Time, God and cosmology

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SECRET PASSAGES HAVE AN ENDURING APPEAL for children, whether they be at the back of C. S. Lewis's wardrobe, in dungeons and dark castles, or at the bottom of the garden. Adults, who think they know better, indulge the same desire to escape the bounds of space and time via the well-worn if less authentic path of tourism. Television, film and fiction all help, of course, but the daily grind gets most of us in the end. Except, perhaps, when we enter the world of art or dream, or pray, or love.

Our desires to escape may only be related to the fact that humankind cannot bear the reality of the present moment. Very likely, however, our need to escape the bounds of space and time also has something to do with our openness to the future. Spirit always seeks to transcend matter, and that also means transcending space and time. The good news is that modern physics offers us a picture of cosmic reality which escapes the bounds of science. There may be fairies even at the bottom of physicists' gardens.

Modern physics not only tells us that matter and space and time are interrelated, but also that a complete description of nature demands the acceptance of a realm of reality which is non-material and in which the usual assumptions of space and time no longer work. It seems there are secret passages in nature. This not only provides hope for accepting the reality of spirit, but also for finding our own secret passages, our own spiritualities, without being judged to be off with the fairies. Before we explore the secret passages, however, we must remember what the walled garden of Newton's absolute space and time looked like.[1]

Newtonian physics and time

The nature of physical time is easy to understand – at least at the first level of investigation. Put simply, Newton imagined the universe as a giant clockwork. To begin with, consider our ordinary use of days and hours and minutes and seconds. When the earth spins once around its axis it moves from facing the sun to not facing the sun, and then round to facing the sun again. This is what we call a day. When the sun is at its highest point in the sky, we call this midday, or noon. When there is exactly the same amount of 'time' – measured, say by a sand-glass, dripping water or some other simple device – between sunrise and sunset as there is between sunset and sunrise, then we have an equinox. How we divide daytime and night-time is arbitrary, but what we do know is that the earth takes apparently exactly the same 'time' every day to spin once around its axis. The movement of the earth around its own axis is mimicked exactly in the movement of the hour hand around the face of a clock. We have decided to break this 'time' into twenty-four hours, and the hours into sixty minutes, and the minutes into seconds.

At first our clocks and watches were arbitrary machines tuned to the earth's rotation which used simple regular devices to give us a sense of the even passage of time. Today these devices are calibrated against the caesium atomic clock which, in particular circumstances, emits electromagnetic radiation at precisely 9,192,631,770 cycles per second. For all its accuracy, hours and minutes and seconds are still just arbitrary divisions of the 'time' it takes for our earth to spin once around its axis. Atomic clocks, however, tell us that the earth is slowing ever so slightly in its spinning, like a huge top. For atomic clocks rest on electromagnetic theory, not the rotation of the earth.

Not only does our earth spin around its own axis, however, but it also moves in an elliptical orbit around the sun. Sometimes it is far from the sun, and sometimes it is close. Because the earth's axis is not quite at right angles to the plane of its motion around the sun, furthermore, we experience seasons of greater sunlight and of less sunlight (unless we live on the equator). We go from summer to autumn to winter to spring . . . and back to summer. And so the cycle continues. We measure this passage of time in our diaries and on our calendars. Each set of four seasons marks one whole revolution of the earth around the sun. We call this a year. It is roughly, but not precisely, 365 days. In other words, our sense of days and hours is based on the earth's spin around its own axis, while our sense of seasons and years is based on the earth's orbit around the sun. The two are otherwise unconnected. Our ordinary physical sense of time has no mystery about it. It is just a convenient way of marking the passage of days and years.

That is the easy part, the surface description of what we call time. Now comes the difficult part. Time has strange properties. First of all, it is not as easy to move in time as it is in space. For example, we can go backwards and forwards in space. If we leave one space (say Melbourne) and head for another space (say London), we can, thankfully or sadly, go back again to where we started from. Not only that, but whether we move or not, other spaces do not disappear. My being in Melbourne does not stop London from existing. Both locations remain part of reality. With time, however, things are different. Though we can go back and forward in time in our imaginations, we cannot do so in physical reality. I cannot transport myself back to medieval Chartres, nor can I go forward to the twenty-third century. I cannot be sure that these times even exist *now*. Time seems, then, to have this directionality about it, at least in our ordinary experience, and we can only live in the transient present.

It was with this sense of time that Isaac Newton shaped the world-view of classical physics, arguing that the world occupied absolute space and time. That is, to put it colloquially, in God's estate the whole terrain was intricately calibrated, like a piece of graph paper, and a single master clock governed every point in the universe, which was contained in this 'encomium' of space and time like a model village in a display case. Time, in other words, was not arbitrary, being a simple consequence of particular physical motion. No, at the bottom of things time had a life of its own, to which all our sense of time was to be related. In the *Principia* Newton wrote: 'Absolute, true, and mathematical time of itself and from its own nature . . . flows equably without relation to anything external'.

Time and modern physics

Newton's view of time, like much of Newton's work, has proved much too simplistic. Just as flat earth theory works very well on the small scale of rolling pastry or making cricket pitches, Newtonian physics works well on a terrestrial scale of physical investigation. But when we explore the very fast, the very large, or the very small, we need a different way of constructing physical reality. Physical time, as Einstein has shown us, is relative rather than absolute. If time is accelerated, or passes a large mass, it slows down. Time is relative to motion and influenced by mass. If time was absolute, then all events in the universe could be calibrated at the same time. Because time is relative, however, two events which seem simultaneous to us – say the implosion of a star in outer space and the beginning of the third millennium on earth – would not be simultaneous to a third observer in some other galaxy. There is no absolute clock in the cosmos. So also with space. There is no fixed grid. As bodies move, the structure of space-time changes, just as the structure of space-time affects the way bodies move. This is hard to understand, and perhaps to many it is incomprehensible, but it does at least demonstrate that even physical time is not easily comprehended.

A second major discovery in science early in the twentieth century further changed our understanding of time. Heisenberg's uncertainty principle suggested that there was a limit to any accurate measurement of time, due not just to limitations on instruments, but to the complex relationship between time and other physical dimensions. Physical time defies useful accurate definition. That is, we might be able to specify time accurately, but to do so would be at the price of any accuracy with respect to measurement of energy.

Further, quantum physics indicates that every physical interaction entails an irrevocable step which shifts reality from a whole cluster of probable futures to just one actual future. Time's irreversible character, not obvious in Newton's physics, is thus written into quantum physics. To many interpreters of the significance of quantum mechanics, led by Niels Bohr, it is impossible for us to think of the universe as a causal, determinist piece of mechanical clockwork, nor can a sharp line of separation be drawn between observer and observed, subject and object.

Bell's theorem and non-locality

The notion that the universe could not be described as a causal machine horrified many physicists, most notably Einstein. The opponents of this revolutionary view of physics – and Einstein was the most outspoken opponent – were frightened of losing Newton's sense of order and control. Even though he had supplanted Newton's views of time, Einstein still subscribed to a Newtonian view of the universe as a machine.

If quantum theory was the last word, Einstein said, 'I would rather be a cobbler, or even an employee in a [gambling den], than a physicist', because 'A final abandonment of strict causality is very hard for me to tolerate'.[2] On hearing of Heisenberg's uncertainty principle Einstein lamented, 'May the spirit of Newton's method give us the power to restore unison between physical reality and the profoundest characteristic of Newton's teaching – strict causality'.[3] Heisenberg and Einstein had a conversation about all this in 1927, which Heisenberg remembers thus:

> Einstein had devoted his life to probing into that objective world of physical processes which runs its course in space and time, independent of us, according to firm laws . . . And now it was being asserted that . . . this objective world of time and space did not even exist and that the mathematical symbols of theoretical physics referred to

possibilities rather than facts. Einstein was not prepared to let us do what, to him, amounted to pulling the ground from under his feet.[4]

In 1963, in order to test once and for all who was right about quantum physics and the uncertainty principle, John S. Bell began to develop a theorem, based on Einstein's assumptions, which could be experimentally tested. The two key assumptions in Bell's work are called the *locality* assumption and the *reality* assumption. These are, in fact, common-sense notions on which ordinary physics is based. The *locality* assumption states that two regions of the cosmos – call them A and B or Andromeda and Birmingham – cannot be instantaneously connected. They are localities; they are space-time separable; no signal can travel between the two faster than the speed of light. The *reality* assumption states that physical entities possess sharply defined physical properties (like position and velocity) whether or not we are measuring them.

In the early 1970s a French physicist called Alain Aspect was able to perform experiments to test Bell's theorem. The results were decisively in favour of quantum mechanics and in breach of Bell's theorem. Something, it seems, must therefore have been wrong with Bell's assumptions. The most probable conclusion is that in our comprehension of the physical world we must go beyond common-sense notions of locality and reality.[5] Such revolutions are not new, but they are not easy to accept, just as our ancestors found many generations ago, under the influence of Copernicus and Galileo, when they had to abandon common-sense notions of sunrise and sunset.

The realm of the spirit

The consequences of Aspect's tests of the validity of quantum mechanics are astonishing. Physics seems to imply now that there is some sort of non-local element in the cosmos which, as it were, links everything instantaneously to everything else. Such a component of reality cannot be imagined as a hidden mechanical system. The kind of secret passage we are talking about here seems to demand that we imagine a different kind of reality at the heart of the cosmos. The physicist John Wheeler, who coined the term 'Black Hole', thus talks about 'the Great Smoky Dragon' of the elementary quantum phenomenon.[6] The French physicist Bernard d'Espagnat goes even further, arguing that quantum physics indicates that all reality must be understood as having two levels. One is empirical and the other, which cannot be defined operationally, he describes variously as 'veiled' or

'Being'. Thus, says d'Espagnat, quantum theory 'opens a window' on the world we live in:

> This 'window' . . . is so important because of its truly surprising nature, which clearly is that of an opening made by rational means – based on today's scientific facts – and that nevertheless leads to something lying *beyond* the totality of experience while not just being an empty yonder.[7]

Taking the physics even further, Peter Forrest describes the meta-empirical domain as 'the *spiritual*' and observes that: 'We think of the physical world as becoming more and more determinate as a result of the operation of the spiritual'.[8]

Bell's theorem and Aspect's experiments have vindicated Niels Bohr's view of physics and the description of nature. Also vindicated is Bohr's close friend and collaborator, Wolfgang Pauli, who saw quantum physics restoring mystery to the world. Pauli argued against the Newtonian ideal of absolute causality on the grounds that the quantum mechanical treatment could not deal with sequences of individual events: '*The physically unique individual is no longer separable from the observer* . . .' he said. 'The individual case is *occasio* and not *causa*. I am inclined to see in this *occasio* . . . a revenue of the *anima mundi* [the soul of the world] which was pushed aside in the seventeenth century.'[9] Where Newton had destroyed the possibility of spirituality, Pauli sought to restore it.

Pauli sought to describe that realm of nature which was responsible for *both* synchronicity and other psychic phenomena *and* for the impossibility of strict causality and objectivity in physics. This realm he described variously as the 'irrational', the 'inside', the 'inner', the '*anima mundi*', 'will', 'transcendental unity', 'unconscious', 'psyche', 'religious' and 'God'. He sought to establish a 'symmetry between matter and spirit', a 'reconciliation of opposites'.[10]

All it takes to live in this new world-view, however, is to persuade yourself that you are more connected with everyone and everything in the cosmos, at all times and places, than you are separate from them. This is what it is like to live with a spiritual imagining rather than a physical imagining. While this is also what it might be like to live in the presence of God, a spiritual imagining does not necessarily imply that God exists. Perhaps creation does, but that is another issue.

Creation, God and the cosmos

There are some who see no room for God in the scientific cosmos. In what has wickedly been described as his 'widely purchased book', *A brief history of time*, Stephen Hawking addresses the questions of whether or not the universe had a beginning, whether or not it will have an end, and whether or not time can flow backwards. He seems to conclude that our universe has no edge in space, no beginning and no end in time, and nothing for a creator to do. Hawking believes that the universe probably did begin with a Big Bang, but then remarks that the initial point would be of such a density that space-time would have a very unusual characteristic. More precisely, there would be an infinite curvature of space-time. The consequence of this would be that the beginning of the universe has no 'edge' in time.

To make his point clear, Hawking points out that the surface of planet earth has no 'edge'. Even though the earth has a finite surface area, it has no beginning or end. You can never walk to the end of the surface of the earth, nor can you find its starting point. So also, even though time is finite, and does not go on for ever, it does not have a precise beginning. Hawking thus concludes that the beginning of time needs no explanation: 'There would be no singularities at which the laws of science broke down and no edge of space-time at which one would have to appeal to God or some new law to set the boundary conditions for space-time'.[11]

For Hawking and Carl Sagan, this seems to suggest that there is no need for a God. For others, like Paul Davies, the brilliant orderedness of the cosmos implies some great designer who is called God.[12] Even if the coming to being of the universe can explain itself, in other words, the orderedness of the universe remains a mystery. Davies' God, however, is no different from the impersonal and distant God of the deists. Like William Paley or Isaac Newton or Albert Einstein, Davies sees God as not only uninvolved in the universe, but also as unable to be involved. Such a view assumes a very causal way of looking at the cosmos.

For others again, notably John Polkinghorne, physics offers the glimmer of an explanation for God's activity in the world through the insights of non-linear chaotic dynamics.[13] While physics is useful in any apologia, the pivotal assumption that God's presence in the world must be malleable to the intentions of physics seems to me to be misplaced. Metaphysics is more interesting.

Physics and metaphysics

Like David Hume, perhaps Hawking regards any questions of divinity, abstract thought, or metaphysics to be utterly useless and therefore to be consigned to the flames. But the tools of physics cannot be used to solve the problems of metaphysics, and physics does not necessarily exclude metaphysics. It was Niels Bohr who said 'I could see no reason why the prefix "meta" . . . was anathema in physics'.[14] Today physicist-philosophers see that physics throws new light on metaphysical issues, and vice versa.[15]

Even so, time is more than physics can tell us it is. Time can be understood simply as a physical parameter – which is the way Hawking views it – and physics can, as we have seen, help us a great deal in exploring the various facets of time. There is, we know, more to the story. For time is also about change, about the past and the future, about fate and destiny, about unknowns, about presence and absence, about incompletion and perfection. Time is not only related to space and matter and motion, as in the world of physics, but time is also related to identity and being, as in metaphysics. The former has to do with the objective empirical world, the latter with the subjective personal world. Both are real.

Where you have matter, there you have time. Without matter there is no time. Yet matter is also the opposite, or at best the complement, of spirit. In a dualist world matter and spirit are kept apart, as are time and eternity. In the Christian world, where the human is open to the divine and the eternal makes its home in history, matter and spirit go together, and where there is time (or the mystique of nature) there also eternity can be glimpsed.

The eternal one and the receptacle of love

John O'Donohue speaks eloquently of the spirituality of time: 'Transience is the force of time which makes a ghost of every experience . . . This means that as things happen in your yesterdays, todays and tomorrows, and fall away with transience, they fall and are caught and held by the net of the eternal in your soul.'[16] Einstein, as Carnap recalls, shared almost the same sentiments:

> Once Einstein said that the problem of the Now worried him seriously. He explained that the experience of the Now means something special for man, something essentially different from the past and the future, but that this important difference does not and cannot occur within

physics. That this experience cannot be grasped by science seemed to him a matter of painful but inevitable resignation.[17]

In a cosmos in which we experience ourselves as transient, and the whole cosmos as transient, God is present as the eternal one, the 'other' who comes, the '*mysterium tremendum*, the secret known only in the trembling which is the trace of its passing'.[18] Or to put it another way, human interest in time and God is less concerned with origins than it is with eschatology. Creation, after all, establishes a world of localities and separations, a world of subjects and objects, a world of the Fall. In the *Parousia*, however, all division is overcome. The cosmos can thus be seen as a space which divine love has created for its reception.[19] To live in such faith, hope and love is to live spiritually.

It may come as some surprise to the reader that the conclusion of this study touches on the work of two philosophers who might be described as deconstructionist. The structures of science, however, have become so strong in our imagination that we have lost the art of using our spiritual senses. Just as the implications of quantum mechanics have begun to undercut a mechanical view of the cosmos, so also post-modern philosophies have, in their best light, subverted the confidence of modernity and restored humility and mystery to humanity; and even, hopefully, restored good spirits to the bottoms of our gardens.

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NOTES

1 For useful surveys of this topic see L. W. Fagg, *The becoming of time: integrating physical and religious time* (Atlanta: Scholars Press, 1995) and D. R. Griffin (ed), *Physics and the ultimate significance of time* (Albany: State University of New York, 1986).

2 A. Einstein, letter of 29 April 1924 to Max Born, in M. Born (ed), *The Born–Einstein letters* (London: Macmillan, 1971), p 82; letter to Paul Ehrenfest, 31 May 1924, quoted in M. J. Klein, 'The first phase of the Bohr–Einstein dialogue' in *Historical Studies in the Physical Sciences* 2 (1970), p 33.

3 Einstein, quoted in A. Pais, '*Subtle is the Lord . . .*': *the science and life of Albert Einstein* (Oxford: Oxford University Press, 1982), p 443. The original is given in *Nature* 119 (26 March 1927), p 467.

4 Werner Heisenberg, *Physics and beyond: encounters and conversations* (London: Allen and Unwin, 1971), pp 80–81.
5 For an accessible account of Bell's theorem and Aspect's experiments, see P. C. W. Davies and J. R. Brown (eds), *The ghost in the atom: a discussion of the mysteries of quantum mechanics* (Cambridge: Cambridge University Press, 1986). More technical works include T. Maudlin, *Quantum non-locality and relativity* (Oxford: Blackwell, 1994) and M. Redhead, *Incompleteness, nonlocality, and realism* (Oxford: Clarendon, 1987).
6 Quoted in Davies and Brown, *op. cit.*, p 66. For a survey of physicists' views of quantum reality, see J. Honner, 'A new ontology' in *Pacifica* 4 (1991), pp 41– 45.
7 B. d'Espagnat, *Reality and the physicist* (Cambridge: Cambridge University Press, 1989), p 205.
8 P. Forrest, *Quantum metaphysics* (Oxford: Blackwell, 1988), pp 207, 213.
9 Pauli to Fierz, 13 October 1951, in K. V. Laurikainen, *Beyond the atom: the philosophical thought of Wolfgang Pauli* (New York: Springer, 1988), p 35.
10 W. Pauli, 'Science and western thought', quoted at length in Laurikainen, *Beyond the atom*, pp 96–103.
11 S. Hawking, *A brief history of time* (New York: Bantam, 1988), p 136.
12 For example, P. Davies, *God and the new physics* (New York: Simon and Schuster, 1983).
13 See J. C. Polkinghorne, 'Theological notions of creation and divine causality' in M. Rae, H. Regan and J. Stenhouse (eds), *Science and theology* (Edinburgh: T & T Clark, 1994), p 235; *Science and creation* (London: SPCK, 1988); and *Reason and reality* (London: SPCK, 1991).
14 See J. Honner, *The description of nature: Niels Bohr and the philosophy of quantum physics* (Oxford: Clarendon Press, 1988), especially chapter 7, 'Microphysics and metaphysics'.
15 See A. Shimony, *Search for a naturalistic worldview, vol II: natural science and metaphysics* (Cambridge: Cambridge University Press, 1993), especially Section D on time.
16 J. O'Donohue, *Anam cara: spiritual wisdom from the Celtic world* (New York: Bantam 1997), pp 211, 215.
17 R. Carnap, 'Intellectual autobiography', quoted in Shimony, 'The transient *now*' in Shimony, *op. cit.*, p 287.
18 The quotation is from J. Derrida, *The gift of death* (Chicago: University of Chicago Press, 1995), pp 55–56; the discussion is from R. Horner, 'Derrida and God: opening a conversation' in *Pacifica* 12 (1999), pp 12–26.
19 These ideas originate from Damien Casey's study of Luce Irigaray. See D. Casey, 'Luce Irigaray and the advent of the Divine' in *Pacifica* 12 (1999), pp 27–54.