

Expanding Universes and Shrinking Humans

Neal Sumerlin

The universe is about fourteen billion years old. It was born in a soup of unimaginably hot and dense matter, and in an incomprehensibly short interval of time, expanded from the size of a proton to that of a grapefruit, at which point its increase in size settled down to a more sedate pace. A few billion years shy of our own epoch, the slowly decreasing rate of expansion began to accelerate. The evidence for this switch to acceleration is compelling; the reasons are, to say the least, poorly understood. Does any of this information about the state of the universe matter? Why should we care? What do obscure speculations about “dark energy” or the “cosmological constant” have to do with the price of tea in China?

Many years ago, I was part of a book discussion group that was examining the latest book on the oddities of quantum mechanics, the very weird and equally successful field that describes the behavior of matter and energy at very small scales. One of the group members, addressing me and a fellow physical scientist, asked just that question: “What difference does it make?” It was a genuine question, asked with the expectation of an answer, not just to make a point of his own. I answered with more than a bit of flippancy that it really did not matter much. Certainly one need not be concerned with the discontinuity of energy flow when adjusting a thermostat! It was the very esoteric nature of the subject that appealed to me. There was a bit too much pride—perhaps arrogance—in my answer, a sense of knowing things that the unwashed masses did not and perhaps could not know. However, my companion gave a different answer. “It makes a difference,” he said, “in how we think about the world.” If the uncertainty principle, for example, precludes an absolutely deterministic universe, what does that tell us about free will? About a God who is bound by His own natural laws? About the limits of our knowledge?

I immediately knew who had given the better answer and said so at the time. Since then, my conviction of its truth has only deepened. In what ways has science changed the way we view ourselves and our world? In what ways has it not? We have moved from the center of the universe to a small planet circling a nothing-special star at the edge of a spiral galaxy undistinguished from hundreds of billions of others just like it. We have moved from the summit of creation to the contingent outcome of a natural process. Is there anyone who can doubt the impact of these discoveries? As science has shown us an ever-larger universe in both spatial and temporal dimensions, it seems that humankind has been concordantly shrunk to insignificance.

We have been down this road before. In *The Starry Messenger*, Galileo Galilei described the worlds revealed to him when he first turned his new telescope to the skies. Certainly the universe was both larger and less anthropocentric than we had imagined. Everything did not revolve around us, either literally or figuratively. Among Galileo's discoveries were four moons of the giant planet Jupiter. Here was a miniature version of the solar system itself, with a center of revolution other than the Earth. Because he first interpreted these points of light as being fixed stars oddly arranged in a line around Jupiter, Galileo was initially puzzled. However, his observations drove him to the conclusion that these points were moons circling the planet. The same physical laws that described the motion of other heavenly bodies described the movements of Jupiter's moons as well.

In our own generation, as recently as 1998, observations of supernova explosions at great distances from us have shown that, contrary to our expectations, the expansion of the universe is not slowing down. In a universe dominated by matter, we would expect that the rate of expansion would slow down, as the gravitational force exerted by this matter retarded its expansion. There must be something else, something previously unsuspected, whose influence

begins to assert itself as the universe expands and its density drops. In such a low-density universe, matter's influence declines, and that of the putative "dark energy" becomes apparent.

Let me pause to emphasize just how remarkable this recent discovery is, so much so that *Science* magazine named it 1998's "Breakthrough of the Year" (Glanz 2156). Forget for a moment the disputes over the exact causes of the original impetus for this universal expansion. Once the expansion has begun, the matter in that early universe will exert a gravitational attraction on all the other matter. Like gentle leashes pulling back on wayward galaxies, this tug would at least slow and perhaps even halt altogether the expansion of space-time, first discovered nearly eighty years ago. That, at least, we understood. At least we thought we did. It turns out that the universal expansion has actually been speeding up for the last five billion years. Nothing that we truly understand now could possibly cause that. "Dark energy" is simply a term for a cause that remains mysterious to us.

Both in 1610 and in 1998, the universe had a surprise for us. In both cases, the world we thought we knew was larger. Galileo took us from a world with humankind at the center and moved us to the periphery. The recent discoveries have indicated that the rate of increase for the unimaginable distances between galaxies is not slowing; it is accelerating. A cold and dark future is coming a few trillion years earlier than we anticipated.

It is hard to dispute the notion that to whatever extent civilization is suffering from existential angst, our unease results from these successive revelations of human insignificance. While science is ill-equipped to decide issues of a spiritual nature (or indeed whether such issues exist at all), it has surely dethroned certain concepts of what sort of god or gods there may be. The universe stubbornly refuses to conform to our notions of what it should or ought to be. It is what it is, and science has developed remarkably subtle tools by which to ask very simple and

limited questions. Has the universe always been as we see it today? Did it have a beginning? What is its future? The answers that science may give us will rely as always on the evidence we can wrest from nature. Our preferences for any particular kind of universe will not influence the outcome. Someone who lives in Lynchburg, Virginia, cannot avoid being aware of the continuing resistance to this centuries-old idea.

Yet I do not believe that the humility appropriate to these revelations must inevitably lead to despair. The natural processes that produced conglomerations of matter capable of considering questions of origin and purpose may be quite rare. We could be alone in the universe. Then again, we may be as common as cosmic weeds. Either way, the only way we will probably ever know is to continue our quest to understand the world, and the worlds, around us. There are surely new surprises awaiting us. To fail to seek them out because we fear their import is not caution, but cowardice.

Works Cited

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