

# ***RAISING THE CURTAIN ON QUANTUM REALITY***

— A service/sermon by Jaco B. ten Hove — Paint Branch UU Church — July 30, 2006 —

*Things are not as they appear to be. Nor are they otherwise.*

—The Lankavatara Sutra (Mahayana Buddhism)

## **CALL TO WORSHIP**

I call us into worship this fine morning with the excellent Hindi word, ***Namasté***.

Derived from the Sanskrit, ***Namasté*** is a South Asian greeting, originating in India, and used when either hello or goodbye would be offered in English.

But the meaning is quite different, suggesting a reverential acknowledgement of the fundamental unity of things and people. One translation would be: "The part of me that is also in you, greets you."

Another way of saying this is: "I recognize and honor the Holy in both of us (or all of us)."  
***Namasté***.

My theme today also points toward a fundamental unity. It is perhaps an ambitious topic for a sermon: quantum reality, which may be something of riddle and a mystery to many of us. Much of it still is to me, even after some prolonged study of the field.

But then life itself is a riddle and a mystery, begging, as it does, some eternal questions that are eternally pursued by almost all systems of thought and belief: *Where do we come from? What are we? Where are we going?*

And now I've given you all the words to our opening song, from the new UUA Hymnal Supplement, "Singing the Journey" [#1003, "Where do we come from?"]...

## **READING:** Quotes from Richard Feynman

[Follows Joyce Poley's song "*Help Me See* the part of me that lives inside of you."]

INTRO: Someone who helped many students of physics "see" the mysteries of the interconnected realms was Professor Richard P. Feynman ["FINE-man"], a Nobel laureate in physics, best-selling author and former member of the presidential commission that investigated the Challenger Shuttle disaster of 1986.

Mr. Feynman was a very popular and energetic lecturer who, despite an 8-year battle with cancer, continued to teach at the California Institute of Technology until two weeks before his death in 1988 at age 69.

He was widely known for his insatiable curiosity, gentle wit, brilliant mind and playful

temperament, but was also called “the most original theoretical physicist of our time” [UPI]. His bestselling autobiography full of rather outrageous anecdotes is called “Surely You Must be Joking, Mr. Feynman!”

For instance, early in his career Feynman was a member of the team that developed the first atomic bomb at the Los Alamos Scientific Laboratory. Characteristically unintimidated by authority, Mr. Feynman spent some of his spare time during these years picking the locks on filing cabinets of classified information. Without disturbing any papers, he left taunting notes that disturbed officials who then knew that their security system had been breached.

He was awarded the Nobel Prize in 1965, along with two others who had all worked independently on problems of quantum electrodynamics, which describes how atoms produce radiation. In reconstructing almost the whole of quantum physics and electrodynamics in his own way, Feynman derived a way to analyze atomic interactions through simple diagrams, a method that is still used widely.

His unconventional and free-ranging approaches were a key to opening up new vistas of scientific thought. A few quotes may give you an impression of the kind of thinking and attitude that it takes to comprehend, let alone teach about, quantum physics...

*“I can live with doubt and uncertainty and not knowing. I think it is much more interesting to live not knowing than to have answers that might be wrong.”*

“If we will only allow that, as we progress, we remain unsure, we will leave opportunities for alternatives. We will not become enthusiastic for the fact, the knowledge, the absolute truth of the day, but remain always uncertain... In order to make progress, one must leave the door to the unknown ajar.”

*About Quantum Mechanics, Feynman said, “I cannot define the real problem, therefore I suspect there's no real problem, but I'm not sure there's no real problem.”*

“When you are *solving* a problem, don't worry. Now, *after* you have solved the problem—*that's* the time to worry.”

“Do not keep saying to yourself, if you can possibly avoid it, 'But how can it be like that?' because you will get 'down the drain' into a blind alley from which nobody has yet escaped. *Nobody* knows how it can be like that.”

*“The first principle is that you must not fool yourself - and you are the easiest person to fool.”*

We can imagine that this complicated array of moving things which constitutes “the world” is something like a great chess game being played by the gods, and we are observers of the game. We do not know what the rules of the game are; all we are allowed to do is to *watch* the playing. Of course, if we watch long enough, we may eventually catch on to a few of the rules.

*"The vastness of the heavens stretches my imagination. Stuck on this carousel my little eye can catch one-million-year-old light—a vast pattern, of which I was a part. Perhaps my stuff was belched from some forgotten star. . . It does not do harm to the mystery to know a little about it. Far more marvelous is the truth than any artists of the past imagined!"*

"Physics is like sex: sure, it may give some practical results, but that's not why we do it."

"The wonderful thing about science is that it's *alive*."

*END.*

Sermon: ***RAISING THE CURTAIN ON QUANTUM REALITY***

by Jaco B. ten Hove

Richard Feynman really lived up to the first syllable of his name: he was *rich*, in character, at least. For instance, there's a whole web page devoted to "Feynman Tricks" [<http://amasci.com/~billb/cgi-bin/instr/instr.html>], which are fun to consider or try, if you dare. They usually alter one's awareness in some productive, if occasionally goofy way.

But some even have to do with science, more or less; like what he called "the Celestial Crawl"—a particularly good summer activity. Here's his suggestion:

On a cloudless warm night, walk around until you can put (the top of) a nearby building or tree very close to a bright star in the eastern sky. Now lay on the ground and move yourself until the (edge) of the building or the top of the tree just *BARELY covers* that star. Wait a moment. The star will reappear. Wiggle along to cover up the star again. It reappears. Keep wiggling along. (This helps you really notice that the entire Earth is rotating beneath you.)

Feynman also advised keeping a pocketful of coins with you at all times, always looking to leave them in knee-level, weird places where only a child would ever see them. Like in half-turned coin slots of candy-dispensers. He really enjoyed imagining the eventual entertainment that would result from this intentional seeding of the universe.

I highlight such quirky aspects of an historically important contributor to advanced physics because Feynman's life story reminds me how essential it is to "think outside of the box," especially since "life is a riddle and a mystery." [Reference to earlier song #1003: Where Do We Come From.]

I believe our best hope as a species for rising to an improved level of consciousness that might lead us to some peace in a crowded world is to encourage more of that attitude, to "not become enthusiastic for...the absolute truth of the day, but...leave the door to the unknown ajar" and stay alert for new awareness that could come to us from any angle at all.

Richard Feynman never got to experience the 21<sup>st</sup> century, but if he were still among us, he'd notice how science is certainly "alive" in our time, too. He'd likely be contributing to that quality, as he did for many years of the 20<sup>th</sup> century...

...As did numerous others before him. In their own fashion, scientists have long tried to help answer big questions, such as "Where do we come from? What are we? Where are we going?" [Reference to earlier song #1003: Where Do We Come From."] The middle question in that trio—"What are we?"—seems to be the one particularly addressed by quantum physics, which is my topic today.

My hope is to provide you with some useable understanding of what I think will continue to emerge as a ground-breaking realm that can and will significantly shape the rest of our lives. I make no claim to comprehend all of quantum theory myself, or maybe even most of it, but I've dabbled enough to be dangerous, I suppose.

Let me begin my humble excursion into this inscrutable field with a little background. A few 19<sup>th</sup> century scientists [notably Sir William Hamilton] did in early foundational work that led to the arrival of so-called "quantum mechanics" in 1925, when the 24-year-old German physicist Werner Heisenberg developed what he first called "matrix mechanics," based on an innovative way of understanding the behavior of sub-atomic particles, using mathematical matrices.

"Sub-atomic particles," you may know, are the tiniest of elements that themselves then constitute electrons, protons and neutrons, which in turn combine to form atoms, which are pretty darn small as it is. At the sub-atomic level, "particles" are so tiny that physicists can only measure what they have at the beginning of an experiment and what's there at the end, resisting any speculation about what actually happens in between, which they can't reliably examine. Thus they use *probabilities* to suggest "tendencies" of behavior.

Back to Heisenberg, whose revolutionary calculations showed the presence of sub-atomic *discontinuities* and quantum leaps in and out of previously unheard of states. His experiments (and those of some colleagues) produced repeatable results that could not be accounted for or predicted using previous understandings of physical science. So a new system was born, although not without controversy and resistance, of course.

About that same time the Austrian physicist Erwin Schrödinger proposed the related but more aesthetic notion of "wave mechanics," which used experimental evidence to show that sub-atomic *particles* were also *wave*-like in nature, again a result that could not be accounted for in the predominant classical physics.

Visualize, if you will, sub-atomic "particles" as relatively solid, and waves as undulations in motion. Schrödinger's contribution was the notion that light, when it is not being measured, is in the undulating waveform, existing anywhere and everywhere as a potential event, called a probability field. Only when it is measured does light "collapse" into particle-form as a solid, suddenly located and observable.

This advance was a comparable leap in awareness to Heisenberg's matrix mechanics, although the two physicists were not exactly aligned. Evidently, Heisenberg found the physical ideas of Schrödinger's theory "disgusting," and Schrödinger was "discouraged and repelled" by the lack of visualization in Heisenberg's method. Oh, well.

Such interpersonal disparagement notwithstanding, these two young giants were among 30 of the world's most notable physicists who gathered for what was a scintillating and memorable conference in Brussels, Belgium in the fall of 1927, to discuss the newly formulated quantum theory.

Another influential young scientist, Niels Bohr, joined them from Denmark, having been awarded the Nobel Prize in Physics a few years earlier. Bohr gets credit for contributing the principle of "complementarity," which showed that sub-atomic elements can be separately analyzed as having several *contradictory* properties. For quantum physics, this principle was another helpful way to understand the incongruous but undeniable complementarity of waves and particles.

Albert Einstein was at this conference, too, certainly, and his earlier work on relativity helped set the stage. But he had some trouble accepting portions of the newer revolutionary ideas, especially what emerged as the first consistent formulation of quantum mechanics, known as "The Copenhagen Interpretation" (so named because it was championed by Niels Bohr, the Dane).

There's a whole lot of abstraction attached to this that I can't paraphrase, but as far as I can figure out the main thrust of the Copenhagen Interpretation is that there is no absolute truth to be found anywhere anyway, so give up trying and just concentrate on what we're actually experiencing, which was a lot of repeatable results that didn't fit into classical physics.

Einstein was never able to settle for explanations that contained inherent contradictions and said, rather famously, "God does not play dice." Bohr evidently shot back, "Einstein, stop telling God what to do." (Their debates around this time are legendary.) When reminded in 1927 that he had revolutionized science some years earlier, Einstein replied, "A good joke should not be repeated too often." And decades later another genius, Stephen Hawking, continued the notable conversation by adding: "Not only does God play dice, but sometimes throws them where they cannot be seen."

In that same significant year, 1927, Heisenberg announced his immensely formative Uncertainty Principle, which is also complex enough to defy a full explanation here, but the gist is that any sub-atomic particle immediately changes when it is measured, so that, for instance, we cannot accurately know a particle's position *and* momentum simultaneously. If we measure its *position*, we cannot also know its motion, which is automatically changed by our attention to it. We can measure for *motion*, but that inherently prevents us from truly knowing its location.

Another way to imagine this, with reference in the larger world, is to realize that every observation we make requires an energy exchange to create the information sought,

meaning that some number of photons move from the item observed to our receptive eye. On a macro level, think of the starlight we see when we look upward at the night sky. We might realize that the light arriving at our eyeball to give us the image of that pinpoint in the sky has been traveling some number of light-years to get to us from its source.

Evidently this kind of exchange happens on a *micro*-level, too, just a whole lot faster and with incredibly tinier distances. At that level of measurement, physicists can predict the characteristics of a single subatomic particle with accuracy equivalent to estimating the distance between New York and Los Angeles to within the width of a human hair, as Richard Feynman liked to say. And they can measure infinitesimal changes, too.

Now, our notice of a bright star in the sky isn't likely to alter its make-up any time soon, but at the other end of the size spectrum, observing alone makes such a difference that investigators could no longer be sure what it is exactly they were examining, because it had already changed.

At the sub-atomic level, this is a really big deal, because any attempt to measure the property of a particle instantly alters it, which severely limits the ability to precisely determine its full characteristics, say, both the position *and* momentum of the particle.

(Here's an example of the kind of joke quantum physicists tell, applying the Uncertainty Principle to larger life: Heisenberg was out for a drive one day when a traffic cop stopped him and asked a typical question in that situation: "Do you know how fast you were going?" Heisenberg confidently replied, "No, but I know *where* I am.")

And so, as of 1927, uncertainty became a given, unavoidable—at least in the sub-atomic realm. (But we're talking about the building blocks of all matter and energy, so there are huge implications for our wider understanding of how things work.)

Five years later, Werner Heisenberg was awarded the 1932 Nobel Prize in Physics "for the creation of quantum mechanics." The next year, Erwin Schrödinger received the same Prize "for the discovery of new productive forms of atomic theory." Numerous of their fellow conferees in Belgium also received similar recognition in that early era of quantum mechanics [e.g., Max Planck, 1918; Albert Einstein, 1921; Louis de Broglie, 1929; Paul A.M. Dirac, 1933—all in Physics].

Let me pause and emphasize that these milestones all happened around 75 years ago. Now I had some vague knowledge that quantum mechanics had been around awhile, quietly animating deeper scientific circles, *but 75 years!*

It's been a quiet revolution since then, generally, unfolding behind a technical curtain, affecting mostly scientific understandings of atomic-level interactions of matter and energy, without impacting much of the everyday world the rest of us are caught up in.

One indication that this is beginning to shift significantly, however, is an increasing propensity to not call it quantum "mechanics" anymore, since the extensions of this realm have become anything but mechanical.

It superseded classical Newtonian *mechanics*, which really did promote a mechanistic worldview, as if the universe were a big machine that could be figured out by knowing how all its component parts worked separately. So that was the first way of thinking about this new realm, too, because “mechanics” generally refers to the study of motion.

But it may be more accurate to call it *quantum theory* or the *quantum reality map*. What’s emerged from this quiet revolution is now beginning to influence wider fields, and the shape it’s taking may well be more organic than mechanistic. As the curtain rises and more of us non-scientists grapple with quantum findings, we are seeing pathways to awareness that point toward a future of hope and holism, even if it be full of ambiguity and uncertainty—“a riddle and a mystery” still.

As expressed by American physicist and former NASA researcher, Barbara Brennan [in *The Hands of Light*, her 1989 book about the Human Energy Field]:

“Quantum physics is beginning to realize that the Universe appears to be a dynamic web of interconnected and inseparable energy patterns. If the universe is indeed composed of such a web, there is logically no such thing as a part. This implies we are not separated parts of a whole but rather we are the Whole.”

Even the quantum pioneer, Erwin Schrödinger, late in his career articulated the meaning of these developments [in “Mind and Matter,” 1958]:

“The world is given to me only once, not one existing and one perceived. Subject and object are only one. The barrier between them cannot be said to have broken down as a result of recent experience in the physical sciences, for this barrier does not exist.”

Subject and object are only one. “(R)ecent experience in the physical sciences” has rather thoroughly trounced on older paradigm understandings of so-called “classical physics,” which derived from the insights of Newton, Descartes and Copernicus—all of which served us well enough for centuries, and, in many ways, still apply.

Over the past 75 years, it’s actually not so much a wholesale replacement of theories as an extension beyond what we knew before. We haven’t torn down classical physics like a barn and put up a new quantum skyscraper in its place. Instead, it’s like we’ve gone farther up a metaphorical mountain and can now see more, including *but beyond* the previous resting spot. We can now see how limited the view was from there, even though that view still works, for what it is.

If you refer to the chart I’ve created [below], you’ll see a (very linear and brief!) comparison of how Quantum awareness has undone pieces of the earlier system of thought about how the universe operates, at least at the sub-atomic level.

For instance (on the chart), in the realm of **Reality**:

We used to believe that one could perceive the physical world objectively, as if it were independent from us, fixed. But now, as the Heisenberg Uncertainty Principle has pointed out, things are not as cleanly observed as we thought, and objectivity is an illusion. We may not recognize this in our everyday lives, but underneath, in the quantum reality, "Subject and object are only one."

<i>REALM</i>	<i>CLASSICAL PHYSICS</i>	<i>The QUANTUM UNDOING</i>	<i>EMERGING PARADIGM</i>
<b>REALITY</b>	Objectively real physical world that is fixed, independent of observers	<b>NOT</b> fixed! (although the everyday world is smoothed out)	?

To me, this may be the most disruptive of quantum influences (although there is certainly competition for that role). What this proposes, quite scientifically, is that objectivity is fundamentally unachievable.

And of course we do not observe everything all at once, so anything that has not yet been observed exists in a state that quantum physicists call "superposition," which means being in all *possible* states at once, since we cannot reliably predict what it will look like once observed, because that act will change it anyway. (See why it's called the "Uncertainty" Principle?)

The most famous example of superposition is the regrettably gruesome thought experiment called "Schrödinger's Cat," in which a feline in a closed box is understood to be neither alive nor dead until the box is opened and the actual cat observed. Until that time, the cat is *both* alive and dead. (Technically, in probability terms, it is half-alive and half-dead.)

In quantum understanding, anything not yet observed—still "in the box," as it were—could be a wave OR a particle. We don't know until it is measured, at which time it "collapses" into an observable event. Until then, like the unseen cat, it could be either.

Now, at the level on which we live, things are generally smoothed out and the rules of classical physics still apply reasonably well, so we don't have to wonder about every step we take, waiting for something immediately before us to "collapse" into form. But under the surface—or up higher on the metaphorical mountain, superposition and uncertainty dominate.

2. Okay, next on the chart, in the realm of **Locality**:

<i>REALM</i>	<i>CLASSICAL PHYSICS</i>	<i>The QUANTUM UNDOING</i>	<i>EMERGING PARADIGM</i>
<b>LOCALITY</b>	Objects are influenced only by direct contact	<b>NON</b> -locality <i>requires</i> un-mediated action at a distance	?

We used to believe that objects could only be influenced by direct contact and immediate proximity. You had to be local to affect something. But other portions of quantum physics that I've not mentioned here [such as Bell's Theorem] explain how this assumption is inaccurate and incomplete.

The speed of light is somehow no longer a limit, and all "information" everywhere is interconnected in such ways that anything can appear anywhere instantaneously. In fact, quantum physics requires this.

It's hard to fathom, perhaps, but a lot of intriguing experiments have confirmed so-called "non-locality" (seen, for instance, in the demonstrated effects of focused group intention on a distant subject). It's still very mysterious, and maybe not *very* effective, but non-local influences do happen nonetheless. Something is going on.

3. Next on the chart, in the realm of **Causality** (or Cause and Effect):

Time was once thought to be absolute and moving in one direction only: forward. But quantum physics has shown that time is no more fixed than any other aspect of reality.

<i>REALM</i>	<i>CLASSICAL PHYSICS</i>	<i>The QUANTUM UNDOING</i>	<i>EMERGING PARADIGM</i>
<b>CAUSALITY</b>	The arrow of time points in one direction: forward	<b>NOT</b> absolute! the appearance of time as "fixed" is an illusion	?

We may not notice this as our lives unfold ever forward, but there is documentation enough now to prove that time is a much more fluid concept than we ever thought, depending a lot on one's frame of reference.

4. And finally, in the realm of **Continuity**:

Classical physics described space and time as smooth, with the natural world as a defining container; whereas in quantum reality *discontinuities* exist in the space/time fabric, which is not contiguous at all.

<i>REALM</i>	<i>CLASSICAL PHYSICS</i>	<i>The QUANTUM UNDOING</i>	<i>EMERGING PARADIGM</i>
<b>CONTINUITY</b>	Space and time are smooth; no jumps beyond nature	<b>NOT</b> contiguous! <b>DIS</b> -continuities exist in the fabric of reality	?

Einstein's General Theory of Relativity (fully published in 1915) unleashed all manner of possibility and undid the rules of Euclidian geometry by showing how in curved space parallel lines can meet, and the sum of the angles in a triangle can be more, or less than 180 degrees, etc. This opened doors for the quantum leaps that followed.

You'll notice on the chart that I've placed question marks in the far right, "Emerging Paradigm" column, because we are still very much in a transitional period. New quantum understandings have undone large assumptions of our previous system of thought, but not much has emerged yet to positively replace the old paradigm. At least we haven't yet been able to clarify how the new paradigm will guide us, beyond the need to unlearn a lot of our basic assumptions about the universe.

We can see that our view before was inadequate, but exactly where we're headed now has yet to come into focus. So our natural tendency is to still generally order our world (and our worldview) with a reliance on classical physics, even as we sense that things are in flux. Indeed they are, and getting used to that reality may be the essence of our next paradigm, as we climb higher on the metaphorical mountain for an ever-widening view.

About the clearest beacon I can see for what's ahead that is a visionary draw forward (rather than simply a denial or defiance of what was), is the notion, already alluded to, of Oneness—which can also be articulated as Interdependence, such as in our Seventh UU Principle (found inside the back cover of most Sunday Bulletins).

Oneness is not really a new idea, of course, but now we are called to intentionally explore it with new eyes, challenging as that path may be.

A large part of me that wants to know Oneness and live coherently with Oneness—whatever that means or will mean—believes fervently in this path. Every fiber of my intuitive being tells me that we as a species must lean in that direction, and the sooner the better. In fact, I suspect Oneness is the "Holy Grail" we seek to help transform our culture and planet from violent materialism to peaceful diversity.

An encouraging resource may be a new independent film, just released, called, simply, "ONE, The Movie." It's evidently a series of insightful interviews of leading figures on the world stage of spiritual thought, all lending their voices and sharing wisdom "in the cause of Oneness." I don't think it's showing yet in this area, but you can find out about it on the web ([www.onethemovie.org](http://www.onethemovie.org)).

My poking around in this odd, abstract and humbling field of quantum science has affirmed for me the direction of Oneness. I expect to spend the rest of my life figuring out what it looks like. I also expect that much of what I think I know now will be proven wrong soon enough, and I will have to adjust and readjust my thinking, perhaps even my metaphors.

But I take comfort in the thought that Einstein himself is an ally "in the cause of Oneness." Listen to this profound quote from Time Magazine's "Person of the (20<sup>th</sup>) Century":

"A human being is a part of the whole, called by us "Universe"—a part limited in time and space. (We) experience (our) self, (our) thoughts and feelings as something separated from the rest—a kind of optical delusion of (our) consciousness. This delusion is a kind of prison for us, restricting us to our personal desires and to affection

for a few persons nearest to us.

“Our task must be to free ourselves from this prison by widening our circle of compassion to embrace all living creatures and the whole of nature in its beauty. Nobody is able to achieve this completely, but the striving for such achievement is in itself a part of the liberation and a foundation for inner security.”

[Quoted in H. Eves, *Mathematical Circles Adieu*, Boston, 1977]

“Inner security” may be what we have to hold onto in an era of increasingly diminished *outer* security. We acknowledge in our hearts that “life is a riddle and mystery,” and hope our minds can stay loose and creative enough to imagine our way out of some of the distressing boxes we’ve gotten ourselves into.

Oneness calls and another quantum leap awaits...

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“Useful as it is under everyday circumstances to say that the world exists “out there” independent of us, that view can no longer be upheld.” — J. A. Wheeler\*

\***John Archibald Wheeler** (b. July 9, 1911) is an American theoretical physicist (and reportedly a Unitarian Universalist). One of the later collaborators of Albert Einstein, he tried to achieve Einstein's vision of a unified field theory. He also coined the term "black hole" in 1967.

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## **PRAYER**

In the name of all that is Holy, which is all the great mystery of the even greater Oneness, let us pause in this beloved company,

to breathe in *compassion* and breathe out *hope*...  
to breathe in *celebration* and breathe out *peace*...  
to breathe in *diversity* and breathe out *Oneness*...

As we breathe consciously, so shall we live consciously, in gratitude for the abundance of our community and in support of those among us in need. Amen and Blessed Be.

## **CLOSING WORDS**

We do celebrate the web of life, which shimmers in radiant, if inscrutable Oneness.

We do know that life is a riddle and a mystery, and that “in order to make progress, one must leave the door to the unknown ajar.”

We do recognize and honor the Holy in all of us. Namasté.

And we do invite the *Spirit of Life* to sing in our hearts, with our closing song, #123...