W. Heisenberg [*Der Teil und das Ganze* {the part and the whole}
(dtv pocketbook No. 903, 9^{th} ed. München 1985)] :

... then Einstein was disturbed, but the next morning at breakfast he had already come up with a new thought experiment, more complex than the first, which was now to show the invalidity of the uncertainty relation. By the evening this attempt had suffered the same fate as the first one and after this game had continued for several days, Einstein's friend Paul Ehrenfest, physicist from Leyden in Holland, said "Einstein, I am ashamed of you; you argue against the new quantum theory in the same way, as your opponents have argued against the theory of relativity." But even this friendly admonition could not convince Einstein.

Again I realized, how infinitely difficult it is, to abandon a belief, that so far has been the foundation of our thinking and of our scientific work. Einstein had made it the work of his life, to explore the objective world of physical processes, which happen out there in space and time, according to permanent physical laws. The mathematical symbols of theoretical physics were to represent this objective world and to allow predictions about its future behavior. Now it was claimed, that such an objective world in space and time does not even to exist, when one descends to the scale of atoms, and that the mathematical symbols represent only the possible and not the factual. Einstein was not prepared to let – as he felt – the rug be pulled from under him.

Even later in his life, when quantum physics had already become a widely accepted field of physics, Einstein could not change his point of view. He would accept quantum theory as a preliminary, but not as a final explanation for atomic phenomena. "God does not play with dice", that was a principle, which for Einstein was an unshakable certainty, and which he would not let go of. Bohr could only respond: "But it cannot be our duty to tell God how to rule the world." [10]

R. Penrose [*The Emperor's New Mind*
(Oxford University Press; New Ed. March 18 1999, p. 324)] :

Regarding ψ as describing the "reality" of the world, we have none of this indeterminism that is supposed to be a feature inherent in quantum theory — so long as ψ is governed by the deterministic Schrödinger evolution. Let us call this the evolution process **U**. However, whenever we "make a measurement" magnifying quantum effects to the classical level, we change the rules. Now we do *not* use **U**, but instead adopt the completely different procedure, which I refer to as **R**, of forming the squared moduli of quantum amplitudes to obtain classical probabilities! It is the procedure **R** and *only* **R**, that introduces uncertainties and probabilities into quantum theory.

The deterministic process **U** seems to be the part of quantum theory of main concern to working physicists; yet philosophers are more intrigued by the non–deterministic *state vector reduction* **R** (or, as it is sometimes graphically described: *collapse of the wavefunction*). Whether we regard **R** as simply a change in the "knowledge" available about a system, or whether we take it (as I do) to be something "real", we are indeed provided with two completely *different* mathematical ways in which the state–vector of a physical system is described as changing with time. For **U** is totally deterministic, whereas **R** is a probabilistic law; **U** maintains quantum complex superposition, but **R** grossly violates it; **U** acts in a continuous way, but **R** is blatantly discontinuous. According to the standard procedures of quantum mechanics there is no implication that there be any way to "deduce" **R** as a complicated instance of **U**. It is simply a *different* procedure from **U**, providing the other "half" of the interpretation of the quantum formalism. All the non–determinism of the theory comes from

[10] We could not find an English translation of Heisenberg's reminiscence, the above is due to A.–A. Ludl.

R and not from **U** . *Both* **U** and **R** are needed for all the marvellous agreements that quantum theory has with observational facts.

M. Tegmark und J. A. Wheeler [*100 Years of Quantum Mysteries* (*Scientific American*, February 2001)] :

... The Copenhagen interpretation provided a strikingly successful recipe for doing calculations that accurately described the outcomes of experiments, but the suspicion lingered that some equation ought to describe when and how this collapse occurred.
(underlined by the present authors)

... the Schrödinger equation itself gives rise to a type of censorship. This effect became known as decoherence ... coherent superpositions persist only as long as they remain secret from the rest of the world. Our fallen quantum card is constantly bumped by snooping air molecules and photons, which thereby find out whether it has fallen to the left or to the right, destroying ("decohering") the superposition and making it unobservable.

... Even though in the Everett view the wave function never collapses, decoherence researchers generally agree that decoherence produces an effect that looks and smells like a collapse.

... it is time to update the quantum textbooks: although these books, in an early chapter, infallibly list explicit nonunitary collapse as a fundamental postulate, the poll indicates that today many physicists – at least in the burgeoning field of quantum computation – do not take this seriously. The notion of collapse will undoubtedly retain great utility as a calculational recipe, but an added caveat clarifying that it is probably not a fundamental process violating the Schrödinger equation could save astute students many hours of confusion.