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GOD & THE BIG BANG

2ND EDITION

Discovering
Harmony
between Science
& Spirituality

Daniel C. Matt

For People of All Faiths, All Backgrounds

JEWISH LIGHTS Publishing

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Preface

In the twenty years since I wrote the first edition of *God & the Big Bang*, there have been several significant discoveries in cosmology. Although none of these has compelled me to change any major themes or formulations in the book, I feel that it is worthwhile to revise some of what I have written in light of these new findings.

One of the most significant scientific facts about our universe is that ever since the big bang it has been expanding. As mentioned in chapter 2, this was first demonstrated in 1929 by the astronomer Edwin Hubble. Until nearly the end of the twentieth century, cosmologists assumed that the expansion of the universe was gradually slowing down, due to the combined gravity of all the matter that exists.

However, in 1997 and 1998, two independent scientific teams reported an astounding discovery. Based on their measurements of supernovas (spectacular exploding stars), they demonstrated that for the past several billion years the expansion of the universe has actually been accelerating rather than decelerating. In recognition of their work, in 2011 both teams were awarded the Nobel Prize in Physics.

What is causing this unexpected acceleration of the expansion of the universe? According to the most widely accepted

hypothesis, it is a mysterious form of energy—a repulsive anti-gravitational force that cosmologists have labeled “dark energy.” Several billion years ago, as the density of matter and radiation dropped sufficiently, this dark energy began to dominate the density of the universe. The term “dark energy” resonates with the kabbalistic term for the initial impulse of creation: *botsina de-qardinuta*, “a spark of darkness.”

The phrase “dark energy” is not really a physical description, but rather an admission of ignorance, a semantic surrender. This energy has never been directly observed—only inferred from astronomical observations. Over the past fifteen years, two significant satellites were launched: first the WMAP spacecraft (Wilkinson Microwave Anisotropy Probe, operated by NASA), and then the Planck spacecraft (operated by the European Space Agency). These have enabled scientists to determine that dark energy constitutes approximately 68 percent of the total mass or energy of the universe. Only 5 percent of this total is made up of ordinary, atomic matter—constituting galaxies, stars, planets, and everything we can see and touch. Most of the rest (about 27 percent) is composed of another hypothetical substance: an exotic type of matter that does not interact with light and is therefore invisible. Like dark energy, this “dark matter” has never been directly observed, but only inferred—partly from its gravitational effects on ordinary, visible matter. Yet even though we cannot observe this dark matter, billions of dark-matter particles are passing through each of us every second.

In other words, according to contemporary science, 95 percent of what exists in the universe is invisible and its nature unknown. We understand almost nothing about dark matter—and even less about dark energy. It seems that the more we know about the cosmos, the more mysterious it becomes.

Does the big bang, which serves as the scientific creation myth of our culture, have anything to do with God? Can it enrich our lives?

Physicists and theologians often contend that religion and science are two separate realms, each valid within its domain and operating under its own set of rules. The purpose of science is to explore nature, while the purpose of religion is to foster spirituality and ethics. But the question “How did the world come to be?” is vital to both disciplines because it is so fundamental—a question that humans have pondered ever since consciousness evolved to a point where it could reflect on itself and the cosmos.

This book opens with an account of creation according to the theory of the big bang. An overwhelming majority of cosmologists regard the big bang as the most reasonable explanation of the evolution of the universe, “the best approximation to truth that we currently possess.”

But the name of this theory, “the big bang,” does not convey the awesome nature of the origin of the universe. Furthermore, it is misleading because it implies that matter and energy exploded like a giant firecracker or an immense nuclear bomb in the middle of empty space. Yet according to the theory, space itself is part of the expansion of the universe, and matter is just carried along by the expanding space. So the bomb analogy breaks down. There were no sound waves to make the “bang” audible; the expansion was smooth and continues to this day.

The term “big bang” was coined by a bitter opponent of the theory: the English astronomer and physicist Fred Hoyle. In 1949, Hoyle gave a radio talk for the BBC on twentieth-century cosmology. Detesting the notion that the universe had

a beginning, he held a different theory, according to which the universe is eternal. In his talk, Hoyle criticized “the hypothesis that all the matter in the universe was created in one big bang at a particular time in the remote past.... This big bang hypothesis ... is an irrational process that cannot be described in scientific terms.” Although it is often claimed that Hoyle intended the phrase pejoratively, he denied this, insisting that he was simply seeking a striking image for the theory he opposed. In any case, the name gradually stuck. The origin of the cosmos has such grandeur, such an effect on our imaginations, that it has bestowed a measure of grandeur on the term “big bang” retroactively.

Still, some scientists and science writers yearned for a different, more evocative name, so a popular astronomy magazine, *Sky and Telescope*, sponsored a contest to find one. Not one of the 13,000 entries impressed the esteemed panel of judges enough to warrant replacing Hoyle’s phrase.

Leaving the name aside, how does this contemporary creation story affect—or challenge—our concept of God? Can it help us discover a spiritual dimension in our lives and recover a sense of wonder? *God & the Big Bang* wrestles with these questions. In conceiving and formulating answers, I have drawn on the insights of traditional Jewish learning, especially the mystical traditions of Kabbalah and Hasidism, as well as contemporary physics and cosmology. I suggest several intriguing parallels, but my purpose is not to prove that thirteenth-century kabbalists knew what cosmologists are now discovering. Rather, in juxtaposing these two distinct approaches—the scientific and the spiritual—I experiment with seeing each in light of the other. I am not trying to synthesize the two, because their unique perspectives should not be collapsed. This book seeks, rather, to bring the two into dialogue.

It is said that science demystifies nature, but scientists on the frontier are awed by the elegance and harmony of nature. As science reveals the secrets of the universe and deciphers the cosmic code, it evokes wonder. What science shows us about the evolution of our universe and our selves is as awe-inspiring as the accounts in Genesis or the Kabbalah. Let me give two examples: the color of the sky and the force of gravity.

Why is the sky blue? Among the wavelengths of light in the sun’s spectrum, blue oscillates at the highest frequency and is, therefore, scattered effectively by molecules of air in our atmosphere. Because the blue light is bouncing off air in all directions, the sky turns blue. To me, this is more amazing than ancient Mesopotamian and biblical beliefs that the sky is blue because of all the water up there.

Of the fundamental forces of nature, gravity is the one that most obviously affects our everyday experience. Gravity was conceived by Newton as a force exerted by objects *in space*, but Einstein showed that it is a property *of space*: the curvature, or “warping,” of spacetime. Imagine stepping on a trampoline. Your mass causes a depression in the stretchy fabric—and similarly with space. If you roll a ball past the warp at your feet, it curves toward your mass. The heavier you are, the more you bend space. As summed up by the physicist John Archibald Wheeler, “Spacetime tells matter how to move; matter tells spacetime how to curve.”

On a cosmic scale, the force of gravity is now overpowered by dark energy, which is accelerating the expansion of the universe. However, our own galaxy is not expanding—it is simply being carried along by the overall expansion—so within our galaxy and solar system, and on our planet, gravity still wields its power unimpeded.

Gravity is relatively weak between objects that have small masses, but it grows stronger as the objects grow in mass. So something as large as the Earth exerts a mighty gravitational force. When you throw a ball up into the air, gravity quickly brings it back down to earth—unless you're Superman, able to throw it at a speed of 25,000 mph, fast enough that it can escape our planet's tenacious pull.

As for the Earth, it is being drawn by gravity toward the massive sun. Fortunately, our planet's forward motion (and inertia) counterbalance the sun's gravitational attraction, keeping us in orbit around our star and preventing us from falling into its fires.

The sun, meanwhile—along with the whole solar system— orbits through our Milky Way galaxy and around the massive black hole at the center of the galaxy. And the entire Milky Way orbits with other galaxies in what is known as the Local Group, which itself feels the gravitational pull of the Virgo supercluster of galaxies.

According to the law of gravity, every particle in the universe attracts every other particle. So every object in the universe feels the gravitational pull of all other objects (although the farther away an object is, the less its gravitational pull). Gravity is constantly trying to tug everything together, drawing each separate thing toward the original unity of the cosmic seed before it sprouted in the big bang. Gravity conveys a yearning for oneness.

God is a name that we give to the oneness of it all. The theme of God as oneness is a recurring motif in this book. In part 2, "God, Self, and Cosmos," I explore the tension between this expansive view of God and the traditional, personal God. I also discuss the link between the concept of a personal God and the notion of self. According to Kabbalah, the world exists and

we have individual consciousness only because the infinite God has withdrawn Itself from a single point of Its infinity, thereby making room for finite being. We exist individually because we have lost oneness through a process the kabbalists call "the breaking of the vessels." Similarly, contemporary physics speaks of "broken symmetry," through which the initial unified state of being shatters, eventually generating the diversity of galaxies, stars, planets, and life. Physicists search for the symmetry hidden within the tangle of everyday reality. They dream of finding equations that link the apparently distinct forces of nature. Spiritual search, too, in its own way, charts a course through multiplicity toward oneness.

But is oneness livable? In part 3, "Torah and Wisdom," I outline a spiritual path that derives from Jewish tradition while remaining open to the wisdom of other faiths and the insights of science. I also touch on the problem of evil and describe the Jewish mystical technique of transforming "the evil impulse."

The book ends with a brief discussion of the fate of the universe and with reflections on our more immediate future.

Where do we fit in the cosmic scheme of things? Earth, our precious little ball of rock 4.5 billion years old, circles the sun once a year. Our entire solar system revolves around the black hole at the core of the Milky Way galaxy once every 250 million years. Our sun is an inconspicuous star, one of at least 100 billion in our spiral galaxy. Our galaxy is one of at least 100 billion galaxies in the observable universe. Andromeda, our closest neighbor, lies two million light years away. The two of us—Andromeda and the Milky Way—are members of the Local Group, on the outskirts of the Virgo supercluster. Beyond lie so many clusters and superclusters that it takes volumes just

to catalog them. They all appear to be arranged into gigantic domains that resemble the cells of a sponge.

We are infinitesimal, yet part of something vast. Becoming aware of this, we strive to comprehend the entirety. On this quest, spirituality and science are two tools of understanding. Their approaches to the question of our origins are distinct and should not be confused; each is valid in its domain. Occasionally, though, their insights resonate with each other. By sensing these resonances, our understanding deepens, nourished by mind and heart.

Acknowledgments

I want to thank a number of people for their help and advice. I benefited greatly from the insights and feedback of the cosmologist Joel Primack and the astrophysicist Howard Smith. Among the others who helped me refine my ideas are David Biale, Arnold Eisen, Elaine Markson, Andrew Porter, Robert J. Russell, and Howard Simon. I was stimulated by my students at the Graduate Theological Union and in a course I taught at Stanford University.

In the course of my writing, I heard that biblical scholar Richard Elliott Friedman was also working on the theme of the big bang and Kabbalah as part of his book *The Disappearance of God*. We met, talked, exchanged manuscripts, and became friends. I appreciate his deep learning, wit, and warmth.

Arthur Magida, editorial director of Jewish Lights, deserves a special thanks from me and the reader for his keen eye and his generous efforts to clarify my writing.

I am grateful to Stuart M. Matlins, publisher of Jewish Lights, for his enthusiasm and encouragement and for his vision.

Finally, an offering of thanks to Hana, for her love and support, for her soothing and inspiring presence.

Notes

Preface

ever since the big bang In this book I sometimes employ the term “big bang” to include the instant of “cosmic inflation” (discussed in chapter 1), although when cosmologists refer to the big bang they sometimes mean the period immediately following inflation.

“dark energy”... “dark matter” See Neil deGrasse Tyson and Donald Goldsmith, *Origins*, 64–97; Joseph Silk, *On the Shores of the Unknown*, 113–57; Joel R. Primack and Nancy Ellen Abrams, *The View from the Center of the Universe*, 100–11; Richard Panek, *The 4 Percent Universe*.

“the best approximation ...” John D. Barrow and Joseph Silk, *The Left Hand of Creation*, 21.

There were no sound waves ... John Gribbin, *In Search of the Big Bang*, 139–40.

Hoyle gave a radio talk ... The transcript of his talk appears in Fred Hoyle, “Continuous Creation”; the quotations appear on page 568. The following year (1950), Hoyle gave a series of talks for the BBC, and in the concluding one he said, “Broadly speaking, the older ideas fall into two groups. One was that the Universe started its life a finite time ago in a single huge explosion and that the present expansion is a relic of the violence of this explosion. This big bang idea seemed to me to be unsatisfactory even before detailed examination showed that it leads to serious difficulties. For when we look at our own Galaxy there is not the smallest sign that such an explosion ever occurred.” See Hoyle, “Man’s Place in the Expanding Universe,” 420–21.

As for his intention in coining the name, Hoyle later explained in an interview: “The BBC was all radio in those days, and on radio, you have no visual aids, so it’s essential to arrest the attention of the listener and to hold his comprehension by choosing striking words. There was no way in which I coined the phrase to be derogatory; I coined it to be striking, so that people would know the difference between the steady state model and the big bang model.” See Ken Crosswell, *The Alchemy of the Heavens*, 113–14.

Two decades earlier, in 1928, the astronomer and physicist Arthur Eddington had written: “As a scientist I simply do not believe that the present order of things started off with a bang.” He later wrote, “Philosophically the notion of an abrupt beginning of the present order of Nature is repugnant to me.” See Arthur S. Eddington, *The Nature of the Physical World*, 85; idem, *New Pathways in Science*, 59.

See also Hoyle, *The Nature of the Universe*, 119; idem, *Home Is Where the Wind Blows*, 253–55; idem, as quoted by Alan Lightman and Roberta Brawer, *Origins*, 60; Simon Singh, *Big Bang*, 351–53; Simon Mitton, *Fred Hoyle*, 127–29.

he held a different theory ... According to Hoyle’s steady state theory, the universe has been expanding forever without changing its overall appearance, as matter emerges in a process of continuous creation. See Hoyle, *Home Is Where the Wind Blows*, 399–423.

The origin of the cosmos has such grandeur ... Richard Elliott Friedman, *The Disappearance of God*, 264.

“Spacetime tells matter...” See John Archibald Wheeler, *Geons, Black Holes, and Quantum Foam*, 235. Cf. idem, *A Journey into Gravity and Spacetime*, 12: “If spacetime grips matter, telling it how to move, then it is not surprising to discover that matter grips spacetime, telling it how to curve.” See also Charles W. Misner, Kip S. Thorne, and John Archibald Wheeler, *Gravitation*, 5.

the infinite God has withdrawn Itself I utilize various pronouns in referring to God in this book. When quoting traditional sources or referring to the traditional conception of God, I often use “He.” When referring or alluding to the kabbalistic terms *Shekhinah* (the feminine divine presence) or *Binah* (the Divine Mother), I use “She.” When referring to *Ein Sof*, the infinite reality of God beyond categories of gender, I use “It.”

the Local Group ... Timothy Ferris, *Coming of Age in the Milky Way*, 175.

Chapter 1

The primordial vacuum ... teeming with virtual particles ... Ferris, *Coming of Age in the Milky Way*, 351–61.

an undifferentiated soup of matter and radiation Steven Weinberg, *The First Three Minutes*, 102.

Kelvin The Kelvin scale begins at absolute zero, the temperature at which molecular energy is at a minimum. This corresponds to a temperature of -273.15° Celsius (or Centigrade). A Kelvin degree is the same size as a Celsius degree.

the universe turned transparent ... “Let there be light!” See Ferris, *Coming of Age in the Milky Way*, 343; Weinberg, *The First Three Minutes*, 7–8; Gerald L. Schroeder, *Genesis and the Big Bang*, 88–90. For a critique of Schroeder’s attempt to fit scientific cosmology into the biblical framework of creation, see Friedman, *The Disappearance of God*, 230–34.

“Well, boys, we’ve been scooped!” Michael D. Lemonick, *Echo of the Big Bang*, 43.

ripples in the fabric of spacetime ... See George Smoot and Keay Davidson, *Wrinkles in Time*, 285; John Gribbin, *In the Beginning*, 37; Joel R. Primack and Nancy E. Abrams, “In a Beginning ...’: Quantum Cosmology and Kabbalah,” 68; Friedman, *The Disappearance of God*, 223–27.

We ... are literally made of stardust Technically, stardust makes up about 90 percent of a human body’s weight (consisting mostly of oxygen and carbon, along with small amounts of nitrogen, calcium, and phosphorous, and tiny amounts of numerous other elements). About 10 percent of our weight is constituted by hydrogen, all of which originated in the big bang and its aftermath, long before any stars were formed. See Primack and Abrams, *The View from the Center of the Universe*, 89; 324, n. 1.

chunks of material ... collided to form planets Ferris, *Coming of Age in the Milky Way*, 167.

“the best approximation ...” Barrow and Silk, *The Left Hand of Creation*, 21.

beyond the limits of the current theory See Willem B. Drees, *Beyond the Big Bang*; Hubert Reeves, “Birth of the Myth of the Birth of the Universe.”