IIFSD .org
Insight and Inspiration, Innovation and Vision For the Developing and Evolving Self
INTERNATIONAL INSTITUTE FOR SELF DEVELOPMENT

Letter for Insight and Inspiration

Volume 3 / Issue 10

Oct./Nov. 2018

Quantum Physics, Belief, and Choice Part (I)

INTRODUCTION

Science has determined how we view the world, what is real and what is not real. The influence of science on our view of the world became most influential with Isaac Newton who lived in the 1600s, the 17th century. He developed what is called Newtonian physics. Do we need to revise which science has a profound influence on our world? Absolutely yes. This revision is part of the evolution of our civilization and quantum physics (also call quantum mechanics) has so much to offer. Its view of the world is so much richer and more powerful that Newtonian physics. Quantum physics suggests a view of reality (how the world works) that is radically different from what we have been taught. (However, Newtonian physics continues to be useful in numerous ways, like providing the mathematics that enabled us to go to the moon.)

We look to science for guidance as to what the future will be. We seek "scientific predictions". What kinds of predictions does quantum physics make? We will explore the answer to this question but it is not what you might think.

Our ongoing purpose is to empower you to create and live the most rewarding life you can. Quantum physics can make a significant contribution to this process. Quantum physics explores the world of the atom. Is it applicable to the everyday world we live in? Yes, but for our purposes it is the principles and meaning of quantum physics that is most significant. In this Letter we will develop a beginning understanding of quantum physics for the purpose of applying its principles to our daily life. In the December Letter we will apply the principles. You will be amazed.

Point of Empowerment: *Understanding and using the principles of quantum physics is as an aspect of the evolution of our civilization.*

If you are interested in having your world view challenged, but not interested in the science, you can just read NEWTON'S WORLD, THE MESSAGE OF QUANTUM PHYSICS, CONCLUSIONS FROM THE EXPERIMENT, and CONCLUSION. Also, *analogies* translate scientific concepts into everyday language.

BIBLIOGRAPHY

Fritjof Capra, The Tao of Physics. Gary Zukov, The Dancing Wu Li Masters. Jim Al-Khalili, Quantum, A guide for the perplexed. Wikipedia: The wave particle duality. https://en.wikipedia.org/wiki/Wave–particle_duality.

NEWTON'S WORLD

According to the Newtonian view of the world, everything that now exists (called the effect) is the result of something that happened earlier in time (called the cause). I punched your arm. This caused the pain that you feel (effect). And, everything that will happen (the future) is predictable if we know all the causes that exist at this moment. Theoretically, we can predict anything but in practice this is impossible since we can never fully know the all the causes for something, except for the simplest of things (punch—pain). The past causes the future and everything we do has an effect. The idea that everything that we do has effects is still held by quantum physics, but there is an intimate connection between causes and effects that goes way beyond that which is described in Newtonian physics.

THE MESSAGE OF QUANTUM PHYSICS

Quantum physics states that you cannot separate the observed from the observer. What is seen is inseparable from the person who is seeing. How the scientist sets up and runs an experiment will determine what is seen. Traditional science states that an experiment measures ("sees") something that already exists. Quantum physics states that what exits before our observation/measurement is something so strange and different from our everyday experience of the world, that the only way we can relate to it is through mathematics.

Quantum physics says (though not exactly in these words) that the future comes to us as "waves of probability." Probability is "maybe this or maybe that, maybe here or maybe there" according to the "odds." To understand *probability*, consider tossing a coin in the air. When we toss the coin into the air the odds of it landing as a head or a tail are 50/50 because there are two possibilities. Of 100 tosses *approximately* 50 will be heads and 50 will be tails. We cannot guarantee a 50/50 result but we can say that this is what will *most probably* happen.

Other examples of probability:

- The probability of rain tomorrow is 60% according to the weather report.
- The probability of winning my next toss of the dice in craps can be calculated according to certain rules. I may have a 1 in 5 (20%) chance for example.
- The probability of the sun rising tomorrow is 100%.

We have experience with *waves*. There are the waves of the ocean, sound waves, or the waves that result when we throw a stone into a still pond. Ordinary physics has a lot to say about waves. However the "waves of probability" in quantum physics are extremely mysterious in that they are difficult, if not impossible, to define clearly.

In a quantum physics experiment, "waves of probability" are set in motion at the beginning of the experiment. An observation takes place when scientific instruments record (measure) the data of the experiment. At the moment of measurement the waves of probability are said to "collapse" into a single measurement. Before the collapse there a numerous possible results for the experiment. After the collapse there is only the one result, which is recorded.

Here is an analogy, using our everyday experience, to help you get a sense of what all this means. The analogy is close but not exactly what quantum physics states because quantum physics deals with the world of atoms not our everyday physical world. Imagine looking out a perfectly calm ocean, an ocean without waves. There are now two possibilities. The ocean will remain calm or waves will start to form. You as an observer "choose" whether or not you will see waves. If you have chosen waves, you will see them as they move toward you. You can measure the force with which they hit the shore. If you choose no waves, you will continue to observe a calm ocean. How your choice "causes" waves or no waves cannot be explained at this time, but it does, according to quantum physics.

SUMMARY

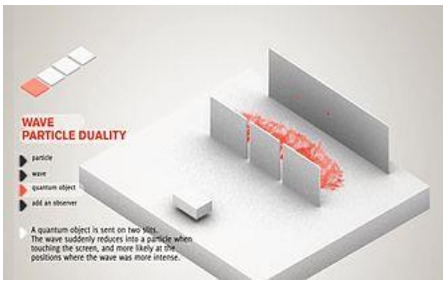
- Quantum physics states that you cannot separate the observed from the observer. What is seen is inseparable from the person who is seeing.
- Quantum physics says (though not exactly in these words) that the future comes to us as "waves of probability."

Point of Empowerment: *Quantum physics puts us squarely in charge of what our world looks like.*

Let's try to understand some of the science behind these statements. We will explore a small part of the science behind the messages of quantum physics.

THE SCIENCE OF QUANTUM PHYSICS

Quantum physics was developed in the early 20th century as the result of scientific experiments that yielded results that were totally unexpected. The most famous experiment in quantum physics is called *the double slit experiment*. Let's watch a Wikipedia video about the double slit experiment and then discuss what it is showing us. Please click the link to watch the video. You will see this image.



https://commons.wikimedia.org/w/index.php?title=File%3AWave-particle_duality.ogv

The video is called the wave particle duality. This experiment is designed to demonstrate the wave nature of quantum particles and how an observer changes a quantum particle's behavior. Why is this interesting or even amazing? First, it demonstrates the bizarre behavior of quantum particles. Particles should behave like particles, but quantum particles behave like waves. This is like saying that a bird I release begins to fly. Then it turns into a flock of hundreds of birds with their feet tied together, but when it lands it turns back into a single bird again.

Secondly the absence or presence of an observer, just watching and not doing anything more, determines the outcome of the experiment. Without the observer you get one result. With an observer you get a different result. This is like saying the bird I release starts to fly. Then it turns into a flock of hundreds of birds with their feet tied together. If I see or hear the birds, they immediately turn into a single bird. But without my observation they stay a flock of birds. Take a moment to think about this bird's behavior—not normal!!! This is quantum physics.

EXPLANATION OF THE EXPERIMENT AND RESULTS

The video represents an experimental set up that contains: a source that shoots out particles, or waves, or quantum objects like photons (particles of light), electrons (a component of the atom), or whole atoms; a barrier with two slits; a screen at the back that is a scientific instrument that registers the presence of what is shot out when it reaches the back; and in part four, the eyeball—an observer.

Here is a description of the experiment and what happens.

1. In part one of the experiment ordinary particles (like tiny steel balls) are shot out and go through the slits. Over time, as they hit the back screen they register a random scatter pattern. This is straightforward. No surprises here.

2. In part two, waves (like light waves) are shot out and go through the slits. Over time, they register as bands on the rear wall. This is straightforward wave behavior. No surprises here.

As the wave goes through the slits parts of the wave interact, "interfere," with each other. Some parts of the wave join together to increase the waves impact, while other parts of the wave join together to cancel out (destroy) the wave itself. Bands form on the screen showing the pattern that is created as a result of this "interference." *When this wave pattern shows up in the quantum particle experiment, scientists are totally baffled and pushed into the new realm of quantum physics.*

3. In part three, quantum particles are shot out and go through the two slits. (The video does not clearly show this in part three, but quantum particles are shot out.) They register like a particle. However, over time, repeated firings give rise to a definitive pattern, the type of pattern caused by a wave. How could this be? A single particle registers as a particle, but repeated shooting of quantum particles through the slits eventually makes a wave pattern not a random scatter pattern. Something "wavelike with probability" is happening to the particles. Quantum physics calls this "wavelike and probabilistic" phenomena the wavefunction. The wavefunction is a mathematical description of the particle behaving like a wave and having a certain probability of showing up somewhere on the screen as a particle. It will register but where it does cannot be exactly predicted. There is only the probability that it will land at a certain place on the screen.

Quantum particles do not travel like particles but transform into some sort (unusual kind) of wave, the strange looking wave in the video. How do we know this? We know this because over time, they form a pattern of bands (wave behavior) even though they start out as particles.

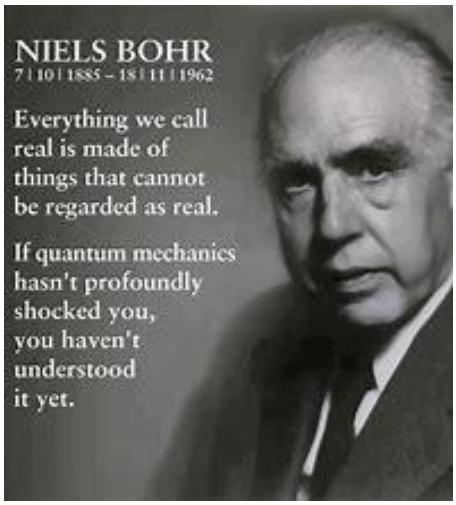
Back to *our bird analogy.* This is like going on a journey starting out as a bird, then changing into hundreds of birds flying with their feet tied together, then landing as a single bird. But, when many birds take this journey they eventually land in a way that spells out the word "BIRD" on a wall. We cannot possibly explain why or how this happens. Pretty weird, but that is quantum physics.

4. Part four has the same experimental set up as part three except that there is an observer ("the eye") present. A quantum particle starts out as a particle; travels wavelike; but gets observed—is "seen by a scientist with his/her scientific instrument." This observation instantly causes the wave to turn into a particle. Since is it a quantum particle it continues to travel wavelike but registers as a particle. The particle starts as a particle, turns into a wave, then back into a particle when observed, but still travels like a wave. Upon hitting the screen it registers as a particle. However, repeated firings of observed particles create the random scatter pattern not the band pattern. The particle has lost its original wavelike and probabilistic nature because it was observed.

Point of Empowerment: *Observing the object (particle) changed what it was.*

Analogy: our bird starts out like a bird; flies like many birds with feet attached; gets discovered; all the birds expect one disappear; the remaining bird then pretends that he is still flying like many birds, but lands like one bird. He left the other birds behind when he got discovered. More birds flying by get observed and therefore land making a random pattern. They <u>do not</u> spell out "BIRD". All this is very complicated and extremely strange. (This could be Alfred Hitchcock's movie The Birds.)

CONCLUSIONS FROM THE EXPERIMENT



What scientists have concluded from the double slit experiment is the following.

1. Light can be shown to be a particle or a wave depending on how the scientist decides to set up the experiment. Analogy: this is like saying that it is raining or not raining depending on what I want as I step outside. I can step outside and decide that it is not raining or step outside and decide that it is raining. Whether or not it is raining in entirely up to me, up to what I decide, want, and expect. If this statement is clear and you understand it, your reaction may by, "No way, that is impossible."

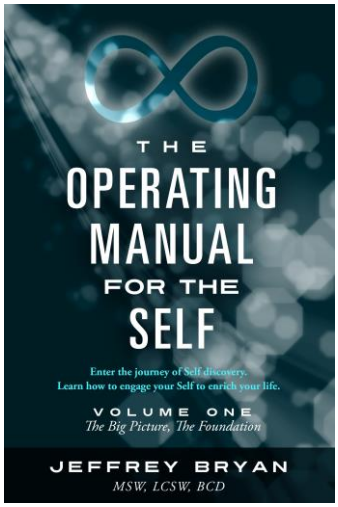
2. The presence of an observer changes (effects) what is measured. This is like saying that I can walk outside decide that it is raining, then change my mind, decide that it is not raining, and the rain stops instantly. Again, "impossible" you might say. (Niels Bohr—one of the founders of quantum physics)

CONCLUSION

Maybe you are now totally confused. You might be saying "B—shit. So what." Confusion and dismissal are normal reactions to the world of quantum physics. But hopefully you have a sense of how bizarre quantum physics is. These bizarre complications have brilliant scientists confused, in denial, and vehemently arguing about what all this means. Despite the confusion engineers use quantum physics to build computer chips and therefore everything that has a computer chip in it. Quantum physics allow us to create our sophisticated technological existence.

Point of Empowerment: *For our purposes the most important explorations are yet to come, applying the world of quantum physics to our daily world. This is tremendously exciting and can turn our world upside-down.*

Next month: using our beliefs as observing and measuring devices to create the world we want.



Like Quantum Physics, The Operating Manual for the Self *can change everything.*

Manualfortheself.com

Let's **unite** in developing our human potential. **Share** this newsletter with others. Please visit our website, IIFSD.org. We invite you to participate, (as suggested in the Participation Menu selection). When you buy *The Operating Manual for the Self* (manualfortheself.com), you **support** our vision and mission. When you read *The Operating Manual for the Self,* you **leap** forward in your personal self-development and evolution.