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ORDER AND CHANCE IN NATURE AND SCRIPTURE:  
TOWARDS A BASIS FOR CONSTRUCTIVE DIALOGUE

by

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Introduction

The question of a dialogue between nature and scripture is not simply an academic one, although academic matters are certainly involved. The great philosopher and mathematician Alfred North Whitehead on reviewing the relationship between science and religion comments that,

When we consider what religion is for mankind and what science is, it is no exaggeration to say that the future course of history depends upon the decision of this generation as to the relations between them. (A.N. Whitehead 1926, p.260)

Whilst a synthesis of medieval science and scripture was achieved in the thirteenth century by Thomas Aquinas (Niebuhr 1951, p.130) no such synthesis has been achieved for modern science and scripture. Particularly since the middle of the nineteenth century, an ever-increasing gap has been emerging between the two. This has been exacerbated by the fact that whereas in medieval times and during the birth of modern science in the sixteenth century the scientists of the day were largely men of the church, in the modern era the separation of the church from the modern university and the rise of atheistic thought has meant that many scientists of today would not claim adherence to any Christian faith. Is there, then, any basis for a relationship at all between the study of nature and scripture? On considering this question John Polkinghorne suggests that,

despite the obvious differences of subject matter, the two disciplines have in common the fact that they both involve corrigible attempts to understand experience. They are both concerned with exploring, and submitting to, the way things are. Because of this they are capable of interacting with each other: theology explaining the source of the rational order and structure which science both assumes and confirms in its investigation of the world; science by its study of creation setting conditions of consonance which must be satisfied by any account of the Creator and his activity. (J. Polkinghorne 1986, p.97)

Elsewhere on the same topic he states that,

Natural theology is important, because if God is the Creator of the world he has surely not left it wholly without marks of his character, however veiled. There must be a consonance between the assertions of science and theology about the world in which we live. (J. Polkinghorne 1986, p.78)

In a similar vein the apostle Paul in reviewing God's relationship to mankind affirms that,

For since the creation of the world God's invisible qualities - his eternal power and divine nature - have been clearly seen, being understood from what has been made, so that men are without any excuse. (Romans 1:20)

It is important to realise at this point that the seeking of a dialogue between science and religion is not just the fluttering attempts of pious well-meaning scientists and theologians to affirm their tottering faith but the need for dialogue has arisen from within the disciplines of science and theology themselves. That is, developments in science and religion have reached the stage where fundamental questions can no longer be ignored.

Torrance confirms this point by saying,

In our day we have reached a turning point in the history of thought at which natural science and theological science are confronted each in its own way with the need to adopt a fundamental attitude to the universe as a whole. (T.F. Torrance in A.R. Peacocke 1981, p.81)

In this essay I will deal with just two aspects related to the fundamental questions being addressed by science and theology. These are the concepts of order and chance. Firstly I will define how these terms will be used in this paper. I will then deal with how the concepts of order and chance have developed within the study of nature in the scientific context and follow this with the use of the concepts in the scriptural context. It is then intended to discuss how these concepts can be used as a basis for dialogue. This is followed by a discussion of features related to the teaching-learning environment and a summary conclusion.

Definitions

Whilst there are many possible ways of defining order and chance (see for example; J. Polkinghorne 1986, p.72 and D.M. MacKay 1974, p.48) I will adopt the following general definitions in this essay.

Order: a reference to a structure or event which is symmetrical, patterned, predictable, or expected. For example, the operation of a well-constructed clock.

Chance: a reference to an event which is unpredictable or unexpected. For example, the result of tossing a non-biased die.

Order and Chance in Nature: the Scientific Context

The Greeks believed that the external order existed only in the heavens whereas the processes of earth were characterised by change and instability. Thus, it was believed, the processes of earth would not yield fruitful results under empirical investigation. However Galileo and Newton in the sixteenth and seventeenth centuries respectively were able to show that earth processes and heavenly processes appeared to match well-defined mathematical equations. So, for example, for a ball rolling down an inclined plane it was possible using the equation describing the motion to predict exactly where the ball would be five seconds hence and five seconds prior to the moment of observation. Alvin Tofler in reviewing the developments of science at this time says,

They pictured a world in which every event was determined by initial conditions that were, at least in principle, determinable with precision. It was a world in which chance played no part, in which all pieces came together like cogs in a cosmic machine. (A. Tofler in I. Prigogine and I. Stengers 1984, p.xiii)

Tofler goes on to explain how this view of the world came to affect civilisation itself.

This view of the world led Laplace to his famous claim that, given enough facts, we could not merely predict the future but retrodict the past. And this image of a simple, uniform, mechanical universe not only shaped the development of science, it also spilled over into many other fields. It influenced the framers of the American constitution to create a machine for governing, its checks and balances clicking like parts of a clock...And the dramatic spread of factory civilisation, with its vast clanking machines, its heroic engineering breakthroughs, the

rise of the railroad, and new industries such as textile, steel and auto, seemed merely to confirm the image of the universe as an engineer's Tinkertoy. (A. Tofler in I. Prigogine and I. Stengers 1984, p.xiii)

In the seventeenth century the universe was consequently regarded as a great clock ticking away with machine-like precision with God as the rational master. Prigogine and Stengers note that,

The clock world is a metaphor suggestive of God the Watchmaker, the rational master of a robot-like nature. At the origin of modern science, a "resonance" appears to have been set up between theological discourse and theoretical and experimental activity - a resonance that was no doubt likely to amplify and consolidate the claim that scientists were in the process of discovering the secret of the "great machine of the universe" (I. Prigogine and I. Stengers 1984, p.46)

The observation of machine-like order and symmetry became powerful reasons for believing in God as the Creator. Sir Isaac Newton himself questions and concludes as follows.

Can it be by accident that all birds, beasts and men have their right side and left side alike shaped...and just two eyes and no more on either side of the face... Whence arises this uniformity in all their outward shapes but from the counsel and contrivance of an Author...We are therefore to acknowledge one God, infinite, eternal, omnipresent, omniscient, omnipotent, the Creator of all things... (I. Newton in H.S. Thayer [ed] 1953, p.65-66)

It wasn't long before the machine-like model of nature was shattered when attention was given to the properties of small objects like atoms and molecules. Scientists in the seventeenth and eighteenth centuries attempted to describe, for example, the properties of a gas firstly from the point of view of rigid orderly molecular arrangements and secondly, when this was unsuccessful, from the point of view of molecules that could move with uniform velocity described by Newton's laws of motion. While this approach achieved some success it proved inadequate in describing completely the properties of a gas. It was Maxwell and Boltzmann in the nineteenth century who showed that an approach based on the laws of probability was able to achieve success in describing gas properties from the microscopic level.

The kinetic theory was a classical mechanical system and mechanical systems, by definition since the time of Newton, were reversible. But if entropy constantly increased, then, by

definition, the kinetic processes were irreversible. Something was obviously wrong somewhere. It was Ludwig Boltzmann who removed the difficulty. Whereas Maxwell had introduced probability theory almost casually into his calculations, Boltzmann showed that probability theory was essential to the very structure of kinetic theory. (L.P. Williams and H.J. Steffens 1978, p.226)

Thus although large objects appeared to obey the machine-like equations of Newton these equations proved inappropriate when very small objects were considered. The kinetic theory showed that gas properties could be best described by considering the constituent molecules to be moving in rapid random (chance-like) motion with varying velocities. Whereas it was possible by Newton's laws to predict accurately the position and velocity of a tennis ball rolling down an incline, it was not possible to predict what the position and velocity of a molecule would be in a gas. What we could calculate, however, was the probability of the molecular velocity being within a certain range. As Bronowski says,

This is a revolutionary thought in modern science. It replaces the concept of the inevitable effect by that of the probable trend. (J. Bronowski 1966, p.92)

When the properties of the electron were considered in the twentieth century using wave mechanics it was found necessary to invoke the principle of 'indeterminacy'. That is, it was impossible to determine the position and momentum of the electron simultaneously and accurately. One could only speak of the probability of finding the electron within a certain volume of space. Thus well-defined orbits gave way to diffuse orbitals for describing electrons.

However, there is an uncanny relationship between what is machine-like (order) and what is indeterminate (chance-like). If we take a sample of water for example, although its molecules are moving chaotically about with indeterminate velocities we know that the sample of water will boil at 100°C at one atmosphere pressure every time. That is, the combination of chance-like molecular movements gives rise to a predictable ordered property, boiling point. As Bronowski says again,

These are the ideas of chance in science today. They are new ideas: they give chance a kind of order: they recreate it as the life within reality. (J. Bronowski 1966, p.93)

More recent developments in non-equilibrium thermodynamics have shown another kind of relationship between order and chance. Ilya Prigogine received the 1977 Nobel Prize in chemistry for his work in this area. Alvin Tofler summarises Prigogine's work in these words.

Thus, according to the theory of change implied in the idea of dissipative structures, when fluctuations force an existing system into a far-from-equilibrium condition and threaten its structure, it approaches a critical moment or bifurcation point. At this point, according to the authors, it is inherently impossible to determine in advance the next state of the system. Chance nudges what remains of the system down a new path of development. And once that path is chosen (from among many), determinism takes over again until the next bifurcation point is reached. Here, in short, we see chance and necessity not as irreconcilable opposites, but each playing its role as a partner in destiny. (A. Tofler in I. Prigogine and I. Stengers 1984, p.xxiii)

In describing new developments in chaos theory Ian Stewart (in D. Calhoun 1990, p.54) speaks of 'designer chaos' to illustrate how order and chance can co-exist in natural systems and be partners in destiny.

In concluding this section we should note that while order and chance were originally regarded as irreconcilable recent developments in science have revealed an uncanny relationship between the two. Prigogine and Stengers called their 1984 book on this subject, 'Order out of Chaos, man's new dialogue with nature'. We now turn to the notion of order and chance as used in Scripture.

#### Order and Chance in Scripture

It would appear that scripture nowhere speaks about the order of nature in machine-like terms as did Newton. The notion of order in terms of 'symmetry' and 'image of God' was probably implied when God called his creation 'good' (Genesis 1:31). Again, when Job is asked to inquire of the rain, the clouds, the lightning, the constellations of Pleiades and Orion (Job 36-38) and the Psalmist says that "the heavens declare the glory of God and the firmament showeth his handiwork" (Psalm 19:1), what catches the imagination of Job and

David is not the clock-work machine-like properties of nature but rather the magnificence in terms of its complexity. In fact in the book of Job the incomprehensibility of nature is used to direct Job's thoughts to God.

In spite of the foregoing, however, it must be true that the Bible writers understood certain aspects of God's creation as ordered in terms of being patterned, predictable, expected. When Genesis 1 declares that there was 'evening and morning' the regular cycle of night and day due to the rotation of the earth on its axis was obviously implied although the writer of Genesis would most certainly not have been aware that the earth rotated on its axis. When God outlined the consequences of obedience and disobedience to Israel in terms of blessing and curse he was outlining the cause and effect relationship characteristic of many ordered systems. Israel knew what to expect if they were obedient and they knew the consequences of disobedience. Thus according to Scripture as I understand it God's creation included those aspects which exhibit pattern, predictability and expectedness but probably the bulk of the references to God's creation refer to His majesty, glory, splendour in the light of the immensity and incomprehensibility of his creation. The notion that God was the great clock-maker in his creation most probably arose in the church about the time of Newton when the universe came to be realised in terms of exact mathematical equations which imposed a machine-like quality on nature.

The notion of chance as I have defined it in this essay appears in scripture in the practice of the "casting of lots". According to the Seventh-day Adventist Bible Commentary,

The method by which Hebrews cast lots is in some doubt. The word translated 'lot' literally means 'pebble' suggesting that stones were used, perhaps of varied colours or of peculiar shapes. Proverbs 16:33 seems to indicate that the stones at times were thrown into a fold of the bosom of a robe, shaken, and then drawn out (Seventh-day Adventist Bible Commentary 1955, 3, 1005)

In the Old Testament the casting of lots was used in the following circumstances :-



- 1) Choosing goats in highly significant ceremonies of the Hebrew Day of Atonement, Lev. 16:5-10
- 2) in allotting land in Canaan to the tribes (Numbers 26:55, Joshua 18:10) and upon the return from exile (Nehemiah 10:34)
- 3) in settling criminal cases where there was uncertainty (Joshua 7:14, 18, 1 Samuel 14:41, 42)
- 4) in choosing forces for battle (Judges 20:8-10)
- 5) in appointing to high office (1 Samuel 10:19-21)
- 6) in allotting cities to the Priests and Levites (1 Chron. 6:54-65)

Blaiklock and Harrison (1983, p.293) suggest that the Urim and Thummim (Exodus 28:30) may have been used in this way although no direct evidence is available. In the New Testament the 'casting of lots' was used to select the disciple to replace Judas (Acts 1:23-26) with the confidence that the Lord would "show us which of these two had been chosen to take over this apostolic ministry". From these examples there is no doubt that the biblical writers had confidence that God's providence was revealed in the "casting of lots". The Seventh-day Adventist Bible Commentary confirms this position with accompanying advice,

In the beginnings of religious life and occasionally since God may have honoured our developing faith by giving us remarkable answers by such means but this does not imply that He wants us consistently to depend upon this method (Seventh-day Adventist Bible Commentary 1955, 2, p.210)

Thus scripture affirms that God's providence can be revealed by his ordered creation as well as through the processes of chance. Thus in answer to Donald Mackay's question, "Is the antithesis between God and chance a genuinely biblical one?" (D. Mackay 1974, p.48), we must answer that there are no biblical grounds for believing that God's providence cannot be revealed through processes of chance as defined in this essay although the advice previously mentioned is worth noting at this point. Mackay goes on to say,

God is declared in the Bible to be creatively active and supreme in every twist and turn of this Great Drama, whether 'chance' or 'law-abiding' in the scientific sense, which he has thought into

being by the word of His power (Heb. 1:2,3). It is a theological blunder to speak of his 'designer's mind' as an alternative, rival explanation to what the scientist may technically classify as 'operation of chance'; or to regard the success of such scientific explanation as discrediting the Bible. (D. Mackay 1974, p.55)

Just as science has revealed an uncanny relationship between order and chance so scripture affirms this relationship particularly in the apocalyptic portions therein. Commenting on Ezekiel's vision of a wheel within a wheel in chapter 1 of that book the Seventh-day Adventist Bible Commentary says,

the wheels so complicated in their arrangement represent human affairs and the events of history in all their play and counterplay. What to the unskilled observer appears to be hopeless confusion, the outworking of chance, the result of human ambition and caprice, is here presented as a harmonious pattern wrought out and guided by an infinite hand toward predetermined ends. (Seventh-day Adventist Bible Commentary 1955, p.578)

Speaking of apocalyptic in more general terms, Collins proposes that,

More broadly the apocalypses provide a comprehensive view of the cosmos through the order of the heavens or the predetermined course of history. This revelation puts the problems of the present in perspective and provides a basis for consolation and exhortation. (J.J. Collins 1984, p.22)

This is again an example of order out of chaos. Thinking of chance more in terms of its unexpectedness, Mackay expresses the relationship between the expected and the unexpected as exemplified in scripture in the following terms.

What the Bible is always saying is that God normally maintains our world according to its regular pattern, as part of a coherent plan: one aspect of the way he has determined that his whole drama shall run. It is just this that the Bible advances as its guarantee of our day-to-day expectations...God, as the Bible portrays him, has a coherent purpose. He is not capricious and therefore we can trust him not to fool us; it is consistent with his purpose to make tomorrow normally according to the pattern of today. This overall purpose has required God to address us in history, and to project himself personally into his drama. If this is true, then of course our scientific study of the normal pattern of events cannot tell us what to expect on such special occasions; and it would in a sense be more surprising if the normal pattern were not superseded. In Peter's first recorded sermon (Acts 2:24) he speaks of the resurrection of Christ not as inexplicable but as inevitable. Biblical theism insists that any breaks with scientific precedent that have occurred were but a further expression of the same faithfulness to a coherent overall purpose which is normally expressed in a day-to-day

reliability of nature on which we depend as scientists. (D. Mackay 1974, p.63-64)

### A Basis for Dialogue

A.R. Peacocke, on considering the interaction of science and theology, comments,

From a theological perspective the physical universe is to be regarded as an open intelligible system which constitutes a consistent whole only in so far as it is completed beyond itself in God as its creative ground...It is a significant fact that a rigorously scientific approach to the universe today, which carries its inquiries into the immanent intelligibilities of the universe to the very boundaries of empirical reality where natural science breaks off, approximates to just such a theological understanding of it. The common factor between those two very different views of the universe, making them open to each other and such an approximation possible, is to be found in the concept of contingent order.. Today natural science assumes both the contingency and the orderliness of the universe. (T.F. Torrance in A.R. Peacocke 1981, p.84,85)

When we say that the universe is contingent we mean that it does not exist of necessity. It might not have been at all and might very well have been different from what it is. In fact our universe depends entirely upon the beneficent free will and act of the Creator for its being and form and is not a necessary emanation of the Divine. On the other hand the universe has an independent reality of its own completely differentiated from the self-sufficient eternal reality of God. Peacocke describes the implications of contingency in this way.

Thus in virtue of its contingency the universe has an orientation at once toward God and away from him. Theology is more concerned with the former orientation of the universe, its dependence on God, and natural science understandably is more concerned with the latter orientation of the universe, its independence of God - yet neither can be held properly without the other...Clearly theology needs dialogue with natural science to keep it properly free and open toward God, and natural science needs dialogue with theology to keep it properly free and open toward the universe. (A.R. Peacocke 1981, p.86,87)

These ideas can be summarised in Figures 1 and 2. In Figure 1 the basis of a dialogue in terms of contingency and order is shown and in Figure 2 the implications of contingency for science and theology is shown.

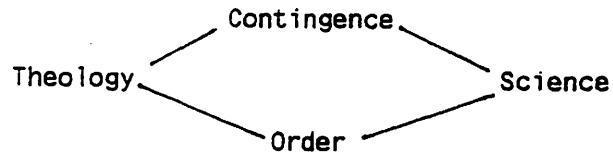


Figure 1

Contingence and order as coordinating themes for theology and science.

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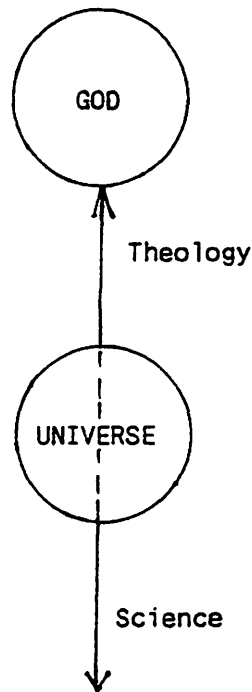


Figure 2

An illustration of the orientation of the universe to God according to Peacocke's description.

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How can one cope with a universe which is both rational and contingent, a universe which brings the expected and the unexpected? Lesslie Newbigin (1986, p.90-91) provides great insight into this question from the Christian perspective by suggesting that the incarnation and a following on the way of the Cross provides the clue to the dilemma. Such events preclude any shortcuts to meaningfulness that would ignore the radical contingency of things such as that belief that supposes that everything can be explained in organismic or mechanical terms or that everything is controlled in the interests of the good. On the other hand one is protected from a sheer

irrationalism for which there is no meaning in the world and everything is an incomprehensible accident. Newbigin proposes that

following the way of the Cross in the light and power of the resurrection, one is able to acknowledge and face the reality of evil, of that which contradicts God's good purpose, in the confidence that it does not have the last word. Here, in the responsible acceptance of this communication of a personal purpose of good, is the ground upon which it is possible to believe that the world is both rational and contingent (L. Newbigin 1986, p.91)

Thus faith is an important element in enabling one to cope with a world which can appear both hostile and friendly. I have tried to illustrate the role of faith in a world of contingent order in Figure 3.

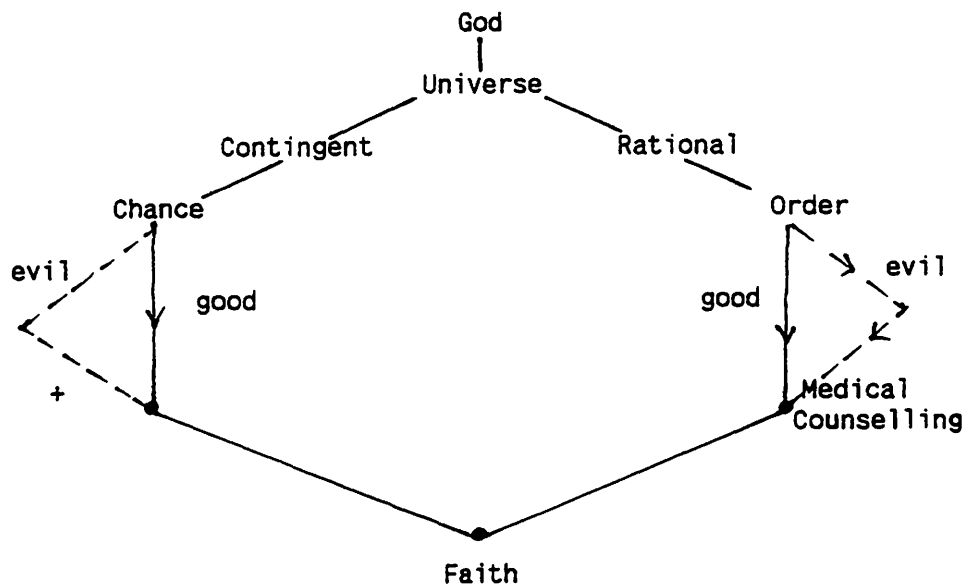


Figure 3

Those things that happen to us in this world tend to have either a coherent rational origin or an unexpected contingent origin. In both cases what happens may contribute to good or evil purposes. In one case, rational processes such as counselling or medical treatment may restore us from the effects of evil and in the other case, God's contingency such as exhibited at the Cross may restore us from the evil which has beset us.

While the contingent and rational are distinct they are never separate. The foregoing discussion of nature and scripture, I believe, confirms this. At the human level faith enables one to cope with the paradox, a world that is both contingent and rational.

#### Considerations for the teaching-learning environment

Opportunities do arise within the teaching of tertiary level chemistry to deal with issues related to order and chance. These opportunities arise certainly in such areas as kinetic theory and thermodynamics. The relationship between order and chance in oscillating chemical reactions is an excellent opportunity to consider such models as presented in this essay. A useful summary and bibliography of oscillating chemical reactions is given by Schibeci (1989, p.11-14, 50-51). A discussion on the natural and human level can clarify the role of Jesus in history and personal faith. Some illustrations are given in Figure 4.

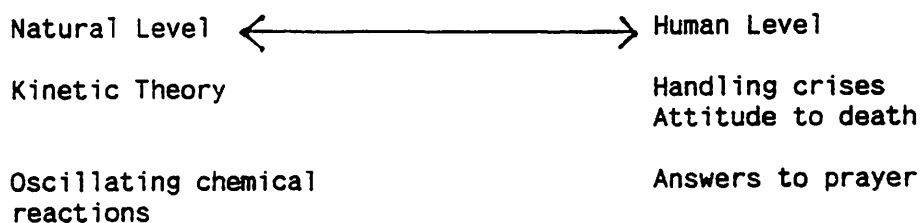


Figure 4

#### Conclusion

In this essay I have attempted to outline the world as it is, reality as it is perceived through the lens of science and scripture in terms of the concepts of order and chance. These concepts form an organizing principle for achieving a dialogue between science and religion, nature and scripture in terms of a universe which is both rational and contingent. I have then outlined the role of faith in the cross event as providing the means of coping with a world of the expected and the unexpected at the human level. The issue

of free will and determinism often surfaces in a discussion of order and chance. Samuel Sandmel has some important comments to make in this regard.

The view that the destiny of each man is predetermined by God is only superficially similar to the Greek view of fate. Fate was a blind force which dictated what was to happen to men and gods alike, and what was fated could not be altered. It is different too from the view known as predestination, which, in a sense, is kindred to fate except that it is God who fixes the unalterable fate. The Jewish view - we might call it providence - never concludes that a totally unalterable future lay ahead, for such a view contradicted God's omnipotence and mercy. Nor did the view that God fixed a man's destiny eliminate either man's free will or his moral responsibility; if, philosophically, a doctrine of providence and a doctrine of free will and moral responsibility seem contradictory (as, when carried to extremes, they are), Jewish thought never so extended either doctrine so as to preclude the other. (S. Sandmel 1978, p.226)

Since the time of Newton our understanding of nature has changed dramatically. The further we peel back the layers of nature the more profound our study becomes. This is not a cause for despair, however, as C.S. Lewis concludes.

Reality, in fact, is usually something you could not have guessed. That is one of the reasons I believe Christianity. It is a religion you could not have guessed. If it offered us just the kind of universe we had always expected, I should feel we were making it up. But, in fact, it is not the sort of thing anyone would have made up. It has just that queer twist about it that real things have. So let us leave behind all these boys' philosophies - these over-simple answers. The problem is not simple and the answer is not going to be simple either. (C.S. Lewis 1952, p.44)

It may be that the distinction between order and chance will grow increasingly fuzzier as science continues to penetrate the cosmos. After all we should remain mindful of the distinction between our perceptions of reality and reality itself. At the human level scripture affirms that God's abiding providence links order and chance in such a way that faith in the Jesus of the Cross guarantees that evil does not have the final say. May God be praised.

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