“Quantum theory poses reality's deepest mystery”. Obituary of John A. Wheeler by Tom Siegfried. *Science News, 173*, 17. May 24th 2008, p.32.

In his later years Wheeler turned his inquisitive powers to quantum physics, devising imaginative experiments that helped to show how quantum reality undermines the old commonsense idea of the universe as a predictable machine. Wheeler never gave up wrestling with quantum theory's implications for the nature of reality. In interviews beginning more than 20 years ago, he articulated some of his thoughts on such matters, excerpted here.
.....

“We have to learn how to use our words. It's a fantastic thing--we humans are so easily trapped in our own words. The word time, for instance--we run into puzzles about the concept of time and then we say, oh, what a terrible thing. We don't realize we're the source of the puzzles because we invented the word....

There's this business about [Niels] Bohr and his nice old professor [Harald] Hoffding about the electron passing through the double-slit experiment [in which an electron apparently is able to pass through both slits in a barrier instead of choosing to go through only one or the other]. Bohr in his younger days, in 1927 I guess it was, was visiting Hoffding in the company of [Hendrik] Casimir who had come to study with Bohr at Copenhagen. Hoffding said, "In this double-slit experiment, where can the electron be said to be?" Bohr said, "To be? To be? What does it mean to be?" ...

We've learned, I think, that we have to say that that is the kind of question we shouldn't be asking. Yet to say it's the kind of question we shouldn't be asking means that we have to accept a picture of the world different from what we've been accustomed to in the past, where we thought of something as chugging along that, every step of the way, you could put your finger on. We realize now that it's a wrong way of speaking, that it hasn't happened until it's been registered. You have no right to talk about where the electron is during that time.

Some people get more and more uncomfortable as they discover what quantum theory really is and what it says.... Einstein had discomfort with a world of that kind. As he said in the last talk he ever gave in his life, speaking to my students in a relativity seminar, "If a person, such as a mouse, looks at the universe, does that change the state of the universe?" He wanted to think of the universe as existing "out there."

Quantum theory is the deepest part of our knowledge of nature and the biggest mystery.... I think it's gradually teaching us to ask the right questions.... The only point is, will so many points of view develop that we have a disarray because it's hard to nail it down? ... You get all kinds of people writing all kinds of papers with all kinds of philosophical views and backgrounds. But if you have some really sound people talking about it, I think you'll get really sound advances....

My feeling is that in this show, the territory we've got to get into is so broad that the only thing to do is to plunge into it and start making tracks, no matter if the track is leading into a swamp. You'll find out.”

*Quote from Wheeler, J.A.* “Recent thinking about the natur eof the physical world: It from bit.”

In *Annals of the New York Academy of Sciences 655, 349-364. (1992).*

From Box 1. “Perspectives on complementarity”

“Harald Hoffding’s question regarding the familiar double-slit interference experiment: “Where can the light quantum be said to be in its passage from point of entry to point of reception?” Bohr’s response: “To be? To be? What does it mean, ‘to be’?” (p.352)

When asked whether the algorithm of quantum mechanics could be considered as somehow mirroring an underlying quantum world, Bohr would answer:
“There is no quantum world. There is only an abstract quantum physical description. It is wrong to think that the task of physics is to find out how nature is. Physics concerns what we can say about nature.”
Bohr’s remark is here reported by Aage Petersen in "The Philosophy of Niels Bohr", *Bulletin of the Atomic Scientists 19*(7) (1963), p12.

Feynman (Lectures on Physics (1963, vol. III, 1.9) said this about the position of an electron as it passes through an analogous 2-hole interference experiment:

> “if one has a piece of apparatus which is capable of determining whether the electrons go through hole 1 or hole 2, then one *can* say it goes through either hole 1 or hole 2. [otherwise] one may *not* say that an electron goes through either hole 1 or hole 2. If one *does* say that, and starts to make any deductions from the statement, he will make errors in the analysis. This is the logical tightrope on which we must walk if we wish to describe nature successfully.”

Einstein (“Autobiographical notes”, in Schilpp, ed. p.81)

> “Physics is an attempt to grasp reality as it is thought independently of its being observed. In this sense one speaks of “physical reality”.”