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**THROUGH MODERN PHYSICS TOWARDS A STRUCTURE
FOR CAUSALITY**

by

Lynden J. Rogers

Science Department
Avondale College
Cooranbong, Australia

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Author's Note: The reader is urged to consult the paper "Does God Play Dice," by Vernon Howe, appearing in this volume, in conjunction with this article.

INTRODUCTION

This paper suggests that from its beginning, science has been one of those factors informing the Christian understanding of human and Divine causality. As it first began to divulge its secrets to the classical scientists like Newton, nature appeared to be so regular as almost to preclude either human free will or divine providence. This influence persisted until the beginning of this century. In the first section of this paper we briefly trace the development of such a mechanistic view of process, noting its effect on Christian thought of the day. The second section attempts to explore the manner in which the recent thought structures of Relativity, Quantum Mechanics, and Chaotic Dynamics might continue this tradition. These theories are introduced, and briefly examined for components of likely significance to our understanding of human and Divine agency. Those quantum mechanics and chaotic dynamics particularly, are then further explored.

We conclude that the new physics suggests a wide-open universe in which the interaction of a Creator-Sustainer god can be postulated with far less confrontation with rational and scientific views of the natural order than was the case with the older Newtonian worldview. This is asserted to be the case both for the circumstance of genuine freedom in the universe, and also for its manner of being.

Part 1: Classical Science and Causality

In the early 1500s the universe and God's action in it were deemed by the church to be well understood. At the center of the universe was the immovable earth, created by God for mankind, the pinnacle of His creation. Around the earth moved the crystalline spheres carrying the seven heavenly bodies, outside of which was the eight spheres containing the "fixed stars". Enclosing this was the sphere of the "prime mover" where was enthroned the triune God, to whom rose the "music of the spheres" as the celestial bodies moved.¹

Natural and social agencies mediated Divine approval and censure in a very direct sense. There was no doubt about God's action in the affairs of men as He strode through the length and breadth of the earth. His close involvement in rain and shine, one's personal fortunes, and one's neighbor's untimely death, was simply assumed. Kings ruled by divine right and the plagues of Europe were seen as God's just judgments on the noxious sins of mankind. Even where it was noticed, deep order and system in nature remained largely unremarked. In those times there was no need to enquire as to how God worked in this world. He just did. And miracles were not, after all, so very much different

in substance to God's other works. All were equally inexplicable. In the absence of what we now know as laws of nature the faithful were spared any conjecture as to how God got around them! Similarly, the fact that humans could genuinely determine outcomes was simply assumed.

Then, during 1543, Nicholas Copernicus published "De Revolutionibus Orbium Coelestium" in which he argued for a heliocentric rather than a geocentric universe, and the stage was set for a major upheaval of not only our knowledge of the natural realm, but much of Christian thought as well. The challenge to orthodoxy was further focused as Galileo's telescope subsequently revealed the moons of Jupiter, spots on the sun, and irregularities of the lunar surface. Thomas Kuhn describes this challenge graphically.² Due to the strong scholastic nexus between motion and perfection; a circular motion for the earth suggested to the church fathers a state of terrestrial perfection. This, however, was theologically absurd. Conversely, the solar and lunar irregularities suggested imperfection in the heavens, which was just as unacceptable. It all tended to remove the Aristotelian division between celestial permanence and perfection and sublunar ephemera and decay, which had been so completely subsumed into the church by Aquinas. Later discoveries suggesting an evolving universe further challenged traditional understandings of a completed and aesthetically perfect creation.

It is difficult to see how this confusion resulted in a growing uncertainty over the extent of God's action within the universe, threatening the existing structure of causal understanding. Questions arose concerning just what it was that God had finished, and what it was that he was still directing. John Donne later lamented this dissolution of the old order in his "An Anatomie of the World."

The new philosophy calls all in doubt,
The element of fire is quite put out;
The sun is lost, and th' earth, and no man's wit
Can well direct him where to look for it.
And freely men confess that this world's spent,
When in the Planets, and the Firmament
They seek so many new; then see that this
Is crumbled out again to his Atomies.
'Tis all in pieces, all coherence gone;
All just supply, and all Relation:
Prince, Subject, Father, Son, are things forgot,
For every man alone thinks he hath got
To be a Phoenix, and that then can be
None of that kind, of which he is, but he.³

As it happened, the arguments of the scientists had little appeal to most ecclesiastics who, even when they understood them, "were unwilling to achieve minor celestial harmonies at the expense of major terrestrial and theological discord".⁴ (Hard they better understood the long term effects of this new thought, they may have been still less impressed). Opposition to the new cosmology was quickly expressed by leading Catholic theologians, with the Galileo affair further hardening resistance.⁵ Statements by contemporary Protestant leaders such as Luther, Melancthon, and Calvin, also strongly opposing the new thought, are well documented.⁶

We know that the subsequent attempts of the Church to deal with heliocentrism not only influenced theology but shaped the religious experience of the common man. As stated by Kuhn, "during the century and a half following Galileo's death in 1642, a belief in the earth centered universe was gradually transformed from an essential sign of sanity to an index, first, of inflexible conservatism, then of excessive parochialism, and finally of complete fanaticism".⁷ However, the apparent resolution of the scientific conflict did not remove the confusion over God's action within creation introduced by the Copernican challenge.

Definite pressure **against** traditional Christian understanding of providence, as well as questions concerning just how human causality should be understood, arrived with the development of scientific reductionism and determinism. From the time of Galileo and Newton it was perceived that many natural systems could be best qualified and quantified by successively breaking them down into their constituent sub-systems. Once the building blocks were understood, they could then be synthesized again. The success of this technique when it was applied in physics, chemistry, astronomy and medicine was impressive. The realization, for example, that the body consisted of systems, such as the circulation system, which were in turn comprised of organs, gave birth to modern medical science. Because of its introspection, reductionism tended to diminish any aspect of reality such as personality and free will, which could not be conveniently reduced, to a position of relative unimportant.

Furthermore, the universe, which had been seen as the playground of capricious or loving deities was now, it seemed, best understood as one of sustained order, this order being best expressed by mathematical laws. This regularity and predictability was seen to be ubiquitous. One of the great scientists of this period, the Marquis de Laplace stated that if one could know the position and velocity of all the particles in the universe then it would not only be possible to totally predict the future, but also to retrofit the past.⁸ This is scientific determinism.

Christian initially had trouble with this notion since it seemed to remove any room for genuine volition, either human or Divine. Indeed it was urged against Newton that by his statement of the law of gravitation he "took from God that direct action on his works so constantly ascribed to Him in Scripture and transferred it to material mechanism"; also that he "substituted gravitation for providence".⁹ Over the following two hundred years, however, the Church adjusted to this idea and came, by the time of the great apologists such as Archdeacon Paley, to see in the vast and accessible order of nature the very strongest arguments for a Divine Designer.¹⁰

There was a real tension, however, between this God of order, and the One of inscrutability. If nature is so predictable through being predetermined, then what of human volition, to say nothing of God's providence? It seemed to many that the only God logically consistent with this view of physical reality was the God of Deism. The universe may well have been wound up, but it had definitely been well and truly let go!

Christians seemed reconciled to a scaling down of providence to the extent that whereas in past centuries they may have prayed for rain and for security in old age, it became more likely that they would turn to irrigation and superannuation instead. As a result of this type of thinking we have become so convinced in modern times of the universality of cause and effect that we even apply scientific reductionist thinking to problems of the church, such as evangelism and church growth. In the process God has become, for some, a God of the gaps, there to do the hard bits. This God has then vanished, like the cheshire cat, as the explanatory power of science grew, until now only His smile is left!

Miracles are not so much looked for, and where they are identified they are regarded as God somehow stepping in and overriding natural process.

Part 2: Modern Physics and Causality

Introduction to the Modern Physics

Then about one hundred years ago the appearance of two novel thought structures heralded a new science and within a few decades the universe was rebuilt under the astonished gaze of classical physics. These thought structures were the theories of Relativity and Quantum mechanics. Within the last fifty years these have been joined by a third, that of Chaotic Dynamics, more popularly known as "Chaos Theory". According to Capek¹¹ the present transformation of physics is far more consequential than even the Copernican Revolution. This time the issue at stake is not only the structure of the solar system but the structure of the universal coordinates as well. Space, time and causality are called into question in a manner which threatens most of what right-thinking people have previously regarded as unassailable common sense.

Special relativity showed that matter may be turned into energy and energy back into matter, thus introducing the atomic age. It also showed that one's measurements of time and space in another reference frame are dependent on the relative speed of that reference frame. Simultaneity turns out to be a relative concept, not an absolute one. From General relativity we learn that in the region of a massive object space is curved, and that the three angles of a triangle do not add up to 180 degrees. We learn that gravity has a grip on time and that if a clock is taken some distance away from the earth, for example, it will run faster than an identical unit back home. Black holes, accumulations of matter so huge that even light cannot escape from them, are postulated. Near a Black hole time would slow down dramatically. If it were possible to hover near the edge of such a black hole, one's clock would stop completely,¹² and one would embark on a journey to not only nowhere, but nowhen! It would be impossible to return from such a journey since the universe would have happened.

Quantum mechanics tells us that on the scale of the very small, such as the atomic level, the old laws of cause and effect break down. Events happen without causes. It transpires that due to Heisenberg's uncertainty principle there are physical limits on what can be simultaneously measured within a system. One just cannot know for example, the position and speed of a particle at the same time. The most definite statements that can be made are those of statistics. The isolated atom, electron, or pion is unknowable, and the concept of the individual particle

loses much of its significance. Matter at times behaves like a wave and visa versa. This is now a cloudy and fitful world. Many scientists, including Einstein were very uncomfortable about the idea of God playing dice with the universe in this way but the evidence has been increasingly against them.

Chaos theory tells us that uncertainty and instability are not only present at the microscopic level, but at the macroscopic level as well. As Polkinghorne says, "even in the everyday there turn out to be more clouds and less clocks."¹³ This is even more unexpected than quantum mechanics both because the results are more noticeable, and because we had thought we had large scale systems worked out. We learn that the stable, linear systems of classical physics are the exception rather than the rule. We discover that nature consists largely of non-equilibrium systems, and that they are not as robust as we had thought. This non-linearity means that small perturbations may have massive consequences. If we doubt this we need only try to predict the weather! In this connection scientists refer to the "butterfly effect" whereby a butterfly fluttering its wings in Cooranbong, Australia, affects the weather over London a month later. Old classifications and laws have gone as we have learned that systematic patterns and chaotic processes are not antithetical at all but rather that there is a symbiotic nexus between them. Now we struggle a new to define concepts such as order and process.

The Contribution of Modern Physics to Causality

Although it is somewhat parenthetical to or main argument it is worth noting, before we leave relativity, that this discipline suggests radical revisions to traditional notions of **initial** causality. If space, time, matter, and energy are all equally and interrelatedly the warp and woof of reality, as they seem to be, then what of time "before" this universe? And since causality for us is a temporal concept, how did God cause the cosmos if time is part of it? Relativity seems to suggest that Augustine was right when he postulated that God was outside time as we experience it.¹⁴ There also seems to be some Biblical evidence suggesting this.¹⁵ Furthermore, one might ask just how God interacts with us across the boundary of space-time?

It is from quantum mechanics and chaos theory, however, that the most interesting speculations arise. In the case of quantum mechanics it was initially assumed by many that the in-determinism encountered simply represented an epistemological uncertainty. The outcome of any process was really fixed, it is just that we can't ever find it out for sure. Indeed Einstein took this stance as the refused to believe that God played dice. However, it has been increasingly realized that quantum mechanical uncertainty represents a genuine ontological in-determinism ie that the uncertainty in knowing represents a deeper uncertainty of being, in the words of John Polkinghorne, "epistemology maps ontology".¹⁶ According to this view the absence of determinism at the constitutional level of matter represents a genuine openness to the future, quite in conflict with classical physics.

In the case of chaos theory, the picture is a little harder to analyze. Polkinghorne suggests a useful illustration, which is well known to Physics 1 students. From the kinetic theory of gases it is possible to calculate that at room temperatures, each air molecule will experience approximately 50 collisions with its neighbors each 10^{-10} s. Suppose we wish to determine just where a particular molecule will be, after these 50 collisions. The slightest miscalculation of the impact parameter of any given collision will, of course, mis-que the next impact, which as any billiards player can assert, will have dramatic consequences down the track. In fact it transpires that if one fails to take into account even something as insignificant as the gravitational attraction of an electron on the other side of the universe, it becomes impossible to predict the outcome. Due to the difficulty of the task this prediction, therefore, is out of the question. This example demonstrates the intrinsic unpredictability and unisolatability of such systems.¹⁷ They are unisolatable because they are so vulnerable to the slightest nudge. When pushed to its logical limit, even quantum mechanical interactions assume significance for such non-linear systems.

This intrinsic unpredictability suggests to Polkinghorne that chaotic indeterminism is also ontological in its origin. Kellert also inclines to this view, when he writes of his belief that "chaos theory not only argues against the predictability of certain systems, but that when combined with quantum mechanical considerations it leads us to grave doubts about the doctrine of determinism itself."¹⁸ It is being increasingly realized that not just the weather, but many natural systems, are best described by chaotic dynamics. According to this view the world is loosened up and liberated from the Laplacian straightjacket. The natural realm is seen as one of true becoming, with a genuine openness to the future which is not then simply the rearrangement of the past.

It remains possible, of course, for inanimate nature to act according to that regular, if ultimately statistical, nature endowed at earliest creation, the investigation of which is what we call science. It is also possible for actions of genuine human volition, which may be mediated to that natural regularity by means of the quantum mechanical or chaotic indeterminism discussed. The conscious will, in some manner we do not yet understand, actually collapses the probability function onto one of its eigenvectors in such a way as to implement a decision. This approximates to the view of the physicist Erwin Schroedinger as he reflected on the circumstance that his body functioned according to natural law even as it responded to his conscious intention. He concluded that

"The only possible inference from these two facts is, I think that I....that is to say every conscious mind that has ever said or felt 'I' - am the person, if any, who controls the motion of the atom according to the laws of nature."¹⁹

Or as Francis Jacob put so succinctly: "Biology can neither be reduced to physics nor do without it."²⁰ Human freedom is thereby seen to be genuine, but circumscribed.

Having admitted human volition and suggested a mechanism, as Christians we should perhaps not be altogether surprised if God had reserved a level of causality for Himself. This then, would be the mechanism of divine providence. Again we would surmise that God is able to act within creation on at least the two levels we have discussed and possibly others of which we are not aware. For all we know He may be continually doing this, albeit in a somewhat regular way. Ellen White makes a number of statements, which suggest that this was her view.²¹

It is even possible that there may be elements of regularity associated with God's causality. Perhaps this is why there is at least a measure of similarity between the experiences of different Christians.

We are then led to postulate a multi-layered causality acting in nature: a "bottom up" causality imposed by the inanimate order, an intermediate causality driven by human freedom, and a "top down" causality by which God accomplishes His inscrutable purpose. Perhaps the writer of Proverbs 16:9 was articulating this idea when he wrote: "A man's mind plans his way, but he Lord directs his steps." Such a view of reality may be used to neatly define an authentically Christian natural philosophy. The problem with the naturalistic world view endemic to modern scholarship is simply that while admitting natural law, and in some instances even human volition, it denies top down causality.

This view also suggests a view of miracle. A miracle could then be seen as god simply doing something a little different than normal, just an additional butterfly here and there. There would then be nothing "supernatural" about it and no natural "law" is necessarily denied. The distinction frequently represented between "natural" and "supernatural" is removed altogether, providing a much greater coherence. Also, we recognize that we may never be able to objectively quantify such interaction. God's action will generally be hidden, never readily disentangleable from other causalities. This, of course, does not mean that god is not able to reveal His action through the inner eye of faith. As I read the Scripture I see that He has frequently done so. Perhaps one of the Bible's principal functions is to declare and uncover God's action in this way. The view is supported by the exploration of "order and chance in Scripture" undertaken at a previous faith and learning seminar by deBerg.²²

On the basis of this understanding Pokinghorne suggests a model for petitionary prayer. It is not us "suggesting a rather clever plan which might not have occurred to God". Nor us "telling Him something of which He may not have been aware". Rather, petitionary prayer may well be the giving back of our volition to God. Could this be the real meaning of the common phrase: "Not my will but Thy Will be done?" (Matt 26:39) Perhaps this is what Paul meant when He wrote: "Let this mind be in you which was in Christ Jesus". (Phil 2:5). In this sense prayer becomes "genuinely instrumental" and actions become possible which were not possible before. Not all things of course, but more things. Just as laser light is powerful because of its coherence since all the photons beat in time as it were, so the union of the human will and the Divine Will places greater volition in the hands of the Almighty than exists otherwise. Consequently, it is maximally effective. This may also explain the direction to engage in corporate prayer, where many people pray for the same thing. Not more fists beating on God's door, but greater coherence, and freedom in the hand of God. As a sobering corollary it is also obvious, according to this view, that prayer is **not** a substitute for action.²³

This model also suggests a partial resolution of some of the many questions arising from Scripture. If it is asked, for example, whether Christ died because of the betrayal of Judas, because of the accumulated weight of human sin, or because Heaven's clock had just chimed the hour?, the answer is "yes". All of these elements and many more were involved in the Christ event. Just how all the causalities interplayed we may not know on this earth. Similarly, we can see that it may be possible for prophecy to be both conditional and unconditional at the same time. This may help the theologians! Perhaps it was the congruence of Abraham's choices with the Divine will that actually presented God with a wider table of options concerning his descendants than was the case with any other racial group. Maybe that is why He was able to choose them as an instrument of salvation for the world. If so, such a scenario suggests the importance of a life rightly aligned. Interestingly, the Bible seems to back this up!

It may even be possible to apply our model to soteriology. Could it be that tone of the basic effects of sin on the universe has been to reduce the causal freedoms available to both God and man. Paul Trudinger suggests that through the fall the fullness of humanities freedom was surrendered and that one of the central themes of Scripture is "Yahweh's constant love which sought to restore mankind to freedom, to salvation, to peace."²⁴ Perhaps sin is to freedom as dark is to light, simply the absence. Within Scripture the motif of freedom is frequently associated with that of salvation. It is also true that many scholars have taken the view that sin has indeed circumscribed the Divine Will.

Conclusion

Of course, one must always beware the temptation to tie God to current scientific or philosophical ideas, for that is ultimately to create a God in one's own image, the ultimate blasphemy. This paper is not to be understood as such an attempt.

We conclude that, at least according to this superficial analysis, modern physics not only underwrites genuine freedom and becoming in this world, but suggests a mechanism by which it is accomplished. One is left to reflect on the circumstance that after four centuries of scientific endeavor we have gone, in a sense, full circle. We find that God is back where He originally was, continually involved with His creation!

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