

THEOLOGY AND THE HEISENBERG UNCERTAINTY PRINCIPLE

Christopher Mooney (Fairfield University) presented a paper entitled "Theology and the Heisenberg Uncertainty Principle." The paper was divided into three sections that dealt with (a) the substance of the principle, (b) its meaning for science, and (c) its meaning for theology. Following the presentation participants engaged the speaker with probing questions and additional insights.

(A) The principle was explained against the background of the narrative of its discovery. From the beginning of the twentieth century onward, through the slow process of interpreting experimental results, science discovered the existence of the microworld of subatomic particles. Max Planck's work on black-body radiation, followed by the explorations of Albert Einstein, Arthur Compton, Neils Bohr, and Paul Dirac, among others, revealed the structure and mechanics of these quanta.

A problem arose, however, when scientists tried to measure with precision the location and velocity (direction and speed) of subatomic particles. Unlike what happens in the macroworld, the measuring process itself creates a disturbance so that a total fix on the whereabouts and dynamism of quanta is not possible. In 1927 Werner Heisenberg summed up the state of affairs in his famous uncertainty principle which states: the more accurately one knows by repeated experiment the position of any subatomic particle, the less accurately one knows its velocity, and vice versa. The quantum state of a subatomic particle (its position and velocity) can thus never be known or predicted with certainty. There is an irreducible fuzziness which science can never escape in observing the subatomic world. This constitutes, said Heisenberg, an absolute limitation on our knowledge of the world; science can get only so close to the underpinnings of nature. We are simply unable to make a measuring mesh of reality that is fine enough to tell us everything that is going on in spaces less than one hundred millionth of an inch. The corollary of such uncertainty is unpredictability, for at this level causes operate with probability rather than in a determined fashion.

(B) This challenge to strict Newtonian determinism has meant the beginning of a whole new vision of the physical. Since the late 1920s physicists have recognized that an inescapable randomness and discontinuity coheres within the operation of the laws of nature. The debate among scientists has been over how to interpret this phenomenon. Is it strictly epistemological, a result of the limitations of the experiments devised to date? Or is it ontological, due to the indeterminacy of nature itself? Einstein abhorred the latter position, as his famous comment that God does not play dice with the universe attests. But in spite of continuing debate this position has gained the field, the consensus being that

uncertainty is a principle of genuine indeterminacy and not merely a principle of ignorance. Whether ontological or epistemological, however, uncertainty appears to be at the heart of every interpretation of microworld reality.

(C) The revolutionary meaning of quantum theory for theology becomes most evident in the areas of divine grace and human freedom, God's creative action in the world, and the doctrine of God itself. Some have sought to use the uncertainty principle naively to predicate God's active presence in every subatomic event. Instead of the universe operating through mechanistic laws, God would be the Hidden Variable working at the roots of reality, orchestrating particle activity to obey the statistical probability of experiment. Such a God would be the polar opposite of the absent God of deism, for such a God would be in total control at all times of each and every quantum event.

Prof. Mooney argues against this option, for unless one holds to predestination, it presumes that God acts in the natural world in a way completely different from God's providential involvement with human freedom. But the boundary between spirit and matter is not so easily drawn, nor is the underlying dualism that this position requires any longer credible. Rather, God's providential activity ought to be a seamless web throughout the processes of the natural and human world. Accordingly, Mooney suggests that the best way to understand how God acts in the indeterminacy of the subatomic realm is by analogy with the traditional theology of how divine initiative relates to the indeterminacy of human freedom through the dynamism of grace.

"God is more inward to me than my inward self" (Augustine), meshing with the dynamics of human thought and initiative in a noncontrolling way to guide choice in the best direction. Similarly, God's activity in the natural world appears not in the gaps but in the hidden looseness of unfolding quantum processes. Here are the "causal joints" of divine action, points at which the future comes into being, where good can be brought out of evil, where God's intention can be actualized without denying to creation the freedom given it to be itself in a flexible process that is structurally open.

God, then, is neither a maker of clocks nor a thrower of dice, but a patient and subtle Creator, content to achieve divine purpose through the unfolding of process and accepting thereby a measure of the vulnerability and precariousness which always characterizes the gift of freedom by love. This understanding of God coheres with what is revealed in the Christ event which is constituted by a divine *kenosis*, a self-emptying into matter in the person of Jesus. In the events of his life and its climax in the cross, divine action is modelled not on the actions of a puppeteer but of a creative, self-limiting lover, and divine power is seen to operate not in a rigidly controlling manner but as powerfully persuasive love. Thus in Christ as well as in the natural and human world, God seems mysteriously content to achieve the divine purpose through the unfolding of process. "It is possible that Love can only work in such a way, out of respect for the beloved."

This does not negate providence in a radically contingent world, but illumines it. Wave packets propagate and collapse, sparrows fall to the ground, humans freely decide for good or ill; yet hairs of the head nevertheless get numbered, elusive quantum particles eventually statistically stabilize, and "where sin increased, grace abounded all the more." Prof. Mooney concludes that, if indeed there are any dice, theology would say they are loaded.

In the discussion that followed a number of points were raised. What is the status of God's future knowledge in the light of the uncertainty principle? Does God know the future before it happens or is God surprised by what develops? Prof. Mooney opined that it is difficult to see how God can know in the abstract what does not yet exist and may never exist.

William Stoeger (Vatican Observatory) pressed home the radical contingency of the evolutionary process by inviting participants to engage in a thought experiment. Roll back the evolutionary clock to the moment when the first living cell emerged in the primeval sea. Then let the clock roll forward again. Would we result? That is, would there now be erect vertebrates with self-consciousness? The answer is no. The chances of the same concatenation of events and choices being made again in the same sequence is so infinitesimal as to be not seriously imaginable. Stoeger also argued strongly as a scientist in favor of continuous creation. This does not necessarily blur the distinction between God and the world; rather, it affirms a notion of God as always freely engaged in the act of creation.

A question was raised about verified miracles such as occur at Marian shrines. While there is no scientific explanation for these, the notion of the ontologically open nature of matter in an evolving universe offers a framework within which such occurrences may at least be made intelligible.

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