SCIENCE SEES THE LIGHT

By Gregg Easterbrook

Suppose you accept the Big Bang theory of the origin of the universe. Here's what you believe, roughly according to the model proposed by Alan Guth, a physicist at the Massachusetts Institute of Technology:

You believe that, once upon a time, all the potential of the cosmos—*all* the potential for a firmament of 40 billion galaxies at last count—was packed into a point smaller than a proton. You believe that within this plenum of the incipient cosmos was neither hypercompressed matter nor superdense energy nor any tangible substance. The genesis plenum was a "false vacuum" through which coursed a weightless, empty quantum-mechanical probability framework called a "scalar field." Probably you're not totally clear on what a "scalar field" is, but then neither are most Ph.D.s.

Next, you believe that, when the Big Bang sounded, the universe expanded from a pinpoint to cosmological size in far less than one second—space itself hurtling outward in a torrent of pure physics, the bow wave of the new cosmos moving at trillions of times the speed of light. You believe that this process unleashed such powerful distortions that, for an instant, the hatchling universe was curved to a surreal degree. Extreme curvature caused normally rare "virtual particles" to materialize from the quantum netherworld in cornucopian numbers, the stuff of existence being "created virtually out of nothing," as *Scientific American* once phrased it.

Further, you believe that, as subatomic particles began to unbuckle from the inexplicable proto-reality, both matter and antimatter formed. Immediately these commodities began to collide and annihilate themselves, vanishing as mysteriously as they came. The only reason our universe is here today is that the Bang was slightly asymmetrical, its yield favoring matter over antimatter by about one part per 100 million. Owing to this, when the stupendous cosmic commencement day ended amid sundering energies beyond comprehension, a residue of standard matter survived, and from it the galaxies formed. That is to say: You believe that a microscopic, transparent, empty point in primordial space-time contained not just one universe but enough potential for 100 million universes.

It's wise to take the Big Bang hypothesis seriously, since considerable evidence weighs in its favor. The galaxies are expanding away from one another as if they had once been in the same place, then hurled outward; the interstellar void is slightly warmer than absolute zero, suggesting the universe was once superheated by something much stronger than the output of stars; the earliest nebulae appear to be composed of precisely the mix of elements that Big Bang calculations suggest. Yet, for sheer extravagant implausibility, nothing in theology or metaphysics can hold a candle to the Bang. Surely, if this description of the cosmic genesis came from the Bible or the Koran rather than the Massachusetts Institute of Technology, it would be treated as a preposterous myth.

Just as surely, the sort of majestic events hypothesized by current thinking about the Big Bang seem hauntingly similar in character to other, more traditional arguments about splendid powers at the core of existence. Something extremely grand must have called forth our firmament, and whether that something was natural or supernatural may be mere semantics. Reflecting on this, Allan Sandage, one of the world's foremost astronomers, recently proposed that the Big Bang is best understood as "a miracle" triggered by some kind of transcendent power. The Nobel Prize-winning physicist Charles Townes, chief inventor of the laser, suggests that "to think that science already knows enough to be certain there are no mystical forces is illogical." Other prominent researchers are beginning to say much the same.

In the century since Darwin, the arc of science has pointed toward displacing belief in anything beyond genes, machines, and the vibration of atoms. Many have waited, expectantly or even impatiently, for the moment when science fully refutes obsolete conceptions of meaning and purpose. Now, however, researchers are encountering profound riddles on many of the very points most concerned with the larger questions of life: What caused the universe? What came before? How did life begin? Why are natural laws and physical constants amenable to biology and consciousness?

In part because it has been assumed that science would inexorably prove existence to be no more than a chance manifestation of pitiless mechanical forces, the

Adapted from *Beside Still Waters: Searching for Meaning in an Age of Doubt* (William Morrow).

main current of postmodern thought in philosophy, literature, art, and their mass-cult equivalents has been silted with gray. But as bleak worldviews deconstruct themselves to the point of depletion—if nothing really matters, why even bother to say that?—such thinking is starting to change. New findings in science point toward a buoyant view of our being: one in which life is favored, not improbable, and the universe a welcoming place, not an indurate domain. As science finds more to existence than previously understood, other intellectual disciplines may be inveigled toward a more hopeful view of the human prospect. Western thought may experience a revival of meaning.

Rightly or wrongly, modernism has treated science and meaning as warring superpowers. One important cause of the modern era was the sequence of events in which traditional assumptions were subject to humiliation at the hands of those in lab coats: from Charles Lyell's mid-nineteenth-century demonstration that the Earth is ancient and weathered rather than newly formed, to Darwin's enunciation of evolutionary descent, to Freud's claimed clinical proof that all human beliefs were "illusions" rooted in a "universal neurosis" of lesser minds, to Einstein's renowned question of whether God had any choice in the creation of the universe.

Some of the conflict between science and meaning has been administrative, tracing to researchers' needs to win academic freedom in university systems once flavored by church politics. It is useful to recall that, as recently as Victoria's reign, the Anglican Church controlled hiring decisions at Cambridge and Oxford. One reason Charles Darwin was so touted by the British scientific establishment, while Alfred Russel Wallace, the codiscoverer of evolutionary theory, was practically blackballed, was that Darwin was an agnostic who threw the rector class into a tizzy, while Wallace was a believer who spoke about "the unseen universe of spirit."

Bureaucratic politics aside, aspects of the conflict between science and meaning reflect deep philosophical division. Postwar science has not only searched for material explanations for all outcomes, as it should, but at times it has evinced evangelical enthusiasm for the overthrow of belief. Steven Weinberg, who won the Nobel for physics in 1979, has famously supposed: "The more the universe seems comprehensible, the more it seems pointless." Francis Crick, one of the discoverers of DNA, once proclaimed, almost with satisfaction: "Your joys and sorrows, your memories and ambitions, your sense of personal identity and free will are in fact no more than the behavior of a vast assembly of nerve cells and their associated molecules." The Oxford zoologist Richard Dawkins, who holds a chair in "public understanding of science," promotes the gray view of life with such ardor that he might be dubbed Mister Meaninglessness. He has written that the universe "has precisely the properties we should expect if there is, at bottom, no design, no purpose, no evil and no good, nothing but pointless indifference."

Statements like these beg the rejoinder: Your life may be meaningless, but not mine! Nevertheless, such sentiments underlie the perception that science has debunked not only the divine but even modest human dreams. Most influential in this regard was the powerful 1972 book *Chance and Necessity* by the Nobel-winning French biologist Jacques Monod. Monod asserted that everything about the living world could now be explained without recourse to purpose, significance, or larger powers: "Man knows at last that he is alone in the universe's unfeeling immensity, out of which he emerged only by chance."

A quarter-century later, the picture seems much less clear. Take the origin of life. Evolution glides over this most engaging of biological questions: natural selection describes the way organisms that already exist adapt to change in habitats that already exist, but it is silent on how the process begins. Even cellular forms of life are so fantastically complex, so different from the azoic world and so fragile compared to it, that it is difficult to imagine how an incomplete, initial organism could have functioned before its components were sufficiently established as to be capable of replication and development. Owing to this, researchers, such as the paleontologist Stephen Jay Gould of Harvard University, have depicted life as a chemical fluke so wildly improbable that it represents little more than a data blip.

Patinaed with what seems like objective science, the notion of life as a vacuous accident is central to contemporary intellectual orthodoxy. But, while life may be pointless, that's an opinion, not an impartial induction. And it is surely an opinion leveraged by the desire of many thinkers to gain retribution against belief by treating it as dismissively as faith once treated science. As Alan Dressler, a prominent astronomer, notes: "Many scientists seem to be on a crusade to run down human worth, because they think this will destroy the old religious arrogance of believing that man is the center of the universe. But nobody believes that anymore, anyway."

More to the point, the life-as-fluke view may be about to collapse. Christian de Duve, a Nobel-winning Belgian biologist, says: "Eventually we will understand that the origin of life was not a highly improbable cosmic jest but rather an almost obligatory outcome of chemical structures, given the right conditions." A branch of research generally called "complexity" theory has made progress toward showing that elaborate living molecules such as the six-billion-point strands of human DNA are surprisingly plausible. Ian Stewart, a mathematician at the University of Warwick in the United Kingdom, has suggested that mathematical rule structures inherent in existence may eventually be shown to operate as if life were their goal, encouraging the development of animation. "DNA may be just one of the many secrets of life, secrets we are only beginning to glimpse," Stewart suggests.

Conventional views about the significance of evolu-

tion may collapse as well. Darwinian theory ranks among the foremost achievements of rationality, yet many proponents insist on presenting adaptation not as a glorious manifestation of the life force but rather as just another vacant, goin'-nowhere mechanism. In this view, there is no evolutionary arrow. The living world has not gotten better or more interesting or more diverse over time; it has merely ground out meaningless genetic responses to meaningless environmental change. Imputing a positive arrow to evolution is decried as "anthropocentrism" because women and men would then be seen as superior to earlier organisms. (Some factions in evolutionary debate become *very* offended at the suggestion that *Homo sapiens* is a higher accomplishment than *Australopithecus*.) Development of intellect is depicted not as nature's highest known achievement but as a random event, signifying nothing. Yet, as de Duve notes, if you "chart out the last 500 million years, you will find that nearly every animal has steadily increased its neurological capacity, if only because brainpower is a marvelous adaptation mechanism." De Duve adds, "Intellectuals and even many scientists mistakenly think that a chance result means the result is insignificant. Chance did play a large role in evolution, but the result is highly meaningful."

New thinking about the Big Bang also suggests that the universe is not an indifferent engineering scaffold but is steeped in resplendent mystery. Supposing that entire constellations really did pop forth from bare pockets of empty space, some creative process of almost infinite power and scope must have been involved: if nothing else, the theological notion of genesis *ex nihilo*, "out of nothing," is looking better all the time. Then there's the little conundrum of what caused the Big Bang. For years, researchers have shrugged this issue off, as if only freshmen or rubes would get hung up on it. (A decade or so ago, I asked an eminent astronomer what came before the Big Bang. He scrunched his face and replied: "I can't stand that question!") Pressed, Bang theorists would say that the genesis detonation destroyed all information about the previous condition, and therefore the subject is forever moot. Increasingly, that has come to seem like a dodge akin to the way pastors and rabbis dodge questions about God's wrath or heaven's origin. The new consensus among cosmologists seems to be that, until Big Bang theory can account for the prior condition, it's all speculation.

Beyond this is the "fine tuning" question—the enigma of why the cosmos assembled itself with stable physical laws and with the kind of natural constants that led to at least one long-lived planet suitable for life.

Researchers have calculated that, if the ratio of matter and energy to the volume of space, a value called "omega," had not been within about one-quadrillionth of one percent of ideal at the moment of the Big Bang, the incipient universe would have collapsed back on itself or suffered runaway relativity effects. Instead, our firmament is stable and geometrically normal: "smooth," in the argot of cosmology postdocs. Had gravity been only slightly stronger, stars would flame so fiercely they would burn out in a single year rather than shine for the ten billion years expected for our sun. The universe would be a kingdom of cinders, devoid of life. Had the "strong" force that holds the interior of atoms together been only slightly weaker, subatomic particles would have attenuated into vapor: stars would not have shone in the first place. The one form of life confirmed so far depends on carbon, which is nearly unique among the elements in having the ability to form exceedingly complicated molecules from small energy inputs, serving an essential requirement of biology. Like most elements, carbon is forged inside stars. But, if it were not for a seemingly highly unlikely quirk of the "nuclear resonance" of stellar reactions, carbon would not exist. The English physicist Roger Penrose once estimated the odds against a cosmos with this one's pleasantly anthropic physical laws as about one in ten to the three hundredth power, a figure far larger than the number of atomic particles believed to exist in the universe.

At the next level, the question is why there are any physical laws, rather than cosmic anarchy. "When you ask scientists how physical law got there, most will just shrug because they haven't the slightest idea," says Leon Lederman, a physicist who won the Nobel in 1988. "It is very puzzling which came first, physical law or the first universe," says the Big Bang physicist Andrei Linde of Stanford University. "Without a cosmos, where would you write your physical law? But, without physical law, how would you start the cosmos?"

Some argue that physical laws are as observed because the present outcome was the only one possible. But quantum mechanics posits otherwise and has produced considerable indications that the universe might well have emerged with crushing gravity, vaporous distortions, or other untenable qualities. Until such time as

science can discern the underlying reasons for physical law—and "we're nowhere near that yet," says Saul Perlmutter, an astrophysicist at Lawrence Berkeley National Laboratory—higher influence will stand as good a chance of being confirmed as disproved, and the meaningless-coincidence analysis will recede.

One scientific idea inspired by the seeming zillion-to-one character of the firmament is a budding theory of the "multiverse." This notion, now advocated by several credentialed researchers, trades on the possibility that, if our universe emerged out of nothing, additional universes may emerge from nothing as well. New firmaments may burst forth in other dimensions as often as billions of times per second, Linde estimates. As multiple heavens are forged, chance determines physical laws; but the deck is shuffled so many times that all outcomes become possible.

Notions of a boundless, overarching multiverse, far larger even than the 13-billion-light-year realm that present telescopes see, arise both from quantum reasoning and from a desire to account for our auspicious cosmos without calling on either supernatural influence or incredible chains of blind luck: for, if universes are created by the bushel basket, it seems more believable that the occasional heavens, such as ours, would come out pleasingly "smooth." Thus, theories of the multiverse may sustain conceptions of an autonomous, wholly natural cosmos.

But, rather than the heartless domain assumed by contemporary thought, a multiverse would be an almost preternaturally sanguine place. After all, if physicists such as Guth and Linde are right, and entire universes can materialize from nothing, then the firmament as a whole may never run down, endlessly drawing new vitality from the quantum netherworld. In recent years, researchers at Princeton, Tufts, and elsewhere have published papers suggesting that the creation of universes is an eternal process, infinitely self-sustaining. Couple this possibility to the notion of biology as favored by inherent aspects of nature, and the intellectual transformation is startling: the universe wants life, and stars will shine forever!

As research has begun to veer toward the metaphysical, the interplay of science and religion, seemingly a dead issue a decade ago, has made a comeback, now growing into one of the liveliest arenas of intellectual discourse. Theology finds itself warming to science, especially to the Big Bang with its discrete, Genesis-like moment of rapid creation, and to the ethereal notions of quantum mechanics, such as that particles can travel from A to C without passing through B. Outside the creationist extremes, religious leaders are taking tentative steps toward natural selection—Pope John Paul II in 1996 called Darwinism "more than just a hypothesis"—as they come to understand both how strong the evidence is and that evolutionary biology behaves with a profound elegance that may suggest larger influence. New schools of thought with names like "design inference" are staking claims to the notion that circumstances such as favorable physical law will eventually be understood as divine latency.

But the Maker cannot be proven from natural beneficence anymore than God could be disproved by indications of impersonal forces. Postwar literary and philosophical thinking have routinely exhibited the mistaken assumption that, if evidence of purely material natural forces is found, then all forces must be purely material. It would be an equivalent error of logic to assume that, if metaphysical grandeur in nature is uncovered, then a lawgiver must be present. All that can be said with assurance is that science is trending away from dispirited views of a merciless cosmos toward a new vision of creation as poignantly favorable to life. That is more than enough to constitute news.

News enough, in fact, that it may inspire a historic shift in prevailing winds of thought. But this is unlikely to happen quickly because modernism is deeply informed by the notion that science has overthrown meaning. Assumptions of purpose-as-exposed run from the nineteenth-century onset of existential dread (Kierkegaard: "Depression is the most faithful mistress I have known"), to the trench-warfare fatalism of the lost generation, to the attempt of logical positivism to banish all metaphysical ideals that cannot be empirically observed, to the mid-century advent of stylish despair (Sartre: "All human actions are equivalent [and] all are on principle doomed to failure"), to the inversion of art from the search for transcendence to an ethic of mandatory disdain (as Frederick Turner of the University of Texas points out, work that sneers at humanity is what the art establishment now lauds, while art that pursues beauty is looked down on as unsuitable), to today's regnant postmodern axiom that there are no truths, only constructs of social context (Stanley Fish: Beliefs are just "norms to which you have been falsely enslaved").

Countless events in the twentieth century do support dismal notions of life: from the Somme to the Holocaust to Rwanda, it can seem that, if anything, Camus and Foucault were understating the case. But countless counterexamples of courage, idealism, and compassion could also be cited to argue the opposite conclusion.

What is telling is that modernism has tended toward the gray in part because it often reads too much heartlessness into misunderstandings of science. Consider the theories of relativity. These masterworks are perceived as strikes against higher purpose, it being common to hear that Einstein proved that the universe is autonomous in origin. Yet Einstein's deductions have nothing to do with the creation of the cosmos, concerning instead the mechanics of gravity and light. Einstein was a skeptic of Big Bang thinking, preferring the Greek notion that the cosmos is a static, eternal realm that had no specific moment of genesis. Personally, Einstein was a moderate on issues of belief, once saying that, the more he learned, the more he believed in a supreme being.

Then there's the name, "relativity theory." Coming at

a time when the trajectory of Western thought was toward relativism in values, culture, and history, Einstein's work seemed to give hard-science vertebrae to contentions that there are no underlying truths or first principles. But rarely has a theory had a less apt cognomen. Einstein's assertion in his first breakthrough, the Special Theory of Relativity, is that central aspects of nature are decidedly *not* relative—natural laws remain the same regardless of motion, and the speed of light is an absolute for all observers despite frame of reference. His second breakthrough, the General Theory of Relativity, concerns the way gravity molds space-time. Einstein could have called his accomplishments the Special Theory of a Cosmic Absolute and the General Theory of Gravitational Absolute. How might twentieth-century thought have developed if its preeminent scientific mind had chosen to favor the word "absolute" instead of "relativity"?

Similarly, the second law of thermodynamics, the "entropy" law, has been widely misperceived as hard-science vindication of eventual desolation. This axiom is usually depicted as holding that systems inevitability consume energy, lose complexity, and decline to a worthless "disordered" condition that can never be reversed: a log can burn to ash, but ash cannot be reformed into a log. During the 1970s energy crunch, it was fashionable for commentators to cite petroleum depletion as foretold by entropy physics. Some thinkers have interpreted the second law much more broadly, saying that it guarantees the universe will end as a cold, blurred nothingness, and, if creation is fated to a senseless demise, then existence must be without point. Thomas Pynchon first caught the eye of the literary world with a short story, *Entropy*, which presented a second-law analysis of existence as inconsequential; the concept would help frame *Gravity's Rainbow* and other works. Since Pynchon, others have seized on the second law as systematic proof that all beings, even gods, are just marking time until inevitable universal doom.

This kind of thinking sounds nicely ponderous, but it overlooks time scale: if the universe is someday to suffer an entropic heat-death, that event waits as much as trillions of years into the future, a span so unfathomably long it might as well be eternity. And, if entropy is a natural agent of decay, life appears to be its leading foe. Earth-borne biology represents "four billion years of defiance of the second law," as the theorist Stuart Kauffman of the Santa Fe Institute has said. Carbon-based organisms have grown steadily more complicated and interesting, employed exponentially more energy, and appear millennia away from exhausting the resources of this one small globe, to say nothing of the immense 100-billion-star galaxy above.

Those who cite entropy as proof of cosmic pointlessness might object that the Earth continuously draws new energy from the sun, allowing local defiance of the second law; someday the sun will dim out, and the universe itself will never receive any power infusion, leaving the gray view triumphant over the very long term. But findings of cosmology and physics are beginning to suggest that the second law need not be destiny.

Current Big Bang theory implies that the genesis merrily violated all laws of the conservation of energy, making the stuff of reality essentially out of thin air. (There is a technical objection to that sentence, but one that ought to concern only specialists.) In turn, one reason so many scientists take seriously the idea of whole universes leaping from the void is that, in particle accelerators and cloud chambers, they observe something from nothing, albeit on a modest scale.

A phenomenon called the "Higgs field" appears to pervade the universe, and, although the Higgs field looks and acts like a vacuum, occasionally subatomic particles pop out of it—that is, out of nowhere. This suggests there may be natural mechanisms capable of replacing what the cosmos consumes over time; some of those mechanisms may even be at work today, in the post-Bang heavens. Last December, astronomers detected a distant "hypernova" that, for an instant, appeared to generate more gamma rays than the rest of the universe combined. The power seemed to emanate from a relatively tiny point, hinting that radical energy-creation mechanisms may exist, amending the second law on a cosmic basis.

Contemporary culture has misunderstood other aspects of science in ways that needlessly imply absence of significance. In 1968, for instance, Francis Crick lamentably pronounced the basic form of DNA a "frozen accident," hit upon by chance and then endlessly copied. Subsequent research has instead found the double helix and its four-base amino-acid substructure to be an exceptionally sophisticated configuration for preserving and passing along information—intimating wisdom and subtlety at the beginnings of life, not some dumb blunder. Nevertheless, the phrase "frozen accident" has caught on in numerous fields of commentary, including historicism (the American century had nothing to do with merit; it was just a frozen accident of ocean geography), sociology (that some cultures flourish while others falter is a frozen accident of resources and climate), economics (profitable firms are merely exploiting the frozen accidents of random market breaks), and so on.

"Chaos" theory is a similar example. This branch of mathematics became an intellectual and pop-culture sensation partly because of the fine book *Chaos* by James Gleick, which has spawned dozens of imitators, but mainly on the misperception that chaos theory constitutes scientific proof of the haphazard character of life.

Chaos mathematics has two main contentions. The first is that outcomes of complicated interactions may be impossible to predict; the second is that simple sets of rules can lead to intricate results. Unless you were rooting for the development of some kind of all-controlling ultimate computer, both these contentions are easily seen as life-affirming. That no amount of data may be sufficient to predict some outcomes suggests that even

the Maker could not know the future and, therefore, is watching human events unfold; those dark moments of history would make a lot more sense if they came as surprises rather than as components of a divine plan. And the notion that simple rules can create elaborate structure sounds favorable to consciousness, suggesting that the ability of fairly basic evolutionary precepts to produce complex minds would not represent a pointless luck of the draw but rather fulfillment of something inherent in the natural order. Affirmatively is not, however, how chaos theory has been perceived. In most citations, this mathematics is treated as a proof that events are out of control or signify nothing.

During the centuries when superstitions were common and churches suppressed rational thought, there was power to the view that society would be served if science overturned belief. Rousseau, for example, thought spiritual convictions undercut social compassion by allowing people to assume God would provide for the troubled: better if men and women realized they had only one another to fall back on. As Claude Welch has written, nineteenth-century German reformers warmed quickly to Darwin because they regarded institutional faith as adverse to the working class (preaching submission now and rewards in heaven) and thus favored any scientific theory perceived as diminishing the divine. Many turn-of-the-century thinkers, such as the anthropologist James Frazer, viewed scientific deflation of spiritual beliefs as a necessary step in social evolution.

But today, in the liberal Western democracies, the torching of purpose is backfiring. Not just religious doctrines but even the higher convictions of humanism are being tossed onto the bonfire, the sophisticated person expected to believe nothing. Education seems adrift, its top levels so gun-shy of being accused of belief as to avoid terms like "right" or "wrong." As David Scott, a former physicist and now chancellor of the University of Massachusetts at Amherst, notes: "Modernism has directed exhaustive objective focus on the world as a database but excluded anything having to do with meaning. This causes wisdom to drop out of favor as a goal of education."

As science continues to be perceived as having exposed life as an automated artifice, a strange kind of homage to meaninglessness has risen up, particularly among the opinion-maker cohort. New scientific evidence that suggests the world is bereft of meaning is welcomed, intimations of purpose discomfit. Imagine a faculty meeting at any Ivy League university or a top-staff meeting at any major East Coast news organization. In rushes a courier to announce that an archaeologist has just discovered proof that the founding scriptures of all major faiths are forgeries; there would be broad smiles and acclaim. Then imagine, instead, that a courier announces that a biologist has just discovered physical evidence of the soul; faculty types would fidget unhappily, while media types would scoff.

Embrace of meaninglessness may be a valid philosophical choice, but it can also become a justification for selfishness on the part of Western elites. Richard Dawkins of Oxford, who has cheerfully written that human beings are "machines for propagating DNA" and that this "is every living object's sole reason for living," further contends that, in a universe of "blind physical forces and genetic replication, some people are going to get hurt, others are going to get lucky, and you won't find any rhyme or reason for it." How convenient that someone who has himself won a privileged position in life blames only a callous universe—not lack of action by persons in privileged positions—for the needs of the less fortunate. If there is higher purpose then we have obligations to one another and will be judged if those obligations go unmet. If it's all pointless anyway then why not focus on enjoying your ironic airs, your capital gains, and your information-age sinecure?

Debate about meaning in life is endlessly sidetracked into all-or-nothing extremes. Traditionalism insists that purpose is preexistent, that the universe was called forth already possessing full metaphysical import. Postmodernism insists that purpose is impossible: we arrived by chance, and chance will someday reclaim us, the universe caring not one whit either way. What's neglected is the intermediate possibility—that our being is sacred and profound, regardless of whether there are higher forces.

The Nobel physicist Steven Weinberg, the same fun guy who once called life "a more-or-less farcical outcome of a chain of accidents," has also said that men and women "can grant significance to life by loving each other, investigating the universe, and doing other worthwhile things." Given Weinberg's stature, his pronouncements about a pointless existence are oft-cited in philosophical debate—traditionalists denouncing them as nihilism, intellectuals praising them as agreeable derision. Hardly anybody ever quotes the second half of Weinberg's argument, exactly because it is so reasonable.

Regardless of whether our mettle is natural or supernatural, purpose is something people can make by leading moral lives and helping carry one another's burdens. Here is a logic of meaning that seems inescapable. If it is true that a divinity gave us being, it is incumbent on people to treat one another lovingly and with justice, earning that divinity's good will. Or, if it is true that no divinity exists, then it is incumbent on people to treat one another lovingly and with justice, honoring the life force they all share. In either case, the human promise is the same.

"When I talk to audiences about the size and age of the cosmos," the astronomer Dressler notes, "people often say, 'It makes me feel so insignificant.' I answer, 'The bigger and more impersonal the universe is, the more meaningful you are, because this vast, impersonal place needs something significant to fill it up.' We've abandoned the old belief that humanity is at the physical center of the universe but must come back to believing we are at the center of meaning." •