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Agency in the Worlds of Classical and Quantum Physics

Newtonian physics introduced a deterministic picture of the universe that seemed to leave no room for divine miracles, providence, or even human free will unless God violated his own natural laws. This was an impetus for the rise of deism and atheism among the scientifically minded. However, twentieth century developments in physics have challenged this deterministic picture, opening ways in which divine and human agency could operate without violating physical laws.

Before Newton, there were many theories of causation in philosophy and theology, but they were dominated by work of St. Thomas Aquinas. He held that God could do anything according to his absolute power, but he has chosen to give his creatures causative power of their own. As primary cause, God is the one who brings creation into being and maintaining its being. He gives creatures the power of secondary cause, and these creatures bring about the changes we observe in the world. The creatures existence and power derive from and are dependent on God as primary cause. Although God could choose to directly cause a change through his absolute power, he

ordinarily chooses to work through his creatures.[1] These secondary causes act according to their natures, and thus they could be studied in a scientific manner. However, God as primary cause remains in complete control over all that happens in the universe. Aquinas presented a picture of an orderly world that could be studied scientifically, but also one in which God was intimately involved and over which he was absolutely sovereign.

Isaac Newton's law of universal gravitation was a mathematical explanation of motion that seemed apply universally to motion anywhere. His system was able to explain the motion of the planets as well as the movement of everyday objects. "The elegance of the inverse-square law of gravity pointed to a God who had chosen to rule the world not by incessant acts of absolute power (though Newton never denied the deity that power) but through the self-limiting mediation of laws."[2] Newton, who was himself a religious man, did not eliminate God from the picture. For one thing, his model of the solar system was unstable, and it indicated that the orbits of the planets should eventually decay without divine intervention. Newton's solution was that God worked through the mediation of comets to keep the planets in their orbits. However, there were others that thought differently. Gottfried Wilhelm Leibniz criticized

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[1] John Henry, "Causation," in *Science and Religion,* ed. Gary B. Ferngren (Baltimore: The John Hopkins University Press, 2002), 137.

[2] John Hedley Brooke, "Natural Theology," in *Science and Religion,* ed. Gary B. Ferngren (Baltimore: The John Hopkins University Press, 2002), 167.

Newton's requirement of God's intervention in the operation of the universe. Leibniz said that Newton's God was a "poor workman" who had to continually adjust his creation. According to Leibniz, God had the power to create a universe that needed no correction.[3] Leibniz saw the universe to be like a divinely created clock. Although human made clocks needed adjustment due to the limitations of human craftsmanship, but God's clock should need no adjustment.

Newton's theory laid the foundation for continued work in physics of a mode which is now called classical mechanics. As more and more discoveries came along, the descriptive and predictive power of classical physics grew. Pierre Laplace was able to demonstrate the gravitational stability of the solar system, eliminating the problem of orbital decay that plagued Newton and suggested the need for divine interference. In Laplace's mind, the science of physics had demonstrated that the world was deterministic and predictable.

> We ought to regard the present state of the universe as the effect of its antecedent state and as the cause of the state that is to follow. An intelligence knowing all the forces acting in nature at a given instant, as well as the momentary positions of all things in the universe, would be able to comprehend in one single formula the motions of the largest bodies as well as the lightest atoms in the world, provided that its intellect were sufficiently powerful to subject all data to analysis; to it nothing would be uncertain, the future as well as the past would be present to its eyes. The perfection that the human mind has been able to give to astronomy affords but a feeble outline of such an intelligence.[4]

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[3] Henry, 138-139.

[4] Carl Hoefer, "Causal Determinism," *The Stanford Encyclopedia of Philosophy* (Spring 2010), http://plato.stanford.edu/archives/spr2010/entries/determinism-causal/

What Laplace is saying is that every event that occurs in the universe is dependent on and determined by the state of the universe prior to the event. Therefore, given a particular state of the universe, the succeeding events are absolutely determined as well as the events that led up to that state. Therefore, if God created the universe a certain way in the beginning, all events must proceed from that point in a determined way according to the laws of physics. Laplace links the idea of determinism with that of theoretical predictability, although it would take a God-like knowledge and intelligence to be able to know the complete state of the universe at a given time, and to calculate the subsequent states. Although God might be able to predict the future of Laplace's universe, the complete interlocking of natural events leaves no room for God's operation in it. When Napoleon asked him about the role of God in his system, Laplace is said to have replied, "Sire, I have no need for that hypothesis."[5]

Although Laplace had eliminated God from the operation of the universe, he was still required to create it and get it going. This idea that God created the universe but was not involved in its ongoing operation resulted in the theology of Deism.[6] Although Deism admitted the existence of a creator God, it denied that such a God interacted with the universe once it was created. Not only was God's involvement in the world not necessary for it to operate, such involvement would be a violation of the very laws of

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[5] Margaret Osler, "Mechanical Philosophy," in *Science and Religion,* ed. Gary B. Ferngren (Baltimore: The John Hopkins University Press, 2002), 151.

[6] Henry, 139.

nature that God put in place. It would contradict the immutability of God for him to put laws into place that he would later violate. Therefore miracles, revelation, and ordinary divine providence were all denied by Deists.[7] Of course, the central Christian miracles of the incarnation of the Son of God and the resurrection of Christ had no place in the deistic framework.

Although determinism appeared to eliminate God's operation in the world, the complexity of the universe and of living things still seemed to require God as a creator. That began to change when Charles Darwin's (1809-1882) theory of natural selection provided an explanation for the development of the complexities of living things through natural processes. The introduction of evolution through natural selection into the clockwork world was enough for some to also abandon belief in a divine Creator.[8] As Richard Dawkins said, Darwin made it possible to be an intellectually fulfilled atheist.[9]

Determinism not only undermined traditional views of God, it also undermined traditional views of man. A long series of events from the beginning of the universe until now resulted in our present existence. These events were determined by the laws of nature and the initial conditions of the universe, and given these laws and conditions,

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[7] *The Catholic Encyclopedia,* s.v. "Deism," http://www.newadvent.org/cathen/04679b.htm (accessed July 23, 2010).

[8] Henry, 140.

[9] Richard Dawkins, *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design*, (New York: W. W. Norton & Company, Inc., 1996), 6.

our existence is inevitable. What we call thinking, emotions, free will, and other functions we associate with our identity and our humanness are simply the continued outworking of deterministic processes of physics, chemistry, and biology. These processes somehow result in a phenomena that we call consciousness in which we appear to freely choose our thoughts and actions, but such freedom is merely an illusion. Everything we have thought and will think, all that we have done and will do is just the playing out of the chain of events predetermined by the laws and initial conditions of our universe. Free will is just an illusion.[10]

Classical mechanics continued to provide this deterministic picture of the universe until discoveries at the beginning of the twentieth century challenged it. However, before moving to the twentieth century, lets examine the claim that a deterministic universe not only does not require intervention by God, but that such intervention is either impossible or inconsistent with the idea of an immutable God of order.

The first issue to address is the idea that divine intervention is impossible due to the immutable laws of nature. What classical physics reveals is consistent behavior of the universe that we can generalize through mathematic descriptions. These mathematical descriptions are called laws because they are observed consistently in a wide range of circumstances, and they have been successfully used to predict future behavior. The fact that these descriptions are called laws does not imply that they are somehow legislating

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[10] Stephen M. Barr, *Modern Physics and Ancient Faith,* (Notre Dame: University of Notre Dame, 2006), 17.

or are enforcing the behavior. Laws of physics are a description of what we regularly observe, but they don't provide any absolute restriction of divine operation, especially in the realm of the miraculous.[11]

C. S. Lewis makes a case that a miracle is not a disruption or breaking of natural laws, but the insertion of an event by God into the flow of the operation of natural laws. If you think of the universe as a deterministic system, and God as external to the system, he as an external agent can feed inputs into the system, to which the system responds according to its natural laws. Because God is external to the system, the deterministic behavior of the system does not affect his actions. Once the miraculous event enters the system, it then proceeds from that point according to the laws by which it has always operated. "Miraculous wine will intoxicate, miraculous conception will lead to pregnancy, inspired books will suffer all the ordinary processes of textual corruption, miraculous bread will be digested."[12] Just as the deist saw God as setting up the laws of nature and initial conditions of the universe at the beginning, there is no reason that God could not continue to provide input to the system as it runs. Such input would not necessarily be due to any limitations of God in his ability to create the universe correctly the first time, but could be due to other motivations.

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[11] C. S. Lewis, *Miracles: A Preliminary Study*, (New York: The MacMillan Company, 1947), 55-56.

[12] Lewis, 72.

Even if miracles do not necessarily break or violate natural laws, they still introduce something that would be external to an otherwise deterministic system, and is that an appropriate thing for the immutable, orderly God to do? It is if God has reasons that are more important than non-interference. Lewis uses the illustration of schoolboys learning to compose Latin poetry. They are taught the rule that they cannot have "a spondee in the fifth foot" because it violates the normal form of the hexameter poetry they are learning to write. It is important for their learning to practice the form exactly and learn how it sounds. If the students were allowed flexibility in the form, they would lazily take advantage of the license and not properly learn hexameter. However, when they read Virgil, they find that he does use a spondee in the fifth foot from time to time, and they may suspect that Virgil is thus a bad poet because he violates the rule that their teacher never let them violate. But Virgil, like other great poets, does not break the rule because he doesn't know better, or is unable to keep the rule, but because he has a higher artistic rule that is beyond the understanding of the students. "In other words, there are rules behind the rules, and a unity which is deeper than uniformity." Similarly, if we understood the plan of God, we would see that far from a violation of order, miracles are part of the perfect, orderly plan of God, who has greater things he is accomplishing than just keeping the laws of physics.[13]

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[13] Lewis, 115-117.

While Lewis provides good defense for the miraculous, even in the context of a deterministic universe, the problem of divine providence is a little different. Miracles are rare exceptional interventions by God, but divine providence is a continual guidance by God. The Catechism of the Catholic Church says:

> Creation has its own goodness and proper perfection, but it did not spring forth complete from the hands of the Creator. The universe was created "in a state of journeying" *(in status viae)* toward an ultimate perfection yet to be attained, to which God has destined it. We call "divine providence" the dispositions by which God guides his creation towards this perfection.[14]

The idea of continual involvement and guidance by God does not seem to fit with a universe that is governed by tightly interconnected processes. Catholic theology sees God as always involved because he loves his creation. The world was created out of love, and God is not content to just sit back and watch it go. The world is not a clock, nor is it, to use a modern analogy, a giant computer running unattended using a program that was installed complete at the beginning. Instead, God is constantly at work perfecting the universe, especially including the human and any other rational inhabitants of it. Such continuous work of God would seem to violate the deterministic laws that had been discovered, but that doesn't mean that it is impossible. As was said before, discovery of mathematical scientific descriptions of physics does not imply laws that God is unable to alter.

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[14] *Catechism of the Catholic Church: Revised in Accordance with the Official Latin Text Promulgated by Pope John Paul II*, 2nd ed. (New York: Doubleday, 1995), 302.

Although it is possible for divine providence to work in a deterministic universe, determinism provided ammunition for those who want to deny it. Happily, developments in physics in the twentieth century have shown that the clockwork picture of the universe was too simplistic. While there are still many unanswered questions when regarding determinism in the universe, today's picture of the world is much more fitting to the idea of divine providence. This is because of the discovery of quantum physics in the 1920s which radically transformed the whole structure of theoretical physics and swept away physical determinism. According to quantum physics, even if one were to know the complete state of the universe at a particular time, one could not exactly predict the subsequent events. Instead, only probabilities of subsequent events can be predicted.[15] John Polkinghorne provides the following description of the transformation in world-view that came about.

> For two centuries, Isaac Newton's mathematisation of physical thinking, expressed in equations whose solutions are uniquely determined by the specification of appropriate initial conditions, had suggested to many people the picture of a clockwork universe of tightly determined process. However, twentieth-century physics saw the death of this kind of merely mechanical view of the world, a consequence brought about by the discovery of intrinsic unpredictabilities present in nature.[16]

This radical transformation of physics began with the nature of light. The understanding of light in the nineteenth century was that it had wave-like properties.

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[15] Barr, 27.

[16] John C. Polkinghorne, *Quantum Physics and Theology: An Unexpected Kinship,* (New Haven: Yale University Press, 2007), 94.

Indeed, the great discovery in the physics of that century was the unification of electricity and magnetism by James Clerk Maxwell, and his equations of electromagnetism are dependent on the wave-like character of light.[17] In the year 1900, experiments in black body radiation produced surprising results that led Max Planck to theorize that energy was absorbed and radiated in packets of a definite size which he called *quanta.*[18] In 1905 Albert Einstein came to the conclusion that conceiving of light as packets that had energy in relation to its frequency explained the interesting behavior of the photoelectric effect.[19] These two conceptions, wave-like and particle-like, were about as different as could be imagined. A wave is spread out and oscillating, like ripples on the surface of a pond, and a particle is concentrated like a bullet. Even though it appeared nonsensical and counter-intuitive, the wave/particle duality of light fit the empirical evidence.[20] From 1900 to 1925, this paradox remained unresolved, and although explanations were made in order to try to deal with it, none of them were satisfactory. The explanations were like patches to classical mechanics, but what ended up being needed was a fundamental change.[21]

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[17] John C. Polkinghorne, *Quantum Theory: A Very Short Introduction,* (Oxford: Oxford University Press, 2002), 3.

[18] Polkinghorne, *Quantum Theory,* 8.

[19] Polkinghorne, *Quantum Theory*, 10.

[20] Polkinghorne, *Quantum Physics and Theology*, 16.

[21] Polkinghorne, *Quantum Physics and Theology,* 17.

Revolutionary discoveries by Werner Heisenberg and Erwin Schrödinger in 1925-1926 resulted in a fundamentally new, internally consistent theory. It solved the problem of the wave/particle duality of light, but required novel and unexpected ways of thought. Paul Dirac introduced the superposition principle to provide a mathematical foundation for quantum theory. Superposition "asserts that there are quantum states that are formed by adding together, in a mathematically well-defined way, physical possibilities that Newtonian physics and commonsense would hold to be absolutely incapable of mixing with each other."[22]

The classic demonstration of the consequences of superposition is the double slits experiment. In one version of this experiment, an electron gun is placed in front of a screen with two slits. It emits a spray of electrons, some of which bounce off the screen, some of which go through the slits. On the other side of the screen is a photographic plate that shows a mark if an electron strikes it. The electrons are emitted one by one, and each one makes a mark where it strikes the plate. The individual arrival of electrons indicates their particle-like behavior. If the electrons behaved like normal particles, we would see accumulations of marks in the areas directly behind each slit. Indeed, that is what happens when one slit is covered. However, in the case of electrons (or any other quantum particle) with two slits, as the marks accumulate, they form a rippled "interference pattern," which is an indication of the electrons behaving in a wavelike

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[22] Polkinghorne, *Quantum Physics and Theology,* 18.

mode.[23] The implication is that each electron travels through the slits as a wave that goes through both slits, and interferes with itself after passing through the slits.[24]

The concept of an electron as a particle of matter was a well accepted aspect of classical mechanics, but what did it mean that it was also a wave? One idea was that the material of the electron was actually spread out into a wave, but Max Born realized that such a view could not accommodate its particle-like behavior. He said that the waves observed in the two-slit experiment, and formulated in Schrödinger's wave equation were actually waves of probability. Multiple possible states of the electron, which included properties such as the electron's position, were combined in this wave. However, when there is an attempt to measure one of these properties, the wave collapses from a set of potentials into a single actuality. Interestingly, Born's probabilistic interpretation of the Schrödinger wave was not popular among the pioneers of quantum mechanics, including Schrödinger himself, because of the indeterminacy it implies.[25] Nevertheless, Born's interpretation has survived and is the most accepted understanding of quantum mechanics today, even though the actual meaning of it is still a mystery.

> When an electron which is in a state that is a mixture of 'here' and 'there' is experimentally interrogated about where it is, using the classical measuring apparatus available in the laboratory, on each occasion a definite answer will be

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[23] Polkinghorne, *Quantum Theory,* 23.

[24] Polkinghorne, *Quantum Theory,* 24.

[25] Polkinghorne, *Quantum Theory*, 25.

> obtained. Not always the same answer, of course, for sometimes it will be found 'here' and sometimes 'there'. The theory enables us to calculate with impressive accuracy the probabilities of obtaining these different answers, but it is unable to explain how it comes about that a specific answer is obtained on a specific occasion.[26]

Everyone agrees that there is an epistemological problem when predicting the behavior of these tiny particles, which is reasonable considering the small size of what is being measured. However, what Born's theory implies is that it is not just a case of epistemology. There is an "ontological flexibility" in the quantum world "whose description in terms of wavefunctions expresses present potentiality rather than persistent actuality."[27] That is, an electron or photon or other particle with quantum behavior truly exists in a state of potentiality over multiple possibilities until some interaction with an external system forces it to resolve into a particular actuality. The "choice" of which possibility will become actuality appears to be random.

Even though there is unpredictability at the quantum level, the probability regions are so small that they are not usually noticeable at the level of normal human perception. Neils Bohr, in an attempt to relate quantum mechanics and classical mechanics came up with his Correspondence Principle, which states that the behavior of quantum mechanics approaches that of classical mechanics when objects become much larger than atoms. This is generally the case, but continued investigation has shown that reality is more complicated. There are some "macroscopic phenomena that

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[26] Polkinghorne, *Quantum Physics and Theology,* 69.

[27] Polkinghorne, *Quantum Physics and Theology,* 92.

display certain intrinsically quantum properties, even including the possibility of technological exploitation."[28]

Instead of a clockwork world where the future is tightly determined by the present, which was tightly determined by the past, we now see a world full of potentials. Every atom and every particle of light in the universe contains an element of unpredictability. Although the range of possibilities is mostly at the subatomic scale, this unpredictability could be a "sign of openness to the influence of causal factors which go beyond the scientific story of energy exchanges between constituents." Whereas classical mechanics seemed to leave no room for God's involvement in the world, quantum mechanics leaves open the possibility of "divine providential agency."[29]

My thesis is that quantum mechanics appears to have opened a trap door down at the subatomic level where divine providence can sneak in without disturbing the normal predictability of cause and effect that we ordinarily experience at the level of everyday life. It must be stressed that this is only a possibility. We don't know what God is doing down there, and it is likely that even if God is exercising providential influence at the subatomic level, we could never know it, no matter how advance science gets. When scientists observe the details of a quantum interaction, they are looking at such a very minuscule part of what would be the whole work of God's providence, that it

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[28] Polkinghorne, *Quantum Theory,* 48.

[29] Polkinghorne, *Quantum Physics and Theology,* 95.

would be impossible to discern anything of the meaning that would be there. It is like looking through a microscope at some ink particles on paper fibers that come from a punctuation mark from a page of the Bible. We might be able to determine that it is ink on paper, but we would not be able to tell what the writing is or what it means. Indeed, at a high level of magnification, we could not tell the difference between part of a great work of literature and random splatters of ink on paper.

Another thing to keep in mind is that it is always possible that someday physics will take another turn to a deterministic model again. There have been repeated attempts during the more than eighty years of the history of quantum mechanics to come up with deterministic interpretations of the theory. The nondeterministic, probabilistic model has continued to be the most highly regarded, but a future model might displace it. For these reasons, we must be careful to not put too much theological weight on this idea. This is a possible way in which divine providence might act, and for the time being the classic arguments against providence are weakened.

When scientists say that the particular actualizations of quantum potentials is random, they are saying that there is nothing in the theory that can tell us which outcome will actually occur. All attempts to provide deterministic explanations for these outcomes have not been satisfactory. However, this does not necessarily mean that the outcomes are meaningless if we allow the possibility that God is determining or influencing the outcomes. Just as we cannot prove that God is influencing quantum

behavior without seeing the big picture of the universe, we also cannot prove that God is *not* influencing quantum behavior. If God were influencing the outcomes in such a way that they always fit within the probabilities that are specified by the quantum theory, such outcomes would be indistinguishable at a human level from truly meaningless random outcomes.

The hidden nature of quantum effects is attractive when considering divine providence. The nature of providence according to traditional Christian theology is that it is recognized by faith. God is caring for his creation because of his love, but his respect for the free will of its human inhabitants is such that he does not make his presence overwhelmingly visible.[30] The believer sees, usually in hindsight, that God was working in particular situations, but when an unbeliever sees the same situation, he writes it off as chance coincidence. When God works in an invisible way, as is being proposed in this quantum mechanics thesis, God gives room for the unbeliever to doubt if he chooses.

Another attractive property of providence through quantum mechanics is that it indicates a great intimacy between God and the universe. Quantum interactions are everywhere. Every atom has electrons, and all electromagnetic energy is made up of photons, from radio waves to light, to X-rays and gamma rays. Electrons and photons, along with the other small subatomic particles that have been discovered, behave

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[30] John C. Polkinghorne, *One World: The Interaction of Science and Theology,* (Conshohocken, PA: Templeton Foundation Press, 2007), 32.

according to quantum mechanics. Therefore, if God is influencing the behavior of each of these particles, he is intimately involved in every aspect of the universe. Such constant interaction with every particle in the universe would require unimaginable intelligence which could only be ascribed to an omniscient God. The power implied by such action would be greater than any other power in the universe. Although extremely powerful, God would also be working in a quiet, gentle, hidden manner. Polkinghorne observes that divine action of this sort would be different than what has classically been understood as the relationship of God to the created world.

> Notice, that if there is an element of truth in this picture of the nature of divine action, it is exercised within the open grain of natural process and not in a way contrary to that process. God may properly be said to interact with creation, but the word 'intervene', with its connotations of arbitrary interruption, would not be appropriate.[31]

Rather than God interfering with creation, he is seen as intimately connected with it. Such intimacy would depict God's immanence, which is a traditional Christian doctrine[32] that is held in tension with God's transcendence. Note that this traditional tension between immanence and transcendence allows us to see God as very intimately involved with creation without sinking into pantheism. God is still distinct from and outside of creation while at the same time penetrating every part of it.

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[31] John C. Polkinghorne, "Kenotic Creation and Divine Action," in *The Work of Love: Creation as Kenosis*, edited by John Polkinghorne, (Grand Rapids: William B. Eerdmans Publishing Company, 2007), 100.

[32] *Catechism*, 239.

A question that remains unanswered is just how much could actually be done by means of controlling quantum outcomes? Needless to say, this does not appear to be a question that physicist have spent much time addressing. First of all, most of them believe that the outcomes are completely random, but even if they thought otherwise, it would be difficult to test.

One possible example of what could be influenced at the quantum level involves the Darwinist theory of evolution, which says that the various species evolved through a process of chance mutations and natural selection. It is thought that certain quantum effects, such as the timing of radioactive decay, could influence genetic mutations.[33] Divine influence through quantum effects would mean that the mutations would not be limited to blind chance, but could be influenced by God. Even if quantum influence is small in the realm of genetic mutation, it could at least have as much creative power as is given to pure chance in Darwin's theory.

Genetic mutation is a microscopic way in which God could act through quantum effects. I present it as a kind of lower bound which we could consider. However, the upper bound is not known. There are many mysteries of quantum mechanics yet to be understood. Most of the work has been at the level of individual particles in isolation, but we know that such isolation is artificial. In reality, particles interact with other

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[33] Holmes Rolston, *Science and Religion: A Critical Survey,* (Conshohocken, PA: Templeton Foundation Press, 2006), 51.

particles in their environment, and the scope of such interaction can be surprising. One such surprise is the "EPR effect."

> [The] EPR effect [is] a counterintuitive togetherness-in-separation that implies that two quantum entities that have interacted with each other remain mutually entangled, however far they may subsequently separate in space. Effectively, they remain a single system, for acting on the one 'here' will produce an immediate effect on its distant partner.[34]

Such entanglement means that the limits of a particular quantum effect would be very hard to determine.

The indeterminacy of quantum mechanics not only has implications for God's providence, but also for human free will. Classical determinism was seen to be a problem for human free will, but quantum indeterminism provides an opening for human free will that is similar to what we have seen for divine providence, except presumably on a smaller, local scale.[35] God would presumably voluntarily hold back his action to leave zones open to human action. Out of love for man, God gives up some of his sovereignty so that man may have free will.

What has been described in this paper is a bottom-up picture of God's action in the world through the indeterminism of quantum mechanics. Although Polkinghorne admits the possibility of this bottom-up approach, he prefers a top-down approach which he calls "active information" that is based on chaos theory.[36] Both approaches see

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[34] Polkinghorne, *Quantum Physics*, 21.

[35] Barr, 27.

[36] Polkinghorne, "Kenotic Creation," 100.

God working through and with the natural processes that we find through scientific investigation. Polkinghorne notes the significance of God allowing natural and human processes to take their own course, and that his work of providence is not in violation of those processes, but working along with them.[37] God does not bring a static world into being with a one-time act of creation, but he brings a developing world into being, which is full of processes by which it unfolds itself. God is seen as working with the universe in an act of continual creation that will continue into the culmination of this world.[38] We find that the view of the world that modern physics gives us fits very well with Christian revelation. In speaking of the story of the incarnation, C. S. Lewis says the following:

> It has not the suspicious *a priori* lucidity of Pantheism or of Newtonian physics. It has the seemingly arbitrary and idiosyncratic character which modern science is slowly teaching us to put up with in this wilful universe, where energy is made up in little parcels of a quantity no one could predict, where speed is not unlimited, where irreversible entropy gives time a real direction and the cosmos, no longer static or cyclic, moves like a strange drama from a real beginning to a real end. If any message from the core of reality ever were to reach us, we should expect to find in it just that unexpectedness, that wilful, dramatic anfractuosity which we find in the Christian faith. It has the master touch—the rough, male taste of reality, not made by us, or, indeed, for us, but hitting us in the face.[39]

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[37] Polkinghorne, "Kenotic Creation," 94.

[38] Polkinghorne, "Kenotic Creation," 95.

[39] C. S. Lewis, *The Problem of Pain,* (New York: Simon and Schuster, 1996), 22.

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