PHILOSOPHICAL COSMOLOGY

by Edwin D. Reilly, Jr.
for the Sunday Gazette

> *As [George] Gamow first realized and as [Ralph] Alpher and his collaborator Robert Herman worked out with greater fidelity, all this means that if the big bang theory is correct, then space everywhere should now be filled with remnant photons from the creation event…. I recently reread the papers of Gamow, Alpher, and Herman that in the late 1940s announced and explained these conclusions. They are marvels of theoretical physics.*
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> –Brian Greene, "The Hidden Reality," Knopf 2011, p. 39

The Friday after one of my Gazette articles appears, my lunchtime friend, E.T. (not an extra-terrestrial), always asks me what I'll be writing about next. Last week, I said that I'd like to write about cosmology but thought that my readers would probably prefer that I stay down to earth; they wouldn't be interested. Ernie demurred, saying "But how come there are so many best-selling books on cosmology?"

So I'll take the plunge, wrestling with a subject whose surface can only be barely scratched within a thousand words or so.

Hidden Reality

My current favorite book on cosmology, "The Hidden Reality" is the second hugely successful best-seller published by string-theorist Brian Greene of Harvard. Greene gives several different scenarios that all lead to the conclusion that the universe is infinite in space and time, and may be part of what is now called a multiverse. And I certainly enjoyed his encomia to my late friend Ralph Alpher and to my teacher George Gamow (for one graduate course at George Washington University in 1955 while I was on active duty in the Air Force). It was Gamow's 1947 book "One, Two, Three…. Infinity" that inspired me to study physics.

Hawking weighs in

The best known author of a succession of works on cosmology is, of course, Stephen Hawking. Hawking is arguably the most intelligent person on this earth, although almost certainly not the most intelligent creature in all the trillions, perhaps an infinite number, of other earth-like planets revolving around an infinite number of suns in a universe containing an infinite number of galaxies. But we'll never get to meet those other guys and gals.

Hawking, now 69, has been living with a neuronal disease related to ALS, amyotrophic lateral sclerosis, a condition that has progressed over the years and has left him almost completely paralyzed, unable to speak naturally, and write only by holding a pen in his teeth. Yet he continues to do brilliant scientific work and write book after book.

Toward the end of Hawking's latest, "The Grand Design," he writes, provocatively, "Because there is a law like gravity, the universe can and will create itself from nothing. Spontaneous creation is the reason there is something rather than nothing. It is not necessary to invoke God to light the blue touch paper and set the universe going."

Hawking uses a British expression I was not familiar with, but Google says that when someone "lights the blue touch paper," they do something that causes anger or excitement. Those angered may believe that he is not a man of faith, but I'll tell you momentarily why that may not be true.

My view

My own philosophical cosmology began to form in early boyhood. My Baltimore Catechism taught that "God had no beginning; He always was and He always will be."

The second part of that premise never bothered me. I can imagine that something that exists—a universe for example—could just run forever and thus never cease to exist. But for something to have existed infinitely long back into the "past" is a thought that hurts the brain. Mine, anyway.

One solution is that there is no "past." Time could be a local illusion, with everything in the multiverse being just "there" and must have always been there "forever." That was the view of both Einstein and his close friend, Kurt Gödel (1906-1978), arguably the greatest logician who ever lived.

One day Gödel ran running to Einstein, saying, "Albert, I just discovered a new solution to your general relativity equation. In a rotating universe, time travel would be possible!"

I can't find a record of Einstein's response, but though he did come to believe in the mathematical validity of Gödel's solution, he didn't believe in the time travel of science fiction. What he probably said was "What could a universe of infinite extent rotate with respect to, nothing?"

The uncertainty of nothingness

Nothing? Well, that is the ultimate philosophical question: "Why isn't there nothing?" That would seem so much simpler. Or, couldn't there at least be "nothing" in a perfect vacuum, or outside the bounds of a finite universe?

The answer, we now know, is "no." No matter how hard experimental physicists try to evacuate a chamber to reduce its contents to "nothing," there is, always a bit of residual energy therein. And this makes theoretical physicists happy because a basic law of quantum mechanics says that the uncertainty in the energy you measure and the uncertainty in the precise moment at which you measure it must be greater than a small amount proportional to what is known as Planck's constant. This is called the Heisenberg Uncertainty Principle after the physicist who first enunciated such an "axiom."

And there is a good reason why that residual energy is always there, namely, pairs of particles of equal mass but opposite electrical charge keep popping out of the near-vacuum, hanging around for an infinitesimal time, and then recombining into a tiny piece of nothingness, leaving behind a Cheshire-cat smile of energy.

Axiomatic physics

So I called the Uncertainty Principle an axiom—something we choose to believe without being able to prove it—but it is the closest thing we have to explaining why nothingness is logically impossible. To build my own philosophical philosophy, I will choose a more general axiom that will subsume Heisenberg's.

My first axiom will be something like Newton's third law: For every action, there is an equal and opposite reaction. Mine is more general: Everything has an opposite. The

opposite of black is white. The opposite of good is evil. And, relevant to the task at hand, the opposite of nothing is, not just something, but rather *everything*. The implication is that the universe is infinite.

My second axiom is: No physical quantity can be continuous. Fundamental particles can be equivalent to mathematical points, such as light particles (photons) are, but those that extend over one, two, three, or more dimensions must be composed of a descending scale of smaller particles within them, each of which is an aggregate of points of energy separated by finite distances.

Now, the axiom implies that space and time, too (space-time), is not homogeneous; it must be "quantized." Space-time is full of a multidimensional grid of points at which something can "happen." The points are not necessarily separated by uniform "distances," nor unchanging ones, but particle motion is, like a movie made of quickly changing frames, an illusion. When their "time" at any point station is "up," it disappears and reappears at some other point. Time, such as it is, doesn't flow, it beats. And the axiom, I claim, implies the Uncertainty Principle.

As additional axioms, I'd throw in the Law of Least Action (you can look that one up) that is the basis for classical mechanics, and whatever others are needed to support what we know about quantum mechanics.

Waiting for Gödel

Now we are ready for Gödel again, a logician who chose to believe in God and a hereafter. His reason may have been based on his achievement in proving the most remarkable mathematical result of all time, one called the Gödel Incompleteness Theorem. What he proved was that in any sufficiently rich axiomatic system of logic, there are things that are true but which cannot be proved from within the system. Such things are called "undecidable."

So now Hawking and everyone has a choice. Those that choose to believe in the Old Testament, the New Testament (or both), the Koran, the Book of Mormon, or any one of several other books considered holy have chosen to be people of faith. Those that choose to believe that no god exists are called atheists. Those that aren't sure what to believe are called agnostics.

Gödel, the greatest logician the world has yet known, was nonetheless a raging paranoid. He believed that the furnace in his basement was trying to kill him; yet he would often run down and hide behind it when someone knocked at his door. He decided that the best way to cope was to stop eating. What would happen was certainly not undecidable. He starved to death.

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