# DIALOGUES WITH DARWIN

# An Evolving Creation

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# Darwin's bicentenary

2009 marks the bicentenary of Charles Darwin's birth on 12 February 1809, and the 150th anniversary of the publication of *On The Origin of Species*, on 24 November 1859. Darwin's student years in Edinburgh were an important period in his intellectual formation: here he encountered the fruits of the Scottish Enlightenment, from the revolutionary geological theories of James Hutton to important advances in medical theory and practice, and adventurous developments in theological and philosophical thought fostered in the University and the City.

In conjunction with the University of Edinburgh and other Scottish and UK-wide academic and scholarly institutions, the Institute for Advanced Studies in the Humanities (IASH) joined the Edinburgh celebrations for the bicentenary by organising a series of "Dialogues with Darwin: Darwin and Edinburgh". The five symposia, held in the spring of 2009, explored aspects of his work in Scottish contexts including circumnavigation, anatomy, theology, and evolution itself. Together, these talks and discussions led by a series of international and local experts offer new angles for understanding Darwin as both a catalyst in the broader Enlightenment project and a model for its subsequent impact. From Patrick Geddes to Charles Bell to James Crichton-Browne, the Edinburgh connection offers a rich kaleidoscope of historical and intellectual links.

The speakers in the series were Professor Ian Duncan (University of California, Berkeley) on "Darwin, Circumnavigation, and the Aesthetics of World History"; Professor David Fergusson (University of Edinburgh) on "Darwin in Scotland";
Dr. Walter M. Stephen (former Chairman of the Sir Patrick Geddes Memorial Trust) on "Charles Darwin: Some Scottish Connections"; Dr. Gregory Radick (University of Leeds) on "Edinburgh, Enlightenment and Darwin's *Expression of the Emotions*"; and Revd. Dr. John Polkinghorne (St. Edmunds College, Cambridge) on "Evolving Creation". Each paper is published separately in this series of IASH Occasional Papers.

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by

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**About the author**

John Polkinghorne spent more than twenty-five years working as a theoretical elementary particle physicist, mostly at Cambridge University, where he was Professor of Mathematical Physics (1968-1979) and a Fellow of Trinity College (1954-1986). In 1979 he resigned his chair to train for ordination to the Anglican priesthood. After several years serving in the parochial ministry, he returned to Cambridge in 1986 to be Fellow and Dean of Chapel of Trinity Hall. In 1989 he was elected President of Queen's College, Cambridge, retiring in 1996, when he became a Fellow of the College. He was elected FRS in 1974 and in 1997 he was made a KBE.

Polkinghorne's work in elementary particle physics was concerned with the analytical properties of scattering amplitudes and with models of high energy processes, particularly in relation to deep inelastic scattering experiments that gave evidence in support of the quark structure of matter.

For the last twenty-five years, his intellectual interests have centred on the relationship between the insights of science and the insights of theology. He sees both disciplines as concerned with the search for truthful understanding, gained through commitment to well-motivated beliefs. Despite their obvious differences, science and theology therefore stand in a complementary relationship to each other. They are friends and not foes. Polkinghorne has written and lectured extensively on these issues. Topics he has addressed include critical realism, creation, divine providence, eschatological hope, a 'bottom-up' approach (arguing from experience to understanding) to Christian theology. Among his many publications are his Gifford Lectures, *Science and Christian Belief* (in North America, *The Faith of a Physicist*), 1994; his Terry Lectures, *Belief in God in an Age of Science*, 1998; *The God of Hope and the End of the World*, 2002; *Exploring Reality*, 2005; *Theology in the Context of*

*Science*, 2008. He has also written an autobiography, *From Physicist to Priest*, 2007, and several books on physics for the general reader, including *Quantum Theory: A Very Short Introduction*, 2002. In 2002 he was awarded the Templeton Prize and in the same year he was the founding President of the International Society for Science and Religion

**Synopsis**

In *On The Origin of Species* Charles Darwin showed how the character of the present has been formed by the events of the past. Others before him had had the idea of descent with modification, but Darwin, by identifying the process of natural selection, was able to show how natural processes could bring about the remarkable adaptation of living forms to survival in their environment. The traditional arguments of natural theology, that this aptness required the direct intervention of a divine Designer, thereby lost their force.

Contrary to much unhistorical assertion, the publication of the *Origin* did not bring about a final parting of the ways between science and religion. The doctrine of creation was certainly subject to some revision, but this was to prove ultimately to be its enrichment, not its abolition. The idea of a ready-made world was replaced by that of a creation so endowed by its Creator with potentiality that creatures could be allowed 'to make themselves' (Charles Kingsley) through the explorations of evolutionary process. The history of the world is to be understood as an unfolding act of continuous creation. Such a creation is a great good, but it has an inescapable shadow side for evolution results not only in great fertility but also in blind alleys and extinctions. Genetic mutation produces both new life forms and also malignancy, and one cannot have the one without the other. Theology can find here some help from science as it wrestles with the perplexities of natural evil and suffering.

Evolutionary thinking is not restricted to biology for there has also been the cosmic evolution that turned an initial ball of energy into a universe with stars and galaxies. All evolutionary processes involve an interplay between Chance (contingency) and Necessity (regularity). They take place 'at the edge of chaos', where order and disorder interlace. 'Chance' simply stands for the specificity of actual

events and it carries no implication of meaninglessness. The insights of the so-called Anthropic Principle show us that Necessity has to take a very particular, 'finely-tuned' form in a universe capable of generating carbon-based life. From the point of view of theology, Chance and Necessity can be seen as the twin gifts of freedom and reliability given to creation by a Creator who is both loving and faithful. The God who is the Ordainer and Sustainer of nature can be understood to act as much through natural processes as in any other way.

## An Evolving Creation

Surely no scientist has had a greater influence on the character of general intellectual discourse than Charles Darwin. The theory of biological evolution, as set out in 1859 in *On the Origin of Species*, set the seal on the understanding, already attained by the geologists, of the paramount significance of the vast periods of deep time that make up the history of the Earth. Historical process was seen to amount to much more than a mere concatenation of contingent events for the nature of the past was recognised as being the creative source of the nature of the present. Time was not simply to be considered as the index of when events had occurred in what was essentially a stable reality, but the world had proved to be intrinsically dynamic, so that time past was seen to be both different from the present and constitutive of it.

Of course, Darwin had predecessors in the acknowledgement of the role of unfolding process in the history of life on Earth, notably Jean Baptiste Lamarck and Darwin's own grandfather, Erasmus Darwin. Yet the *Origin* presented a well-argued and substantial foundation for considering seriously what had previously had something of the character of fascinating speculation. Darwin's great idea of natural selection showed how the patient accumulation of small differences from generation to generation, and the process of selective sifting through

competition for survival in an environment in which only those well-adapted to its circumstances would be able to leave abundant offspring, could, over long periods of time, account for the rise of new species and the remarkable aptness of their being. At a stroke, Darwin had undercut the celebrated arguments of the physico-theologians, such as John Ray and William Paley, who had claimed that it was just this aptness of being that indicated that creatures must have been directly and individually designed by their Creator. One could now see how the purely natural process of evolution could lead to the appearance of design without the need to call for the direct intervention of a divine Designer in order to bring it about.

In consequence of this fatal challenge to the old-style of natural theology, much popular presentation of the events of 1859 speaks of them as if they were an ultimate parting of the ways between science and religion. The media myth is that all the scientists immediately cried 'Yes, yes' to Darwin and all the religious people, especially the obscurantist clergy, cried 'No, no'. This is simply historically incorrect. On the scientific side, there were real doubts. Sir Richard Owen, the greatest comparative anatomist of the day, never accepted Darwin's ideas. A major problem was to understand what was the origin of the small inter-generational differences to which Darwin had to appeal. Ironically, a few years after the publication of the *Origin* the missing clue was

provided by the genetic discoveries of the Austrian monk, Gregor Mendel, but he published them in an obscure journal and they went unnoticed at the time. It was only later, in the twentieth century, that the recovery of Mendel's genetic ideas led to the synthesis of evolution and genetics which constitutes the modern neo-Darwinian basis of evolutionary biology.

The reaction on the religious side was equally mixed and there was a significant degree of welcome for these new ideas. Darwin's clergyman friend, Charles Kingsley, soon coined a phrase that seems perfectly to sum up how one may think theologically about an evolving creation. He said that, while God could no doubt have brought into being a ready-made creation with permanently fixed species, Darwin had shown us that the Creator had done something cleverer than that in bringing into being a world so endowed with potentiality that creatures could be allowed to 'make themselves'. The shuffling explorations of evolutionary process are to be understood theologically as the bringing to birth in particular ways of the divinely-willed fertility of creation. If the nature of God is love, as Christian theology asserts, then creation will not be a kind of cosmic puppet theatre in which the celestial Puppet-master pulls every string. The gift of love is always the gift of some due degree of independence granted to the objects of love. We may dare to say that an evolving world is a more fitting creation for such a God than a ready-made

world would have been. Creation is not just some prior initiating act after which God does nothing in particular; it would be more accurate to say that the unfolding of evolutionary process is a continuing expression of the Creator's will. The theological power of this insight, involving the Creator in a continuous relationship to the history of creation, led the Oxford theologian, Aubrey Moore, to say that Darwin, in the guise of foe, had done the act of a friend. Darwin's North American colleague, Asa Gray, who was both a Harvard professor of biology and a staunch Presbyterian, did much to popularise the ideas of evolution in his home country. A 'clergyman friend' (probably Kingsley) wrote to Darwin that he had come to recognise that 'there is grandeur in this way of life, with its several powers, having been originally breathed by the Creator into a few forms or into one' - a quotation which was inserted into the second edition of the *Origin.* Darwin was an agnostic in his later years, but he once said '[i]t seems to me absurd to doubt that a man may be an ardent Theist and an evolutionist'.

Scientific discoveries constrain the shape of metaphysical thinking, but they no more determine its exact form than the foundations of a house prescribe uniquely the details of the rest of the edifice. Evolutionary thinking has certainly had significant influence on all subsequent theological discourse about creation. I have already suggested that the most promising theological approach is one that interprets an evolving world as a creation in

which creatures are allowed to make themselves. Of course, the move to interpret evolution in this way is not one of strict logical necessity, but it is a coherent and intellectually satisfying way of finding consonance between the insights of science and the insights of theology. The result is an enriched concept of the doctrine of creation. The idea of *creation ex nihilo*, creation out of nothing, certainly still remains important. To understand properly its role, it is necessary to recognise that the concept is concerned with ontological origin, rather than temporal origin. It is not focussed on the query 'Who lit the blue touch paper of the big bang?', but it addresses Leibniz's more profound question, 'Why is there something rather than nothing?' After Darwin, it has been necessary to add to the idea of creation out of nothing the concept of *creatio continua*, continuous creation. This involves the theological acknowledgement of the unfolding creative process that has turned a universe, which originated in the simplicity of an almost uniform expanding ball of energy, into the richly complex universe of today, the home of saints and scientists. This is just the idea that Aubrey Moore found so illuminating, the recognition that creation is not just a once-for-all act, but an unfolding dynamic process. Many contemporary scientist-theologians working in the interdisciplinary field of science and theology have placed great emphasis on this concept, perhaps most notably the biologist Arthur Peacocke.[1]

There are good grounds for claiming that an evolving creation in which creatures make themselves is a greater good than an instant, ready-made world would have been. Yet it is a good that has a necessary shadow side. The shuffling evolutionary explorations of potentiality will bring rich novelty to birth, but they will also have their ragged edges and blind alleys. There will be mass extinctions and ugly aspects of predation. In an evolving world, the death of one generation is the necessary cost of the new life of the next. This ambiguity is simply and directly illustrated by genetic mutation, the engine that has driven the three and a half billion year history of life on Earth, transforming a world that for at least two billion years was populated simply by single-celled entities such as bacteria, into the home of mammalian life. But if germ cells are to be able to mutate and produce new forms of life, which can then be sifted and preserved through natural selection, it is inevitable that somatic cells will also be able to mutate, and sometimes this will result in malignancy.

That there is cancer in the world is an anguishing fact about it and I do not want to pretend that such suffering does not present a serious challenge to religious belief. There is no simple and total answer to the perplexities of theodicy, the search for reconciliation of belief in a good and powerful Creator with the way that creation is actually found to be. Yet evolutionary insight does offer us some modest but valuable help, for the inescapable shadow side of

creative evolutionary process does at least suggest that ills such as cancer are not simply gratuitous, something that a God who was a bit more competent or a bit less callous could easily have eliminated. We all tend to think that had we been in charge of creation, frankly we would have done it better: we would have kept all the nice things (flowers and sunsets) and got rid of the nasty (disease and disaster). However, the more science has helped us to understand how the world works, the more we have realised how mutually entangled things are. It is just not possible to separate the good from the bad, to keep one and throw away the other. Rather, it is a package deal. Think of the ambiguity of genetic mutation. This insight by no means removes all our perplexities, but it is of some help to theology as it wrestles with what is surely its most profound problem.

I have been concentrating on evolutionary insight as exemplified in the history of terrestrial life. However, since Darwin's day we have come to realise that evolutionary process in a general sense has been characteristic of the whole 13.7 billion year span of cosmic history. The essence of this evolving process is not a generalised notion of natural selection as such, but the interplay of two opposing tendencies which we can call 'Chance and Necessity'. These are slippery words and we must be clear about what they stand for. Chance does not mean the capricious activity of the Goddess Fortuna; it stands for the contingency of

actual events. To offer an example, this particular genetic mutation occurred and it turned the stream of life in this particular direction. A somewhat different mutation might have happened, in which case there would have been a somewhat different history of life. Some biochemists believe that the precise form of the terrestrial genetic code may be an example of such historical contingency. Necessity stands for the lawful regularities that constrain what can happen.

A non-biological example of this interplay of 'Chance and Necessity' is given by the process by which stars and galaxies formed in the early universe. The expanding ball of energy that emerged as the immediate aftermath of the singularity of the Big Bang, was not completely uniform, but there were small fluctuations in its matter/energy density. A little more matter here than there meant a little stronger gravitational attraction towards here rather than there. This resulted in a snow-balling effect by which, over a period of about a billion years, the universe became grainy and lumpy as its matter condensed into stars and galaxies. The actual pattern of the resulting galaxy distribution was determined by the contingent pattern of the aboriginal fluctuations. This was the role of Chance. The condensation process was the result of the regular operation of the law of gravity. This was the role of Necessity.

Another way of formulating the concept of general evolutionary process is to recognise that regimes in which it is possible for genuinely new entities to emerge always exist 'at the edge of chaos', that is to say where order and disorder interlace in a balanced interaction. Too much on the orderly side of this border and things are too rigid for anything truly novel to emerge. Too much on the disorderly side and things would be too haphazard for anything really new that emerged to be able to persist. Once again the case of genetic mutation illustrates the point. If there were no genetic mutations (just Necessity), there would be no new forms of life on which natural selection could act. If there were an excessive number of genetic mutations between each generation (all Chance), no stable species could form on which natural selection could act. The fruitfulness of biological evolution has depended upon the rate of genetic mutation lying between these two extreme limits.

Before leaving biology, we should note that while there can be no rational doubt that the history of life has been that of a process of descent with modification, and that natural selection has played an extremely significant role in that process, it is not clear even scientifically that this is all that needs to be said. Neo-Darwinism has often been presented as a process so dominated by contingency that it can be thought of as resulting in something like a drunken random walk through an almost infinite space of

biological possibility. Hence the celebrated claim by Stephen Jay Gould that if the tape of biological history were to be rerun again, nothing at all like *homo sapiens* could be expected to emerge on that second occasion.[2] In other words, from this point of view, our world and human life in it are no more than an incredibly lucky accident. This view has been strongly disputed by Simon Conway Morris.[3] He points out that in terrestrial biological history, essentially similar organs have evolved several times completely independently – the eye is a striking example. This repeated convergence on similar solutions to the problems of survival necessity suggests that the range of biologically accessible and functionally effective development is in fact constrained, and that evolutionary exploration of possibility space is far from being an uncontained ramble that would never take a similar route twice.

A related insight that supports this view has emerged from the infant science of complexity theory. It is just becoming possible to study moderately complex systems treated in their entirety, rather than having to follow the time-honoured scientific strategy of spitting them up into component constituents. Some of these systems have been physical and some have been computer models. None has anything like the complexity of a single living cell. Nevertheless, even at this modest level of complexity, these systems are found to display a quite astonishing holistic power spontaneously to self-organise themselves to produce certain

patterns of elaborate dynamical behaviour in a manner quite unforeseeable from considering the properties of the constituents treated singly. At present complexity theory is at the level of natural history. The type of behaviour described is repeatedly encountered, but the general theory that must surely underlie these particular examples is currently unknown. Stuart Kauffman, who is a leader in this field, has suggested that in complex biological systems analogous effects may operate to shape the kind of structures that can emerge in the course of evolutionary process, once again implying that the arbitrary extent of possibility space has been greatly exaggerated.[4]

In conclusion, some comments can be made about the results of theological reflection on these great scientific developments. It is clear that the attempt by some biologists such as Jacques Monod so to emphasise the role of Chance as to imply that cosmic and terrestrial history is meaningless, amounting to no more than a tale told by an idiot, cannot be sustained. Chance is simply contingent happenstance, theologically understood as the result of the gift by the Creator of a degree of independence to creation so that creatures can indeed 'make themselves'. Similarly, the regularities of Necessity are theologically understood to reflect the gift of reliability made by a faithful Creator to creation. Many biologists seem reluctant fully to acknowledge the remarkable insight that the physical form of this regularity had to take a very specific –

one might even say 'finely-tuned' – form for the development of carbon-based life to have been possible anywhere at all in the universe. This recognition, that a universe capable of evolving life must be a very special universe indeed in terms of its given physical fabric, is sometimes called the Anthropic Principle, a somewhat unfortunate choice of terminology since the insight is concerned with the possibility of carbon-based life in general rather than the contingent specificity of *homo sapiens* ['anthropos', from Greek, means 'human being']. While as far as we know, life did not develop in the universe until it was about ten billion years old, nevertheless it was pregnant with life from shortly after the Big Bang since physical law then had this necessary character. Many considerations lead to this conclusion,[5] but just one example must now suffice. Nuclear reactions in the very early universe only produced the two simplest chemical elements, hydrogen and helium. No carbon at all was present after the big bang. There is only one place in the universe where carbon can actually be made, in the interior nuclear furnaces of the stars. Every atom of carbon in our bodies was once inside a star. We are literally people of stardust. We understand very well the stellar process by which this carbon is produced. It turns out to be very delicately balanced and only possible at all because the nuclear forces in our world take a very specific, 'finely-tuned' form. Theology can readily understand anthropic fine-tuning as the gift to creation by the

Creator of the precise form of lawful Necessity that has enabled the universe to have so fruitful a history.

If God is the Creator of the world, ordaining its nature and sustaining its existence, then God acts as much through natural processes as in any other way. It is not necessary to seek for gaps in the scientific account in order to see the Creator at work. Those who are seeking to serve the God of truth should welcome truth from whatever source it comes and never be in fear of it. Science does not give us all the truth that we need, but it certainly does give us some that we should accept gladly. Darwin was right, people can indeed be ardent Theists and evolutionists. By combining the insights of science and the insights of religion they will be enabled to see more and understand more than they could with either insight simply on its own.

**Notes**

1. A.R. Peacocke, *Creation and the World of Science* (Oxford: Oxford University Press, 1979).
2. S.J. Gould, *Wonderful Life: the Burgess Shale and the Nature of History* (London: W.W. Norton, 1989).
3. S. Conway Morris, *Life's Solution* (Cambridge: Cambridge University Press, 2003).
4. S. Kaufmann, *At Home in the Universe: Search for Laws of Complexity* (Oxford : Oxford University Press, 1995).
5. See, for example, R.D. Holder, *God, the Multiverse and Everything* (Surrey: Ashgate, 2004).

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