

First Church in Belmont UU
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Playing with Reality Unfettered Fantasy

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READING: Three quotes from Albert Einstein

When I examine myself and my methods of thought, I come close to the conclusion that the gift of imagination has meant more to me than my talent for absorbing absolute knowledge.

Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world.

Physical concepts are free creations of the human mind, and are not, however it may seem, uniquely determined by the external world. (with Leopold Infeld)

This sermon is called "Playing with Reality: Unfettered Fantasy." Its central message is that every scientist, indeed professionals in every field, increase creativity to the extent that they bring imagination and fantasy to their thinking. Why is this a sermon? Because imagination and fantasy are also fundamental to our religious quest and to actions that flow from our beliefs.

The opposite of fantasy is supposed to be fact. We say that science deals with facts. A friend asks you, "Exactly how many people are in your church?" She wants a number, a fact. What number do you give her? The number of official members? I see here today people active in the church who are not members. What does your friend want? How many people come to service? How many pledge financial support? How many serve on committees? You can see where I am going with this: The answer to the question, "How many people are in your church?" depends on the purpose to which the number is to be put. To answer the question, we funnel the chaotic richness of our human experience in this church, filtering it to select the appropriate fact.

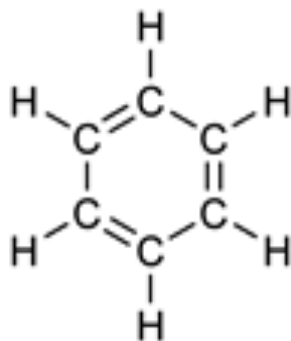
Think of an hour glass. Here is the picture of an hour glass for you young people who have not seen one. Sand takes one hour, more or less, to pass through the narrow neck from this wide upper bulb to this wide lower bulb. Let the upper bulb represent the richness of your entire experience in our church. We focus that experience, funnel it down in order to establish the number of people in our church.

Focusing, funneling is the way every profession operates. You go to a doctor because your abdomen hurts. The doctor narrows down your symptoms to find a diagnosis: Indigestion? Diverticulitis? Appendicitis? If the doctor is competent and you are lucky, the result is a cure.



What puts ideas into the upper bulb? Where do ideas come from that become medical cures and verified scientific theories? Einstein and Infeld tell us: *Physical concepts are free creations of the human mind, and are not, however it may seem, uniquely determined by the external world.* Scientific theories are born in imagination.

In 1861 the chemist August Kekule had a reverie or day-dream about a snake eating its tail. He woke to establish the circular benzene ring as the basis for the chemistry of aromatic compounds. How many of us have gone to bed with a problem and awakened with the solution? Dreams can be central to creativity.



John Archibald Wheeler, who recently died at age 96, was co-author of two books with me. He made famous the name "black hole" for a collapsed star. Wheeler was immensely inventive; imagination was a major source of his scientific creativity. My strongest memory of him is his almost frightening intensity in reinventing the subject of relativity in order to teach it. When our writing was blocked by a physics or teaching problem, fire would come into John's eye. One radically different proposal followed another, many of them wild, most of them obviously useless but keeping up the drum-fire assault. John quoted his mentor Niels Bohr: "Genius is the ability to make all possible mistakes in the shortest possible time." Imagination is too mild a word for this process; I call it unfettered fantasy.

Now I'd like to challenge *your* imagination. The next four minutes will be an extended example of how fantasy can lead to an immense stride in physics. Work with me here! Or take a short nap; I will tell you when it's time to wake up.

Recall your junior high school science: Every atom has a tiny nucleus made of protons and neutrons. Around the nucleus is a much larger cloud of electrons, more electrons or fewer electrons depending on the atom. The atom is held together by the attraction between the positively charged protons in the nucleus and the negatively charged surrounding electrons. The key point here is that, as far as we know, every electron in the Universe is identical to every other electron in the Universe.

Now the story: Long before I knew him, Wheeler was the graduate thesis advisor for Richard Feynman. Here is a famous telephone conversation in the early 1940s between Professor John Wheeler and graduate student Richard Feynman in his dormitory:

Wheeler: "Feynman, I know why all electrons have the same charge and the same mass."

Feynman: "Why?"

Wheeler: "Because they are all the same electron!"

Wheeler is saying that there is only one electron in the Universe. You need to know one more piece of background information: The positron is another fundamental particle, like the electron. The positron has the same mass as the electron but a positive charge instead of the electron's negative charge. Wheeler figured out that, as far as the mathematics goes, the positron can be thought of as an electron moving backward in time.

Here's how Wheeler's idea works: An electron goes forward in time; we count it as the first electron. Then the electron moves backward in time as a positron. The same electron again moves forward in time, which we count as the second electron, then backward in time as a positron. The same electron goes forward in time again, which we count as the third electron, then backward in time as a positron. And so on, filling up the Universe with one single electron which we observe, at the present moment, as trillions and trillions of electrons.

Feynman instantly saw the difficulty with Wheeler's theory: We do not see many positrons around. If Wheeler was right, we should see just as many positrons (that single electron going repeatedly backward in time) as we see electrons (the same single electron going repeatedly forward in time). Feynman said, "But Professor, there aren't as many positrons as electrons."

Wheeler replied, "Well, maybe positrons are hiding in protons or something."

Turns out it is impossible for a positron to hide in the proton, the major component of the atomic nucleus. Worse: When a positron and an electron meet they annihilate, emitting gamma rays. If there were as many positrons as electrons around us, they would self-destruct -- and we would all be dead from radiation. Wheeler's theory does not fit through the neck of the physics hour glass and has to remain a fantasy in the upper bulb. But isn't it a wonderful fantasy? Drifting off to sleep at night, I often think of our far-flung Universe populated with a single electron. As a work of imagination, Wheeler's vision is right up there with a patch of the Sistine Chapel ceiling or a scene from Hamlet.

But there's more to this story. Feynman grabbed the idea that the positron is an electron moving backward in time -- he says "I stole that!" -- and put it into his theory of the interaction of electrons with light, a theory called quantum electrodynamics. For only the tiniest fraction of a second an electron moving forward in time is paired with a positron, the same electron moving

backward in time. Quantum electrodynamics is the most accurate scientific theory we have, for which Feynman and others were awarded the Nobel Prize. Fantasy often pays off, but usually not in ways we expect.

Wake up! The physics part is over.

There is a famous saying attributed to JBS Haldane: "The universe is not only stranger than we know, it is stranger than we *can* know." I do not believe that for a minute, but the saying harbors a deep truth: Nature extends to the extreme limit of our ability to imagine and fantasize. Feynman says, "Our imagination is stretched to the utmost, not, as in fiction, to imagine things which are not really there, but just to comprehend those things which *are* there." The ability to imagine is not a luxury in science. It is the essence of science and the essence of every creative process.

Most of you are too polite to say the following, but may be thinking it: "Taylor, almost by definition a fantasy is a lie. You are asking us to encourage lies -- lies in others and lies in ourselves."

O friend! Have you not heard of Sigmund Freud? Whatever you think about details of his work or the excesses of his followers, Freud nailed this truth: We swim, we flounder, in a swamp of fantasy: fantasies about sex, Oedipal fantasies, fantasies about power and powerlessness -- did I mention sex? We are simply not aware of much of our motivation, and the result can make us look and feel crazy. But you do not have a choice about whether or not you have fantasies: *You got 'em!* I am guessing that harnessing our deep fantasies for creative purposes helps to civilize and control our unconscious urges, but that is only a guess.

Rich human experience, imagination, and fantasy fill our lives, the upper bulb of our hour glass. The neck of the hour glass focuses and filters experience and imagination through competence.

And the lower bulb of the hour glass? In the lower bulb live the products of our imagination, shaped by our particular skills. Think of Bach or Mozart or Michelangelo or Shakespeare or Einstein: Limitless inspiration in the upper bulb, incredible technical facility at the neck, masterpieces in the lower bulb, masterpieces that illuminate our lives. They contribute to our immensely rich cultural and intellectual heritage.

And here is the central point about the lower bulb: None of these products are the whole story. Every single masterpiece is partial, depending on circumstances for its validity. The diagnosis of appendicitis for your painful abdomen fits only you and only now. Einstein's general relativity tells us nothing about the structure of the atom. Michelangelo's Sistine Chapel ceiling is a cosmic vision from the Renaissance. Bach's B-Minor Mass gives us no instructions about solving global warming. In that sense these masterpieces serve as fantasies for us. They enter the *upper* bulb of *our* hour glass to feed our imagination, inspiring us to produce masterpieces of our own.

Fill your life with fantasy! Be open to every wild whim, both as a professional and as a person. Fill the upper bulb of your hour glass with pulsating ideas from history, culture, childhood fairy tales, from dreams. You will be a more productive professional, a more joyful person. Don't worry: you are not being fuzzy-minded or irresponsible. Let the neck of the hour glass -- your personal competence or belief system -- sort out what can pass through the neck of the hour glass and expand into the lower bulb, from fantasy to action for the benefit of the world.

And this invitation to fantasy also includes your religious life: embrace sagas and drama and literature and sacred music and sculptures and stained glass windows and paintings and Bible stories -- even sermons. What is the neck of the hour glass for religion? Listen to the first item in our Unitarian Universalist statement of conviction: *The inherent worth and dignity of every person*. That one principle goes a long way toward giving us direction in our lives, serving as the neck of the hour glass to determine what fantasies, what inspirations, what living styles pass through to benefit ourselves and others.

Fantasy and imagination are central to playing with reality. Playing with reality makes us better scientists. Playing with reality makes us better professionals. Playing with reality makes us better church members. Playing with reality makes us better people. Go and do thou likewise.

Amen