names propel both the cataphatic descent and the apophatic return, divine energy works in equal and opposite directions to push creation out and pull it back—like a carefully calibrated cosmological constant. Dionysius called these two functions prōdos and épistropbē; Meister Eckhart called them effluxus and refluxus. At the same time that it fires forth into creation, the divine energy gathers creation back to itself, until creation itself is, or as Eckhart would put it, until everything is fire.
In the End

The discovery of dark energy therefore poses the same problem for theology as it does for physics: it threatens to throw the cosmic scales off balance. As Jacques Derrida has pointed out on numerous occasions, even “the most negative of negative theologies” knows where it’s going and goes where it comes from.45 Even the most tortuous path of Dionysian denials is still a path, starting and ending with the alpha and omega who processes outward to draw all things home. But dark energy seems to obliterate this path, leaving us with an excess of prōōdos over ἐπιστροφή: with an outpouring that does not, or will not, or cannot, gather itself back.

This dominant theory is called “the inflationary hypothesis,” first posited by Alan Guth in 1979.46 A patchwork of twentieth-century discoveries, the theory of inflation integrates the big bang hypothesis from the 1930s with the dark matter discovered in the middle of the century, the “inflationary energy” championed by Guth in the 1980s, and the dark energy discovered in the 1990s.47 The new, improved story goes like this: 14 billion years ago, space and time fired out from a tiny nugget of imponderably high density. After a millionth of a second, this nugget expanded into a flat and smooth cosmic terrain, 13.7 million light-years across.48 This sudden transition is attributable to a mysterious force of nearly infinite power called “inflationary energy,” which appeared for a flash and then disappeared forever.49 Three cosmic stages have ensued: the first dominated by radiation, the second dominated by matter, and the third dominated by dark energy (36). During the radiation phase, matter and antimatter erupted and canceled each other out, with matter gaining a slight advantage over its opposite. Quarks and gluons bound to form protons and neutrons, and the whole world was a hot-as-hell cosmic soup. As gravity gradually overcame radiation, the primordial plasma cooled and atoms emerged. Gravity attracted matter to cores scattered throughout the universe, and stars, planets, and galaxies began to form. Then, 9 billion years after the big bang, dark energy’s push began to exceed gravity’s pull, and the universe’s expansion sped up. With the demise of gravity, no more cosmic bodies will be created. From now on, the universe will continue to accelerate until galaxies, stars, and matter itself are unbound, either ripped apart or dissolved into a void of dark energy—an end that some physicists have dubbed “the Big Whimper.”50

It seems to me that this whimpering end of inflation reveals the secret ontotheological yearnings of all of us; it’s no wonder it gives scientists high blood pressure. Nor is it any wonder the numbers don’t work out. At the moment that dark energy overran gravity, the whole cosmos seems to have been let loose with no ticket home. What we have here seems a terrifying excess of the incalculable over the calculable, of procession over return, of Abraham over Ulysses, of Kierkegaard over Hegel. To the charign of seekers of orthodoxy and a Grand Unified Theory alike, it seems that God might indeed play dice. In fact, God seems to throw the dice outward, beyond even God’s own reach.

But even in a Kierkegaardian universe, there is always an “or.”

Or in the End

In the five years since the WMAP results emerged, an alternative hypothesis has been taking shape through the work of two theoretical physicists, each of whom was instrumental in setting forth and developing the inflationary hypothesis they now jointly contest (6).51 Paul Steinhardt and Neil Turok’s alternative cosmology was born out of their three-pronged dissatisfaction with the dominant model. First, this model seems to them a “patchwork” of different elements, periodically adjusted to accommodate a newly discovered force, but with “no overarching principle” (66). Second, in order to explain how the universe gets so big and flat so quickly, it has to posit “inflationary energy—an impossibly explosive force that lasts for an instant and then disappears forever.” And third, while the inflationary hypothesis can account for the events after the big bang, “the big bang itself is not explained. It is simply imagined that space and time emerged somehow” (6). In other words, the inflationary hypothesis posits a big bang ex nihilo, and as Steinhardt and Turok put it, “there are no rigorous physical principles that dictate how to go from ‘nothing’ to ‘something’” (226).

We will recall that the farther of the big bang theory, in addition to being an internationally renowned physicist, was a Roman Catholic priest. It is said that Lemaître took pains to keep his science independent of his theology, and perhaps for this reason (or perhaps heeding the warning of St. Augustine’s colleague52), he never ventured an opinion as to whether there was anything “before” the big bang. Nor was there any scientific consensus on the matter in 1951 when Pope Pius XII nonetheless declared it to be in perfect line with Catholic doctrine. “It would seem,” Pius told the Pontifical Academy of Science, “that present day science, with one sweep back across the centuries, has succeeded in bearing witness to the august instance of the primordial Fiat Lux, when along with matter, there burst forth from nothing a sea of light and radiation, and the elements split and churned and formed into millions of galaxies.”53 In the decades since then,
Steinhardt and Turok claim it has become commonplace among cosmologists simply to assume the big bang produced space-time out of nothing, but apparently there is no more physical evidence of such a thing than there is biblical evidence of it.

Over against the inflationary ex nihilo, Steinhardt and Turok posit their alternative: a cyclical universe, in which the big bang is not the beginning of time or space. Rather, it is a brief flash of cosmic renewal that takes place every trillion years or so. "In each cycle," they explain, "a big bang creates hot matter and radiation, which expand and cool to form the galaxies and stars observed today. Then the expansion speeds up, causing the matter to become so spread out that space itself approaches a nearly perfect vacuum. Finally, after a trillion years or so, a new big bang occurs and the cycle begins anew." This alternative model addresses all three alleged inadequacies of the inflationary hypothesis. The cyclical world is eternal; hence there is no need to jump from nothing to something. The universe remains relatively large, flat, and smooth throughout the cycles, so there is no need to posit "inflationary energy." And unlike the "patchwork" composing the inflationary model, the cyclical model does have an "overarching principle": dark energy guides the whole process.

Steinhardt and Turok's story more or less follows the trail of the accepted hypothesis, except without the inflationary energy. First there is a big bang, then radiation, then matter, then dark energy, but at this point, when the dominant model posits the gradual unraveling of the world, the cyclical model changes course. Dark energy does not continue to speed the cosmos outward forever, either ripping it apart or dissolving it into a void. Rather, after a trillion years dark energy begins to decay. Its outward force starts to reverse, propelling the cosmos into "a phase of very gentle contraction." This contraction draws the universe into a "big crunch," at which point another big bang bangs and the universe is thrown outward again. Perhaps the most significant ontological distinction between these two models, then, is that while the inflationary hypothesis maintains that creation ended with the onslaught of dark energy and will eventually be entirely undone, the cyclical hypothesis promises (in rather hymnic syntax) that after each bang, "created anew will be galaxies, stars, and planets like Earth on which intelligent forms of life may develop."

According to the cyclical model, the whole world seems something of a phoenix, periodically undone and remade in fire. And in fact the first name Steinhardt and Turok gave to their hypothesis was ekpyrosis: out of fire. They borrowed the term from Stoic cosmology; as Cicero's Balbus explains in *On the Nature of the Gods*, the early Stoics taught that "there will ultimately occur a conflagration of the whole world. . . . nothing will remain but fire, by which, as a living being and a god, once again a new world may be created, and the ordered universe restored as before." We will note that in the Stoic cosmos, the god who creates, orders, and consumes has no essence in excess of its energy: the god is this fire itself. Similarly, for Steinhardt and Turok, the role is played by dark energy. As the "overarching principle" of the cyclical model, dark energy "regulate[s] the cycling" by causing cosmic expansion, stabilizing the universe, and absorbing systematic shock. What this means is that all things visible, "stars, galaxies, and the larger-scale structures observed in the universe today owe their existence to the period of dark energy domination in the previous cycle. And the dark energy dominating the universe today is preparing similar conditions for the cycle to come." So rather than unmaking the world once it overtakes gravity, the dark energy of this model is dominant the whole time and creates, by virtue of this perpetual dominance, and executes the whole affair according to a plan.

With the exception of this sudden anthropomorphism, the cyclical model recapitulates not only Stoic ekpyrosis but also Hindu cosmology, theories of Buddha worlds, not to mention Nietzsche's eternal return. The major difference lies in the last major component of the cyclical model, which is that our universe is not the only universe. There is one more. We will recall that Saul Perlmutter, leader of one of the teams that discovered dark energy, said that cosmologists were "even willing to listen to string theorists" in order to reconcile quantum mechanics and general relativity. And indeed the cyclical model draws its inspiration from the mysteriously named "M-theory," which Edward Witten proposed in 1995 as an integration of all existing string theories. Steinhardt and Turok's interpretation of M-theory posits not 10^500 universes, but two. According to this hypothesis, the whole world—from our hands, to the stars, to the remotest galaxies—exists on a flat, extended membrane, or "braneworld." Across a tiny gap along an imperceptible dimension there is another braneworld, filled with all sorts of matter and energy as well. In fact, the reason "dark matter" exerts such force on our cosmos without being visible could be that it is lying on this other world. The brane next door hovers a hairbreadth away—perhaps 10^−30 cm across—but we cannot see, touch, or hear it. "We are stuck like flies on flypaper," Steinhardt and Turok explain, "and can never reach across the gap to the 'hidden' world, which contains a second set of particles and forces with different properties from those in
our braneworld” (139). Nearer than hands and feet, it remains totally inaccessible. Nothing can reach across this gap—except dark energy.\textsuperscript{55} Dark energy shuttles along the fourth dimension, pushing the two branes apart and then drawing them closer together.

What this means for the cyclical universe is that the big bang does not produce a world that is 13.7 million light-years in radius out of a single point. Rather, it marks the collision of the two braneworlds (143). This collision produces the familiar primordial soup and radiation on each braneworld, matter eventually gathers and forms on each braneworld, and then dark energy prompts the expansion of space-time along each braneworld, while also increasing the distance between them. As the force of dark energy reverses itself, it causes the branes to contract slightly and draw closer to each other, ultimately colliding in a big crunch: “The collision between two branes would produce a searing white light, signaling the beginning of a new cycle of cosmic evolution” (193). And another big bang bangs, and the world is born again out of red-hot plasma.

\textit{Flints}

In this contemporary debate between the inflationary and cyclical hypotheses, we seem to have two models of creation that do not quite fit any of the old theological standbys.\textsuperscript{64} To be sure, each of them contains familiar elements, but in combination with unexpected partners. The inflationary hypothesis gives us a world created ex nihilo, in good orthodox fashion. At the same time, it presents a future without redemption or renewal, abandoned to a growing void that will ultimately consume it. The cyclical model, on the other hand, begins from the heretical conviction that nothing comes from nothing, so the world must be eternal. But the force that oversees this eternity “prepares” cycles in regular intervals, conserves the world’s mass-energy, and all in all, issues a fairly ontological guarantee of procession and return. So the inflationary Elohim breathes out, and out, once and for all. The cyclical Elohim breathes out, and in, and the cosmos is reborn.

The Eastern churches teach us that one participates in the very life of God, dwelling in the Inaccessible, by means of the divine energies. Yet how exactly does one attain such participation? We will recall that the \textit{energeiai} are wisdom, power, goodness, beauty, truth—all the manifestations of the hidden God. As Aristotle Papanikolaou explains, the energies are “the bridge of the unfathomable gap between the uncreated God and God’s creation.” To share in these energies would therefore mean to receive them as they cross this unfathomable gap and to reflect them back across and out into the world. The crucial passage here is from I Corinthians:

\begin{quote}
Now there are diversities of gifts, but the same Spirit. And there are diversities of administrations, but the same Lord. And there are diversities of operations [\textit{energema\i}], but it is the same God which worketh [\textit{bo energon}] all in all. But the manifestation of the Spirit is given to every man to profit withal. For to one is given by the Spirit the word of wisdom; to another the word of knowledge by the same Spirit; To another faith by the same Spirit; to another the gifts of healing by the same Spirit; To another the working of miracles; to another prophecy; to another discerning of spirits; to another divers kinds of tongues; to another the interpretation of tongues. But all these worketh \textit{energetis} that one and the selfsame Spirit, dividing to every man severally as he will.\textsuperscript{66}
\end{quote}

Each of the spiritual gifts is an \textit{energema}: the Holy Spirit gives them so that creation might mirror the divine energies. We might therefore think of the divine energies as a call and the charisms or virtues as a response: God acts, and by virtue of our reception of this action, we are enabled to act in like fashion, imitating God’s love, healing, wisdom, power of reconciliation, and creation—to such an extent that we share in the divine life itself.\textsuperscript{67}

This is almost right, except, as David Bradshaw has argued, the workings of the Spirit are a bit more complicated than action and reaction. In a number of highly systematic studies, Bradshaw has shown that every one of Paul’s twenty-six uses of \textit{energeia} and \textit{energein} describe the actions of God, Satan, or demons—\textit{never} of humans.\textsuperscript{68} Or \textit{never} of humans alone. One example Bradshaw gives is Colossians 1:29, “where Paul refers to himself as ‘striving according to Christ’s working [or energy, \textit{energeia}], which is being made effective [or energized, \textit{energoumenen}] in me.’ “On the one hand,” Bradshaw explains, “the divine energy is at work within Paul, transforming him, so that from this standpoint he is the object of God’s activity; on the other it finds expression in Paul’s own activity, so that Paul’s free agency and that of God coincide.”\textsuperscript{69} So it is not quite the case that God works and then humans work back. Rather, God works in me in such a way that my working is God’s working: the defined creation does the healing and reconciling and creating \textit{along with God}—to such an extent that the actors, in a sense, merge. Bradshaw calls this strand of Paul’s theology “synergis-
tic": "The energies are precisely the realm of *reciprocity*, that in which God shares Himself [sic] with creatures and summons them to offer themselves to Him." Thus offered, humanity becomes the venue of the divine energy; as Eckhart might explain it, "God is his own place to work in." Insofar as it relates to creation, then, the divine *energetia* is *synergieia*.

But here we tread on dangerous ground. Here we risk making the divine operation somehow dependent upon creation's participation in it. It is for this reason that the Orthodox—Bradshaw included—install a double-glazed barrier between the theotic creation and the *theos* itself. The first layer to this barrier is the eternity of the energies: God is said to manifest Godself, *internally and externally*, independently of creation. Yet we have seen two major cracks in this pane: first, not all of the energies can be said to be eternal ("creation" being chief among them), and second, without creation there would be no place to which God might manifest Godself. Hence the second layer exists to contain the leaks of the first: the divine energies, it is said, are not the divine essence. So even if the energies get muddled up in the mess of the world, there is still a reservoir of divine ontology that remains uncorrupted, untainted—totally removed from creation. Again, however, we have seen this distinction collapse as well, in short because of the pesky conviction to which Lossky himself gives voice: God cannot not express Godself. Which is to say God's essence, in all its unknowable darkness, *is* energy.

What happens, then, if the divine essence is energy and the divine energy is synergy? (And here I can almost feel the flames at the base of my heretic's stake.) This, according to Rowan Williams, is the greatest danger the *energetiai* (which he uses interchangeably with the Dionysian *dynamis*) present: they seem to evacuate the contingency of the world. As Williams demonstrates in his own *dismantling of the osial/energeia* distinction, "it is hard to avoid the conclusion that the world must be eternal, insofar as the *dynamis* are eternally engaged, by their very nature, in communicating the divine perfections to some second term or order of being. God and the world appear to be bound up in a kind of organic unity—a foreshadowing of Whitehead or Hartshorne." Williams tries to avoid this unsavory prospect by means of Aquinas's equation of essence and energy in the Godhead, establishing God as pure actuality and creation as its contingent recipient. But it seems to me the damage has been done: if the energies cannot be dislodged safely from the divine essence or from creation, then they do seem to bind the whole lot into an eternal, synergetic dance. This is not to say that God is creation or that creation is God, but by virtue of

the eternal energy that "bridges" them, it is possible that both become, and unbecome, in mysterious relation to each other.

Across an imperceptible divide, a strange fire flings this world away from that one and then slowly joins them back. So our universe is haunted: what we know is there won't quite show itself. But a dark force races between worlds, drawing us into the rhythm of creation; breathing out and breathing in. Thrown outward in a sea of light, we are gathered back by the darkness, from fire to fire. "And the dust returns to the earth as it was, and the spirit returns to God who gave it," and "the quarks and gluons of which we are all made join the flood of new quarks and gluons created at the bang, and the cycle of the cosmos is renewed." World without end. Perhaps.