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In the beginning of the 20th century, The Quantum Revolution changed reality. It is not the most well known revolution, but its implications may be among the most dramatic ever. It is at the base of almost every technological advance of the 20th century, from perms to PCs, and space travel to surfing the Web and still, its implications remain highly controversial and counter- intuitive.

The two people at the heart of The Quantum Revolution were Albert Einstein and Niels Bohr. They are often described as close friends who, in being confronted with the consequences of their research, became adversaries in a debate about the structure of reality.

Both contributed to the overthrow of Newtonian physics as the universal explanation of natural forces. When introducing his theory of special relativity, Einstein dismissed the theory of the Aether (nowadays only used by radio hosts) and thereby broke with the idea of a universal frame of reference. According to the theories of relativity, the observers' velocity and position relative to another observer can result in different experiences, in turn causing even time and space to bend. Although Einstein's theories fairly quickly became widely accepted, the upheaval that they caused within physics was far-reaching and controversial. The tidy clockwork universe of Newton had been replaced by a universe in which the relative position of the observer played an important part. Influenced by his research, Bohr developed the model of the atom, and with a group of prominent physicists, he proposed one of the defining and most controversial ideas of quantum mechanics, the Principle of Complementarity. This principle roughly states that matter can behave as a wave or particle, depending on how it is being observed. In combination with Heisenberg's Principle of Uncertainty, which states that it is not possible to know both the location and the mass of a particle at the same time, Bohr concluded that, at quantum level, it is principally impossible to see exactly what 'is going on', and that, as a consequence hereof, we cannot speak of a universe separate from the observation of it.

This was a groundbreaking statement. It instantly shattered the foundations of the traditional Western dualistic world view. It completely defies our daily experience of the world and our common sense. The materialistic heritage from Descartes was proven scientifically wrong, and the relationship between the observer and the observed had to be completely revaluated. 'We' were no longer 'detached' from a world 'outside', as such concepts are meaningless in quantum mechanics - somehow, there is interconnectivity between consciousness and the world. Einstein disproved Newton's concept of a universal frame of reference and substituted it by the relative position of the observer, but to involve the *act of observing* into the equation was to break with the perceived objectivity of science itself. In addition, on a deeper level, if an observer influences the outcome of an experiment, then it is impossible to speak of a reality separate from the observer; the search for a Newtonian 'truth', any absolute truth, made no sense anymore. These implications led Einstein, during a nightly walk in Copenhagen, to ask a colleague: "...but, do you really believe the moon only exists when you look at it?".

Einstein was a realist, he believed in a physical universe. His research was aimed at understanding how that physical universe worked, and eventually combine all of nature's forces into a single theory, which would be able to contain and explain everything. He had proclaimed that two observers standing at different positions could see the universe differently and both would still be right, but he

remained confident that somewhere beyond their observations that there still was a universe, indifferent to the individual observers. Bohr simply said that the two observers would see two different realities because they were looking for two different things, and that the two realities they saw were equally valid, even if they were contradictory. According to Bohr, there is no universe beyond the observations and there are no hidden variables.

Einstein could never come to terms with Bohr's interpretation, known as The Copenhagen Interpretation, of quantum theory. He simply could not let go of his realist views, and consequently spent the rest of his life trying to find a flaw in the Copenhagen Interpretation. He devised brilliant thought experiments to try to prove Bohr wrong. It is in part thanks to Einstein's intransigence that quantum mechanics became as successful as it did; he tested it to the limits of his genius, and yet, it didn't budge. Bohr was able to refute all of Einstein's thought experiments. For all of Einstein's genius, his ability to relativize and see things from different perspectives, he was unable to let go of the solid world even when experiments proved him wrong. He had toppled the Newtonian universe of classical mechanics as a young man, but he could not bring himself to kill the absolute world that he so strongly believed in - there had to be something beyond the observations.

Bohr may not have been happy with the demise of the physical universe as he knew it, but he was able to accept the uncertainty and complementarity of the Copenhagen interpretation. He accepted that although science may be objective that does not mean its subject shares that objectivity - *the* truth is not out there.

There are many versions of the story of their friendship and how it gradually deteriorated because they disagreed on how to interpret the results of their research. These stories probably all exaggerate the animosity between the two former friends somewhat, but nevertheless eyewitnesses tell of how in their later years, at parties, they would be standing at opposite sides of a room, each with their own group of followers.