

In the Beginning, 13.73 Billion Years Ago

Howard Smith | Fri. Oct 13, 2006

Since the start of the Hebrew month of Elul in late August, Jews have been examining the year past in search of lessons to apply to the year ahead. Now, as the holiday season winds to a close, the weekly cycle of Torah readings offers another opportunity to examine the past as we return to the study of the very beginning: Genesis and the story of creation. This year, modern science has something new to add.

The medieval commentator Rashi famously asks why the Torah, nominally a book of laws, begins with a seemingly incidental cosmology narrative. He answers, citing a midrash, that the account is included to demonstrate to all the nations that God created the Earth, and that the land of Israel can therefore be given to whomever God chooses. Land belongs not to people, but to the Lord.

Some 500 years after Rashi, the kabbalists of Safed developed their own perspective on the lessons of the Torah's cosmology. They built on a different midrash on Genesis, one formulated by the first-century rabbi Yonah and cited in the "Beresheit Rabbah."

Yonah asks, in the name of his teacher, why the Torah begins with the letter Bet — .a. His answer is that this letter is shaped like a bracket —] — closed behind, above and beneath, so that "we have no permission to discuss what is above or below, in front or in back, only onwards from the moment of creation."

The first mark in scripture then, after that signifying bracket, is the tiny dot inside the Bet that hardens its sound from "v" to "b." This dot signifies the primal point of creation, the embryonic universe, what the kabbalists called the "Resheit." "Beyond this point," says the Zohar, "nothing is known, and so it is called the Resheit, the first word of all." The Torah's literal opening statement is thus, "With the Resheit God created the heavens and the Earth."

The kabbalists weave an intricate account of the universe created from this infinitesimal speck, describing how it expanded and evolved with light and substance into our world. Like Rashi, the kabbalists derive a lesson from their cosmology: Humanity has a role in this drama. They explain that the work of creation has not been completed.

Tikkun olam is humanity's task — to heal the breaches and injustices of our society, imperfections that were embedded in the very fabric of the newly formed cosmos. The import of these lessons remains as appropriate today as ever, as we educe new interpretations from these old teachings.

There are also new teachings in the cosmological story, and some other lessons to derive as well. This has been another remarkable year for astronomers investigating how the universe was actually created — yes, today we know how the creation really did proceed. Readers may perhaps recall the essence of those ideas; they are expressed in the big bang model.

About 13 billion years ago, the universe as we know it exploded from an infinitesimally small point, much smaller than even an atomic nucleus, in a creative event dubbed "the big bang." The universe has been expanding from this point and evolving ever since, with its current dimension being approximately 46 billion light-years. The foundations for the big bang description were laid by decades of mathematical thinking and meticulous studies that culminated with Edwin Hubble's unexpected 1929 observation: Other galaxies are moving away from us with velocities that indicate a systematic recession, but yet, in accord with Albert Einstein's then recent theory of

relativity, the Earth has no privileged position. Hubble's results shocked people who only a few years earlier thought that our galaxy was the entire universe and that — as Einstein, too, had originally thought — the universe was static and eternal.

Hubble's data made use of 46 nearby galaxies. This past year, several different teams of astronomers reported progress on their programs to measure the recession velocities of hundreds of thousands of galaxies. Their results — with evidence from galaxies hundreds of times farther away than Hubble's sample — support Hubble's conclusion that the universe is systematically expanding.

There was other news as well. The newborn universe was tiny and fantastically hot, and its light was scattered by the plasma of electrons like headlights in a fog. Three hundred and eighty thousand years after the big bang, once the universe had cooled down enough for neutral atoms to assemble, light was finally able to travel through space unimpeded. That light is seen today as the so-called "cosmic microwave background radiation," and it permeates all of space. It is faint — but it is everywhere.

The cosmic microwave background radiation was discovered in the 1960s, and like the recession of galaxies, it has become one of the essential diagnostic features used to investigate the details of exactly what happened in the beginning. In 1989, NASA launched a small satellite, the Cosmic Background Explorer, to measure this radiation more precisely. Just last month, the Nobel Prize in physics was awarded to two astronomers who, with their teams, designed the explorer. NASA now has a newer cosmology satellite in orbit, the Wilkinson Microwave Anisotropy Probe. Last month this satellite team announced the results of the first three years of nonstop surveying of the cosmic microwave background radiation.

The universe, the probe satellite team reports, is 13.73 billion years old, with a formal statistical uncertainty in that number of only about 1%, or about 150 million years — less time than it took for the dinosaurs to come and go. (The team also measured another half-dozen fundamental properties of the universe with similar precision.) Wilkinson Microwave Anisotropy Probe and the various galaxy studies have bolstered our confidence in our understanding of the early universe, and solidified ideas that would have seemed completely ludicrous a century ago — ludicrous to scientists, that is, though not to kabbalists.

The same remarkable astronomical research, however, has simultaneously uncovered stunning new mysteries. The universe is not simply expanding, it appears to be accelerating outward into endless oblivion. Astronomers can account for only a paltry 10% of cosmic matter as being in known forms like planets, stars, galaxies or gaseous nebulae. The other 90% of substance is "dark matter," almost certainly some kind of unknown material.

Einstein's hoped-for theory to unite gravity and the other three forces of nature remains unrealized. The rigor with which the cosmic age has been determined only lends credence to the profundity of these three mysteries and other ones still remaining.

Like the cosmology of Rashi and the Safed kabbalists, modern cosmology also lends itself to a message and a lesson. The message is that our basic concepts about the universe are well-founded: The universe is not eternal and static; it was born, has evolved and is expanding. Yes, there are deep puzzles remaining, but we have increasing confidence in the scientific methods needed to resolve them.

The lesson comes when applying these realizations to the current political debates that have regrettably presented science and religion as antagonists — evolution, intelligent design, stem-cell research and human behaviors, to name a few. In the case of astronomy, and more generally as well, both science and religion are speaking to the same mysteries. In the arena of cosmology they offer perspectives that, though different, are consonant, not contradictory — as I hope the example of the Kabbalah illustrates.

Science and religion should therefore be partners, not adversaries, in the effort to fashion sensible and fair

political solutions. In this coming year of 5767 we owe it to ourselves to be more tolerant of divergent opinions, to abandon defensive and bitter rhetoric in favor of open inquiry and respectful listening, and to become better informed about the marvelous nature of the world which, as per Genesis 1, was created with language, and judged to be "very good."

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