God's Omniscience and Free Will: A Response to Alan Kadish

By: NATHAN AVIEZER

In his interesting article, "G-d, Man, Chaos and Control: How G-d Might Control the Universe," Alan Kadish discusses the well-known question of how to reconcile G-d's omniscience with man's free will. Omniscience—the knowledge of everything—implies that G-d knows everything, including what will happen in the future. If G-d already knows what a person will do before he does it, then that person does not have free will to act as he wishes. The absence of free will implies that one cannot be held responsible for his or her actions. However, the Torah repeatedly states that every person is responsible for his or her actions. Kadish writes that "despite more than 2000 years of inquiry, an accepted rational solution" to this conundrum has not been found.

I believe that there is a solution to this problem. The solution involves quantum theory, but the reader need not fear. The basic ideas of quantum theory can be understood even by those without a scientific background.

Quantum theory was the greatest scientific revolution of the twentieth century. Its development spanned the period 1900–1930. According to quantum theory, physical systems behave in a completely different manner from the prediction of the previous theory, which is called classical theory. The most astonishing aspect of quantum theory is that it is a *probabilistic* theory of nature. This means that for any physical system, the most that can ever be known about its future behavior are the *probabilities* that certain events might occur. Through the Schroedinger equation, the fundamental equation of quantum theory, one can calculate the *probability* for the occurrence of each possible event. However, precisely *which* of the various possible events will actually occur in practice in the future can *never* be known beforehand.

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The probabilistic nature of quantum theory leads to an important conclusion that is easily stated: the present *does not* determine the future. The fact that the future is not determined by the present is called *quantum indeterminacy*.

It is important to emphasize that quantum indeterminacy of the future is *not* due to lack of knowledge. That is, it is *not* correct to state that the future is already determined but no one is able to predict it because the calculation is too complicated and depends on too many factors. Quantum theory states that the future cannot be known *because it has not yet been determined in the present*. This can be illustrated by the following example: If one performs the same experiment twice, with the two experiments being *absolutely identical* in every single respect, one may nevertheless obtain different results for the two experiments. In other words, the *same present* (the same experiment being performed twice) has led to *two different futures* (different results for the two experiments). This scenario is *impossible* according to classical science. In fact, this phenomenon violates the essence of classical science.

The reader may be wondering how such a dramatic phenomenon (the present *does not* determine the future) was not noticed earlier by Newton and other great scientists. More to the point, our everyday experience tells us just the opposite. Throughout our lives, we observe that the present *does indeed* determine the future. Every soccer player knows that if he kicks the ball in the right direction (the present), in a few seconds (the future) the ball will enter the goal to the roar of the crowd. Why do athletes, as well as all the rest of us, remain unaffected and unaware of quantum theory in our daily lives?

The reason is that the effects of quantum theory are significant *only* in the description of very minute particles. When dealing with macroscopic objects, such as soccer balls, the difference between the quantum prediction and that of classical science is completely insignificant. (A tiny speck of dust weighing less than a *trillionth of a gram* is a *large* object in this context.) When the soccer ball is kicked in the right direction, classical science predicts a goal with 100% certainty, whereas the quantum prediction is that the chances of the ball entering the goal are 99.99999999....%, with only an *extremely* small chance of the ball missing the goal. Since the difference between these two predictions is unmeasurably small, an athlete need not be aware of quantum theory to become a soccer star. As long as one deals with large macroscopic objects, the predictions of classical science are correct.

It should be emphasized that quantum theory is of utmost importance for understanding the universe. Many fundamental features of the universe depend *crucially* on the principles of quantum theory. In fact, the *very existence* of a stable universe would be impossible if the classical laws of nature were correct.

Whenever one deals with submicroscopic particles, such as electrons and atoms, quantum effects are dominant, and classical science gives a completely erroneous description of nature. Twentieth-century studies of atomic structure led scientists to question the validity of classical science. These studies showed that according to *classical* science, each atom in the universe should *spontaneously collapse* within a billionth of a second! Since it is obvious that atoms are perfectly stable and do *not* collapse, it was clear that the principles of classical science are inadequate to describe the universe. Extensive scientific investigations eventually led to the development of quantum theory.

Let us now consider the specific example of an electron in a hydrogen atom. The solution of the Schroedinger equation determines which energy values are possible for the electron in a hydrogen atom and what is the probability of obtaining each of these possible values when measuring the energy of the electron. However, the Schroedinger equation does not predict *which* of the possible values will actually be obtained in practice when measuring the energy of the electron. This can be known only *after* performing the measurement.

The above scenario raises the following questions: What is the energy of the electron *before* one measures its energy? Does the electron even have a well-defined energy in the absence of a measurement? *Quantum theory answers "no."* According to quantum theory, the energy of the electron *does not exist* until it is measured. The measurement *produces* the energy. This extremely strange result is known as "quantum reality."

However, Albert Einstein was convinced that the answer must be "yes." He maintained that a measurement *reveals* the energy; it does not *produce* the energy. Einstein published a paper in 1935, known as the EPR paper (after the initials of its authors: Einstein and his assistants Boris Podolsky and Nathan Rosen), in which it was claimed that it is absurd to think that a measurement *produces* a result that did not exist before the measurement was performed.

An important advance occurred in 1964, when John Bell showed that one can distinguish *experimentally* between the view of Einstein and that of quantum theory. (Bell's discovery is known as Bell's inequality.) The experiment is very difficult to carry out, but the technical difficulties were finally overcome in the 1980s by several groups of scientists and the measurements were performed.

The results of the measurements were unequivocal. It is far beyond the scope of this discussion to explain exactly what was measured and how the measured results relate to Bell's inequality. We will suffice here with simply stating the implications of the results. They clearly showed that Einstein was wrong and that quantum theory is correct. That is, before performing a measurement of the energy of an electron, *the value of the energy does not exist*! The measurement *produces* the value of the energy; it does not simply *reveal* the value of the energy. This result enables us to resolve the apparent contradiction between man's free will and G-d's omniscience.

Consider first a related power of G-d: His omnipotence—*having the ability to do everything*. There is a famous riddle, beloved by schoolchildren, concerning G-d's omnipotence. Can G-d make a stone that He cannot lift? A negative reply implies that G-d is not omnipotent because He cannot make the required stone. A positive reply also implies that G-d is not omnipotent because He cannot lift the stone that He has made. Therefore, goes the riddle, we have proved that G-d is *not* omnipotent!

The resolution of this riddle lies in the recognition that such a stone *cannot exist*, because G-d can lift every stone. Omnipotence implies the ability to make any object that *can exist*. Not being able to make a stone that *cannot exist* is therefore not a defect in G-d's omnipotence. For exactly the same reasons, G-d's inability to prove that two plus two equals six does not indicate that G-d lacks omnipotence.

Let us now apply the same consideration to G-d's omniscience—*His complete knowledge of everything*. Omniscience means knowing *whatever is possible to know*. However, it is *impossible* for G-d to know the future, because the future *does not yet exist*. In other words, the future is *not* already determined in the present; we *produce* the future as time passes. Since the future has *not yet been determined in the present*, it is *not* a defect in G-d's omniscience to say that He does not know the future.

However, there still seems to be a problem. In many places in the Torah, G-d announces that some particular event will occur in the future. If G-d does not know the future, as here asserted, how is it possible for G-d to state with certainty that a particular event will occur?

In fact, human beings also possess the ability to make definitive statements about the future. For example, I might announce to my students that there will be a test in physics next Monday. My announcement does not mean that I have suddenly been blessed with the power to predict the future. It simply means that I have the ability to make that event—the test next Monday—happen in the future, and I have decided to exercise that ability. Similar considerations apply to G-d's pronouncements regarding what will happen in the future.

The Torah relates that G-d commands us to do good deeds. G-d has bestowed upon every person the ability to choose, *without His interference*, whether or not to obey His commandments. This is the essence of free will. As we read in the Torah:

> "*I set before you this day, life and good, and death and evil... therefore, choose life.*" (Devorim 30:15, 19)