

The Important Stuff is Invisible  
A sermon by Rev. Steven Epperson  
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UCV

Thirty plus years ago, UUs in North America went through a process of exploring and coming to an agreement on a set of Principles which would best express what we value and believe together as a religious community. It took several years, and lots of discussion and negotiation—(we are Unitarians after all!). Then in 1985, it seemed all was set: six principles, beginning with an affirmation of the dignity and worth of persons, and from there, a consensus on a set qualities of character and ways of being in relation in community and beyond that were most descriptive of us as we were, are and aspired to be.

And then, from the floor of the General Assembly, an additional Principle was proposed, and in that very moment, it was agreed: a seventh principle should join the other six--it was like, *how could we have forgotten this?* And so we read: *"We affirm and promote respect for the interdependent web of all existence of which we are a part."*

The affirmation of the interdependence of *all existence* arises from fundamental theological and scientific insights. From the ecological sciences (which I think inspired the seventh principle thirty years ago), there is an agreed understanding that every form of life depends on other living things, and on the non-living, physical environment as well—from the subatomic realm to the utmost bounds of the cosmos. Charles Darwin noted this when, over 150 years ago, he wrote: "It is interesting to...reflect that these elaborately constructed forms [of life], so different from each other, and *so dependent upon each other in so complex a manner*, have all been produced by laws acting around us."

Our seventh principle is also a theological statement; it expresses that this is how we believe and feel the world just *is* in its deepest, truest sense. Stating that we all participate in an interdependent web of *all existence* is a worldview which sees a oneness in things; it's the felt idea—it's something we feel utterly to be true—it's the deep seated belief that everything is part of a single underlying substance and reality. Essentially, this means that in spite of appearances, there is no true separation between things and people and planets—that at the heart of the matter, there is a universal oneness.

No wonder the seventh principle was so readily adopted thirty years ago. It anchors our seven principles and now resides at the very heart of the *Vision Statement* of the Canadian Unitarian Council—that interdependence, felt and in fact, is most true and truly desired by us and that it gives rise to our acting out toward each other and this one and precious world of ours in love and justice. It affirms what we know of the world from ecological and social sciences. The Seventh Principle also accords with a conviction of our Unitarian tradition, going back, in fact, a half a millennium—the Unitarian assertion of the unity and interrelationship of all things in the heavens and the earth. That insight carries with it the consequence of a ethic of respect and responsibility to justice and the well-being of all things.

I can't stress that fact about us strongly enough; it is, I believe, our most precious heritage. In rare, priceless moments we see and feel it; we point to it with awe and reverence, as best we can, in spite of all our limitations to comprehend; we gesture to and affirm that cosmic, earthly and affective unity, that astonishing interconnection. We approach this insight, we try to express it, when we talk about our personal experience of “transcending mystery and wonder,” of when we perceive “forces which create and uphold life,” and when we learn and speak of the “interdependent web of all existence.”

For fifteen years now, I have used the occasion of our First Advent Sundays to imaginatively journey together with you into realms of wonder disclosed by the sciences. So poorly educated myself in these domains while growing up, it has been a source of deep delight, in my autumnal years, to learn more about the splendours of the world around, within and beyond us. And so it is today. And what I want to talk about in the time remaining are recent scientific discoveries which testify, in fact, to interdependence and connecting webs—to heretofore hidden realities beneath our feet and stretching to the utmost bounds of the universe.

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It's hard to appreciate that before the 1930s, the universe, as pictured by astronomers, consisted of our Milky Way, surrounded by a static void of space of undetermined size and age. That's it: one galaxy and emptiness beyond! Now, stretch out an arm, make a dime-size space between thumb and forefinger, extend them above your head, and imagine you're looking at the night sky. In one small aperture like that, the largest telescopes in the world peer out and focus into deep space; and what they can see now is literally hundreds of thousands of galaxies like our own. Imagine sweeping the entire sky like that over the whole the entire earth, and feel the sheer awe tipping into vertigo: two trillion galaxies (!), each a system of millions and billions of stars in an expanding universe about 14 billion years old. (<https://www.theguardian.com/science/2016/oct/13/hubble-telescope-universe-galaxies-astronomy>)

And now hold on to your hats, because only 5% of the ordinary matter plus energy content of the Universe is known to us; the remaining 95% of the Universe?—roughly 1/3 of it is made of “dark matter” and the other 2/3rds is comprised of what's called “dark energy.” Each is still largely mysterious and essentially invisible to us—and yet without either of them, our universe and us could not exist. Discovered only in the past 20 years or so, dark matter and

energy “ultimately determined the dynamics of the formation of the structure in the universe.” And what’s that something we’ve learned about that structure? Here it gets interesting for us.

You’ve heard of or seen a topographical map, right?—it’s a two dimensional rendition of the three dimensional contours of the earth’s surface. Serious hikers and mountaineers depend on these kinds of maps to anticipate the degree of difficulty or ease of the rise and fall of the landscape across which they’re travelling, and prepare themselves accordingly.

Well, try to imagine a three dimensional map of the Universe. Using astronomical observations obtained from our most advanced telescopes, cosmologists have been running computer simulations of the evolution and overall mass and structure of the Universe on the largest scales possible. The results, coming in only in the past few years, have been the creation of stunning three dimensional maps of the Universe as it evolved from initial conditions after the Big Bang right down to the present and beyond. And what have they seen, what do they tell us? The distribution of those two trillion galaxies isn’t random—they’re not thrown out there, nor have they evolved willy nilly through space and time.

Rather, galaxies are organized, even today, in a manner resembling an enormous network—a cosmic web! That’s what cosmologists and astrophysicists are calling it: *the cosmic web*. Under the relentless push and pull of gravity, ordinary matter, enveloped by dark matter, has clustered into vast nodes of stars and galaxy groups. In turn, they’re connected to each other over vast, vast distances—hundreds of light years—by galactic filaments consisting of star groups and super heated clouds of matter rich gases. This term, writes astrophysicist Richard Gott, *the cosmic web*, "captures both the topology of the large scale structure and the thinness of filaments, reminiscent of a spider's web." (J. Richard Gott, *The Cosmic Web: Mysterious Architecture of the Universe*,

2016, p167)

Scientists are saying that the filaments not only form a network of bridges between galaxies, they're now thinking that these filaments accelerate the formation of new galaxies and funnel them toward larger galaxy clusters. And finally, the voids of space between filaments and star groups are home to that invisible dark energy which, in opposition to gravity, is causing the expansion of our universe to accelerate—something that's happening throughout the cosmos. "The cosmic web is expected to play an important part in understanding the mystery of dark energy, which astronomers now believe comprises 70% of the stuff of the universe today." (Gott,

193; on filaments and accelerated evolution of galaxies see <https://ucrtoday.ucr.edu/25894>; also <http://www.bbc.com/news/science-environment-25809967>; <https://astronomynow.com/2016/08/12/astronomers-use-cosmic-voids-to-study-the-universe/>; <https://www.sciencedaily.com/releases/2015/12/151202132934.htm>; <https://blogs.scientificamerican.com/sa-visual/the-beautiful-complexity-of-the-cosmic-web/>;) )

And it's the action of dark matter, acting on galactic scales, that's keeping the universe from literally flying apart. In sum, "the largest structures in the universe are giant filaments of galaxies stretching between the great clusters—[they] are the greatly expanded fossil remnants of initial random quantum fluctuations [after the Big Bang]. Grown by gravity with the help of the mysterious cold dark matter [and stretched out by dark energy] they form a magnificent, sponge-like cosmic web." (Gott, 179)

Those words were written by an astrophysicist in a book published just this year. Scientifically speaking, we didn't even know about nor could we prove something called "the cosmic web" back in 1985 when our Seventh Principle was adopted by Unitarian Universalists at a General Assembly. There's something kind of thrilling about the coming together of an inspired religious insight about the fundamental nature of all existence on the one hand, and the rise of the term "cosmic web" into the vocabulary of contemporary astrophysics which recognizes the interdependent action of energy and matter, heretofore hidden from view, on cosmic scales of time and space.

Let's just savor and wonder at that for a moment...because now we're going to plunge into another important hidden reality which, for the most part, has long been invisible to us, and yet is essential to life on this planet.

In his recent book, *The Hidden Life of Trees*, the forester and botanist Peter Wohlleben, writes this: "We know less about the ocean floor than we know about the surface of the moon; we know even less about...the complex...life in the soil...that busies itself under our feet....There are more life forms in a handful of forest soil than there are people on the planet. A mere teaspoon contains many miles of fungal filaments. All these work the soil, transform it, and make it so valuable for [the living well-being of] trees" and plants. (Wohlleben, *The Hidden Life of Trees: What They Feel, How They Communicate: Discoveries from a Secret World*, p 86; see also 49-51, 83-6)

Now botanists have known that there was *something* mutually beneficial about the relationship between plants, trees and fungi since the late 19<sup>th</sup> century. But until only the last two decades, most of what they knew was guess work; and little did they know how fantastically mutual that relationship was in fact. Then, in 1997, Dr. Suzanne Simard of UBC discovered that Douglas fir and paper birch trees transferred life enhancing carbon between them via a vast network of below ground fungus. Since then, scientists in Europe, China and North America have shown that plants and trees, even of different species and widely separated from each other, exchange carbon, nitrogen and phosphorus as well using the same route. (I'll come back to that in a minute.)

Take a look at the picture on the upper right side in today's order of service. Above you see a seedling, below ground, its relatively thick roots stretch and branch out into the soil. Look closer again, and we see, extending from those roots, a web of filaments attached to the seedling roots by small round nodes and extending out and beyond into the soil. And if your eyesight is really good, we see even more minute filamentary threads branching out through the dirt. It's all

a symbiotically connected network of roots and fungus—a network absolutely essential to the health of both forms of life—tree seedling and fungus.

I have three wonderful terms for us to walk away with today: *mycorrhizal network*, *mycelium* and *hyphae*. *Mycorrhizal* is a mash up of the Greek word *mycos*, meaning fungus, and *rhiza* meaning root. *Mycelium* is the fungal web attached to plant and tree roots extending out through the soil. *Hyphae* are the tiny filamentary tendrils of the mycelium. Being so small, *hyphae* can voyage where no plant root can go; *hyphae* conduct moisture and nutrients from the soil directly through the mycelia to root cells of plants and trees. In exchange for water and nutrients, the fungal network receives food from plants in the form of carbon based sugars. These sugars are manufactured above ground by plants through the process of photosynthesis—the carbohydrates are thus conveyed down through leaf, branch, stem and root, from the world above of blooming sun and fragrant air, down into the teeming life of roots and mycelia below.

The *mycelia*, symbiotically connected directly to the roots of their host tree and plant, also hook up with other mycelia below forest floors, meadows and gardens via their filamentary webs. And I'm talking extensive hooking up. It's been discovered that over centuries, a single fungus can cover many square miles and network an entire forest of trees of various species together as well as other plants beneath the forest canopy.

This interdependent web of plants and fungi gets even more beautiful and pleasing to contemplate. For in addition to the direct nutritive exchange I've described above, other kinds of exchanges are going on. Fungal connections enable the transmission of chemical and electrical signals from one tree and plant to the next, helping them to exchange news about insects, drought and other dangers and to take defensive action. For example, it's been shown that mycorrhizal

networks transmit messages about insect infestations on certain oak trees which led neighbouring oaks to increase the flow of insect resistant tannins in their veins. (Wohlleben, 10)

A series of studies begun by UBC's Suzanne Simard, and then carried out by other scientists around the world, is showing that large trees help out small, younger ones using the fungal internet—yes, botanists and science journalist are now calling below ground mycorrhizal network of fungus and roots the “wood-wide web.” In these studies, seedlings and small trees languishing in the shade and starved for food actually receive carbon and other nutrients from larger photosynthesizing trees via transmission through the extensive mycelia network. Says Dr Simard: “Plants are not really individuals” in the sense of competing for individual survival of the fittest. “In fact they are interacting with each other, trying to help each other survive.”

Kathryn Morris of Xavier University writes, “These fungal networks make communication between plants, including those of different species, faster and more effective. We don't think about it because we can usually only see what is above ground. But most plants [up to 90% of them] are connected down below not through their roots but via mycelia connections.” Christina Kaiser of the University of Vienna cautions: “we don't think there is an intention of a tree to help its neighbor....But it's clear that even a very mixed forest is much more connected than we thought.”

(see Nic Fleming, “Hidden under your feet is an information highway...” [www.bbc.co.uk/2014/11/11-plants-have-a-hidden-internet](http://www.bbc.co.uk/2014/11/11-plants-have-a-hidden-internet); Ed Yong, “Wood Wide Web,” *Atlantic*, [www.theatlantic.com/science/archive/2016/04/the-wood-wide-web/478224](http://www.theatlantic.com/science/archive/2016/04/the-wood-wide-web/478224) )

The fungal filamentary web exemplifies one of the great lessons of ecology: seemingly separate organisms are often connected and they mutually depend on each other. Similarly, contemporary cosmology is now speaking of the large scale structure of the universe as a “cosmic web” with galaxies interconnected, and their evolution accelerated, via galaxy to galaxy filamentary bridges. It's quite extraordinary!

Cosmic web. Wood wide web. World wide web. Funny how the latter term was created by the British Unitarian Sir Tim Berners-Lee, who was one of the principal inventors of the internet's world wide web. None of these terms were known or in use when, in 1985, Unitarian Universalists adopted the Seventh Principle as expressing something essential about us. Call it a happy accident, or a moment of fitting, even prophetic insight.

What I've hoped to convey today is a deeper appreciation for those words and for their scientific, theological and ethical meaning and worth to us. *"We affirm and promote respect for the interdependent web of all existence of which we are a part."*

Let's try not let the recitation of these words lapse into thoughtlessness. Let's ponder them, savour them—for if we do, the gates of perception may swing wide open to us through which we step into a landscape of wonder and gratitude for the bounty, both seen and unseen, of this one and precious world in which we move and live and have our being.

*[[[There are factors beyond number that account for our existence, of our being alive here and now, of the human family teeming in its billions across the surface of our planet Earth. One such factor were creatures very much like ourselves, who, eons ago on the African savannah, suspected that behind the rustling of branches might lie an unseen predator, and thus they took precautions to preserve their lives and those of their kin.*

*We're here, due to the fact that our remote ancestors knew that there is more to the world than we can see; that there are realities hidden beyond the reach of normal vision and experience. They passed this hard won knowledge down through the generations. In time, they went on to imaginatively formalize insights about things invisible by, among other things, "creating religions to help them make sense of mysterious forces in the world around them, to provide solace for the inequities of nature, and to ultimately deal with their own mortality." More recently in our history, the ancient Greeks and others speculated about a fundamental, unseen essence underlying all matter, and believed that what they called "aether" permeated both heavens and the earth, connecting stars and planets, the earth and us. This theorizing, in turn, has given way to and been supplemented by scientific discovery and the development of instruments to perceive what our eyes and ears cannot. And what has become manifest in our lifetimes, is the fact that the world of our normal experience reflects, indeed, but a mere part of a much greater whole. (Lawrence M. Krauss, "The Universe, 'The Important Stuff is Invisible,' New York Review of Books, March 10, 2016. I lifted the title of this sermon and the three examples below from Krauss.)*

*Just a couple of examples: every cubic centimeter of space is teeming with three hundred photons—that is particles of light—left over from the Big Bang explosion nearly 14 billion years ago. Every second, over 600 billion neutrinos—subatomic particles emanating*

*from nuclear reactions deep inside the sun—penetrate every square centimeter of our bodies, traversing them and the earth. Our bodies are literally vessels of cosmic freight and particles of light—something science has brought to our awareness in only the past few decades.]]]*