THE FIRST UNITARIAN SOCIETY OF MILWAUKEE

COSMOLOGY TODAY

By

THE REV. DR. ANDREW C. KENNEDY

THE FIRST UNITARIAN SOCIETY OF MILWAUKEE
1342 North Astor Street • Milwaukee WI 53202
Telephone: 414 273-5257 • Fax: 414 273-5254
E-Mail: office@uumilwaukee.org
Visit us on the World Wide Web at www.uumilwaukee.org

READING from *Reflections on the Nature of God*
edited by Michael Reagan[1]

This morning, I would like to talk about "Cosmology Today."

If you follow developments in the area of astronomy or astrophysics at all, you know that these are astonishingly exciting times. There is definitely a new "golden age," of sorts, in progress right now in the development of astronomy and astrophysics and, by extension, cosmology.

By cosmology, I mean that branch of astronomy (and sometimes metaphysics) that deals with the nature of the universe in which we live. Thus, cosmology deals with the origin, the structure, and the destiny of the universe, and includes such basic questions as what kind of universe do we live in, and what is our place in it?

Our Reading for this morning is a brief passage by the popular author and scientist Paul Davies. It is found in a book called *Reflections on the Nature of God* – which, by the way, has some beautiful pictures in it (not of God, but of the stars). The book is edited by Michael Reagan.

> Physical processes come in two varieties — lawful and random. Traditionally, scientists assumed that the origin of life was a chemical fluke of stupendous improbability, a quirk of fate [nearly] unique in the entire cosmos. If so, then . . . the existence of life on Earth, in all its exuberant glory, is just [an] . . . accident.
>
> On the other hand a growing number of scientists suspect that life is written into the fundamental laws of the universe, so that it is almost bound to arise wherever earthlike conditions prevail. If they are right — if life is part of the basic fabric of reality—then we human beings are living representations of a breathtakingly ingenious cosmic scheme, a set of laws that is able to coax life from non-life and mind from unthinking matter. How much more impressive is such a magnificent set of physical principles . . . than the sporadic intervention of a deity who simply conjures these marvels into existence.

[1] Davies, Paul, in Reagan, Michael (ed), *Reflections on the Nature of God* (Philadelphia: Templeton Foundation Press, 2004), p. 25. In fairness to Davies, I should note that Davies portrays the first option noted (the random appearance of life) in a decidedly negative light, suggesting that if life arose simply by accident, then ours is but a "sterile universe" and it is all "just a meaningless accident." I do not think that such a negative view necessarily follows from adopting the random appearance of life hypothesis. Consequently, with apologies, if necessary, to Mr. Davies, I deleted some of his value-laden adjectives, such as "sterile" and "meaningless" because I believe his larger point is still eminently worth contemplating.

Cosmology Today

The Rev. Dr. Andrew C. Kennedy

On February 11, 2003, the first results started arriving from the new Wilkinson Microwave Anisotropy Probe. The Wilkinson Probe is an orbiting observatory — something like the better-known Hubble telescope — but with the capacity to detect a one-millionth of a degree temperature difference in what is called the cosmic microwave background. The cosmic microwave background is detectible throughout the universe, and is believed to be a residual effect from the original explosion of the Big Bang billions of years ago. In any case, the Wilkinson Probe confirms, with remarkable resolution apparently, that we live in a shadowy universe comprised of three types of matter or energy.

First, there is what we might think of as "ordinary" matter – things like the stars, the planets, dust and gas – things we can see and maybe touch (if they're not too hot). Just a few years ago it was discovered, and now the Wilkinson Microwave Anisotropy Probe has confirmed, that only 4% of the matter and energy of the universe is what we normally think of as this "ordinary" matter.

Secondly, the new Wilkinson orbiting observatory found that about 23% of the matter and energy of the universe is so-called "dark" matter. This dark matter, in large part, is what is thought to hold the universe together since it exhibits strong gravitational properties.

And, thirdly, the Wilkinson observatory found that the remaining 73% of the matter and energy in the universe is what the astronomers call, not dark *matter*, but dark *energy*. Dark energy is even more mysterious than dark matter, and is that which is thought to account for the fact that our universe is not only expanding, but – contrary to all the previous predictions and hypotheses – it is actually picking up speed! That is, as the universe expands, oddly enough, it has been discovered in just the last couple of years that its speed is actually increasing!

So, 4% of the universe is ordinary matter and the rest consists of dark matter and dark energy. (And when I say "dark," I mean that it is fundamentally invisible and largely undetectable. It's not just that there is no light around to see it.) Thus, a whopping 96% of the universe is largely a mystery to us since scientists have only the sketchiest of ideas about what dark *matter* is, and, so far, are almost absolutely clueless as to what dark *energy* is.

So, as humbling as it is, for the most part, we do not know what the universe is made of and we cannot see most of it. We do know there was a Big Bang about 14 billion years ago that released all of the matter and energy into the universe, but we do not know what caused it.

One intriguing, but highly speculative theory which speaks to what might have caused the Big Bang, or what might have happened before the Big Bang, is a theory first formulated by Lee Smolin of Pennsylvania State University. Smolin starts with black holes. Black holes, as you may know, are often formed when giant stars explode as supernovas and become neutron stars. They are so ultra-compact and their surface gravity is so incredibly powerful that nothing can escape a black hole – not even light. So the stars and gas and planets that get sucked into a black hole are never to be seen again – not in our universe anyway.

However, Smolin's theory suggests that beyond the horizon of a black hole – that is, if you went into a black hole, on the "other side," if you will, of the black hole — may be the beginning of another universe, punctuated, presumably, by another Big Bang. This would offer an answer to that perennial question of, "What happened before the Big Bang?" What happened before the Big Bang? Everything got sucked into a black hole in *one* universe and came bursting forth with a Big Bang in *another* universe. Now, given that there are about a hundred million black holes in our galaxy alone, this would suggest an enormous number of universes being created on the other "side," if you will, of our black holes!

Wouldn't that be interesting?!

II

Surely we inhabit a strange and sneaky universe that so cleverly hides itself and perhaps at certain black hole nodes turns itself inside out. It is as though we are in a giant three-dimensional, universal black sea, with the stars and planets like icebergs that show above the water, while the overwhelming bulk of the universe's matter and energy floats eerily below the surface, largely undetected and inexplicable.

Yet there is another curious, counter-intuitive fact, here, which further confounds even the nature of the matter we do see around us, namely, the fact that matter as we know it – like the wood of this pulpit – is composed chiefly of nothing! That is, matter is composed of atoms, which in themselves, of course, are very small. If, for example, we could see one of the atoms of this pulpit enlarged to the size of, let's say, a grain of sand, then on that same scale of enlargement, the pulpit would be about 2000 miles high – and stretching more than halfway across the country!

So, atoms are small, but they are mostly empty because they are made up chiefly of an electron cloud on the outside and a tiny nucleus on the inside which is 100,000 times smaller than the atom itself – with virtually nothing but space in between.

Now, if atoms are so small and largely empty, we might wonder just why solid matter, like this pulpit, is so solid. The answer is that the electron clouds, made up of incredibly fast electrons moving around the nuclei, exhibit very strong electrical charges which give atoms their characteristic shape and substance. But as Carl Sagan used to observe, if we were somehow able to turn off the switch — to turn off all of the electrical charges throughout the world, including the Earth — then everything would instantly collapse into an invisible dust, the Earth would disappear, and nothing would be left but diffuse clouds of virtually undetectable elementary particles. For, indeed, what we know as matter is mostly empty space.

Fortunately, however, no one has pulled the plug yet, nor is it likely anyone will.

So, in sum, 96% of the universe's matter is invisible, and the 4% that is visible is mostly empty. Humbling, isn't it? Okay, cosmologically, this tells us a little bit about the kind of universe in which we live. Now let's turn to time and space and to the deceivingly simple cosmological questions of "Where *are* we?" and "What is our place, as human beings, in the universe?"

III

Not so long ago, it was all pretty simple. We lived, it was thought, in three-storied universe. The Earth was at the center of the universe. God lived upstairs in heaven among (or beyond) the Sun, the moon, and the stars. People lived on Earth and were ordained by God to have dominion over the beasts of the land, the fish of the seas, and the fowl of the air. And Satan lived downstairs in the basement — in hell.

In 1543, Nicholas Copernicus, interestingly a Polish Catholic priest by training, changed all of that by proposing that the Sun, not the Earth, was at the center of the universe. Moreover, the Earth, he suggested, was just one of several planets — all moving in circular (or elliptical) orbits around the Sun.

Copernicus's works were banned by the Roman Catholic Church, the ban not being lifted for almost 300 years until 1835. The Protestants were equally outraged; some, like Martin Luther, calling Copernicus a "fool" and an "upstart astrologer." Some of the Copernican dissidents were punished by taxation, exile, torture, and even death. Nevertheless, Copernicus, of course, was proved to be right. Regrettably, the church's image of intolerantly resisting science has never fully recovered.

Other, equally stunning revolutions have come along since Copernicus's time which have also radically altered our way of thinking about the universe, its size, and our place within it. For one thing, the Sun is hardly the center of the universe anymore. The Sun was discovered, of course, to be part of a much larger system of stars, namely, the Milky Way Galaxy.

Until as recently as the 1920's, in turn, astronomers used to think that the Milky Way Galaxy, with its third to a half a trillion stars, was, again, at the center of things. Indeed, until Edwin Hubble in the 1920's, the Milky Way was thought to be the whole show – the whole universe! We now know, of course, that the Milky Way is only one of billions of galaxies.

The Milky Way is shaped, as you may recall, like a beautiful pinwheel of stars. All the stars in the Milky Way are gravitationally bound and are rotating around a giant spiral disk at the center of the galaxy. This disk is made up of older, redder stars. In one of the spiral arms of the galaxy's pinwheel, at a distance of about 30,000 light-years from the center of the galaxy, is our solar system.

Now, to get a sense of perspective here, if our solar system (the Sun and the planets) were able to fit in the palm of your hand, then the Milky Way Galaxy would be roughly the size of North America. So, our solar system is a small part of the much larger galaxy.

We are also moving.

Now, the Earth rotates, of course, and it revolves around the Sun, but our solar system is also moving. Our solar system is revolving around the center of the galaxy, but it takes 230 million years to make one revolution. Now, that sounds pretty slow, perhaps, but we will be covering 1.1 million trillion miles.

Meanwhile, to get the bigger picture here, our whole galaxy, the Milky Way, in addition to rotating, is also moving laterally. Indeed, it is cruising through the universe at a very respectable 1.4 *million* miles per hour, heading in the direction of the constellation Hydra.

Can't you just feel the wind blowing through your hair?

While scientists are not sure, they believe the Milky Way is probably being pulled along by a super cluster of galaxies, which is the term given to a group of galaxies that are traveling together. While 1.4 million miles per hour certainly seems pretty fast, it is notable, perhaps, that it would still take a spaceship over 2,100 years at this speed (at 1.4 million miles per hour) to travel from Earth to the Earth's next nearest star, Alpha Centauri, which, ostensibly, is pretty close by.

So, again, the Earth is rotating and is revolving around the Sun. The Sun and the rest of the solar system is revolving around the center of the Milky Way Galaxy, which is huge – with billions and billions of stars. The Milky Way, in turn, is part of a cluster of about twenty other galaxies, which are thought to be moving at 1.4 million miles per hour in the wake of a still larger configuration called a super cluster of galaxies. Each super cluster typically contains thousands of galaxies, each galaxy of which contains billions and billions of stars strewn across incredibly vast distances.

Now, as you probably know, when we look out into space, we also look back into time. What we see is not what there *is*, but what there *was*. Light is extremely fast – the fastest thing there is, in fact – but space is incredibly vast. From our galaxy, for example, to the next nearest spiral galaxy (called M31) is a distance of two million light years. Thus, when the light we see today from M31 (the next nearest galaxy) left for Earth, there were not even any human beings yet on the planet.

Similarly, the distance from the Earth to the most remote quasars is thirteen or fourteen billion light years away, which means that we see them today as they were before the Milky Way Galaxy – including our Sun and the nine planets – was even formed!

So, indeed, as we look out into space, we also, inevitably, look far, far back into time. And what we see is not what there is, but what there was.

IV

So, where is our place in the universe? The brilliant British theoretical physicist at Cambridge University, Stephen Hawking, in his best-selling book, *A Brief History of Time*, describes our place in the universe like this. He says,

> We have developed from the geo-centric cosmologies of Ptolemy and his forebears, through the helio-centric cosmology of Copernicus and Galileo, to the

> modern picture in which the Earth is a medium-sized planet orbiting around an average star in the outer suburbs of an ordinary spiral galaxy, which is itself only one of about a million million galaxies in the observable universe.[2]

Now, to some, this all may add up to create a somewhat unsettling picture of our place in the universe, and understandably so. For, at each step of the way, we, as human beings, have been moved farther and farther away from the center of the cosmic drama. Meanwhile, some of the most mind-boggling cosmological discoveries have occurred within our own lifetimes. Indeed, some are taking place right now, so that we have had very little time to assimilate the latest findings. So, all of this, I recognize, may be unsettling to some of you.

Meanwhile, the church, as an institution, in my judgment, has long foolishly resisted science, and in some quarters, regrettably, it still does. Witness the silly fights over the teaching of evolution.

One of the hallmarks of Unitarian Universalism, however, has been our ability to courageously embrace – and moreover, at best, to joyously celebrate – new knowledge as it emerges. After all, as human beings, clearly we are dignified, in part, by the very courage of the questions we are willing to ask and by the truthfulness and the elegance of the answers that we are able to grasp. Moreover, the grandeur of the cosmos – as huge and as strange and as impossible as it may be – this grandeur would be largely wasted if there was not some consciousness, like our own, to see and to hear and to feel and to revel in its glory.

And that, I would suggest, is our job – first, to fearlessly uphold the truths of science as they emerge, and second, to revel in the glory of the incredibly wondrous universe in which we live!

---

[2] Hawking, Stephen W., *A Brief History of Time* (New York: Bantam Books, 1986), p. 126.