

Book Reviews

Roger Penrose

Shadows of the Mind

Oxford University Press 1994; Hbk
£16.99; ISBN 019 853978 9
1995; Pbk £7.99 ISBN 009 958 2112

Shadows of the Mind, like Roger Penrose's previous offering, *The Emperor's New Mind* (ENM), is long. And although Penrose claims (as he did with ENM) that it will be accessible to the average reader who is prepared to do a bit of work, this claim is misleading. Just reading, never mind following, these books and the intricate arguments Penrose deploys, takes a lot of work. Furthermore, if your interest is in brains and minds, long before you get to issues that are recognisably relevant, much work is required to follow very detailed arguments from mathematics and quantum mechanics that Penrose believes are vital for the task in hand. In part this is because his aim is '... ultimately comprehending this phenomenon of consciousness in scientific but non-conceptual terms.'

He states four propositions at the outset ranging from the 'strong AI' position to one which adopts the position that 'awareness cannot be explained by physical, computational, or any other scientific terms'. This fourth proposition, 'regards the mind as something that is entirely inexplicable in scientific terms, is the viewpoint of the mystic ... seems to be involved in the acceptance of religious doctrine'. While the physicalist/materialist position is the predominant view amongst both neuroscientists and philosophers today many, at least among the philosophers, feel that consciousness is a phenomenon whose explanation will involve more than the scientific explanations arrived at using the

methods of science. But this does not make them mystics. There are overtones here of the conflict metaphor. Science, and science alone, either now or at some future date will provide explanations of all 'natural' phenomena. To deny this is to be a mystic! As far as the activity of God is concerned, Penrose makes his position clear when he suggests that although 'perhaps we should seriously consider ... that our intelligence might indeed require some ... act of God' he is 'holding to a scientific viewpoint.' (p. 144) There you have it; either you hold the scientific viewpoint or that of the mystical religious believer.

Penrose's basic thesis is that consciousness is a phenomenon which does have a physical explanation, but it is not the same as computation. He marshals a number of arguments in the first half of the book seeking to show that possessors of consciousness also possess insight and understanding, features which even the most powerful computers lack today. However he goes further and argues that insight and understanding are fundamentally different from computation. Therefore, computers as currently constructed, will never exhibit consciousness regardless of how powerful they become. He takes mathematical reasoning, as perhaps the most likely to be simulated by a computer and seeks to show that, in the terms of a fifth proposition 'mathematicians do not use a knowably sound algorithm in order to ascertain mathematical truth' (p. 76). Much of this section focuses on an extended discussion of Gödel's theorem and Turing machines. Most of this discussion is clear, if convoluted in places. But the broader case for consciousness being basically different

from computations is well made and fairly convincing.

However, if consciousness is explicable by science, but is not Turing-computable, how are we to explain it? Penrose says that 'science must enlarge its scope so as to accommodate such matters'. He is explicit about the enlargement required in the second part of the book in which he claims that we will have a chance of explaining consciousness when we have a new quantum theory. One of the problems currently in quantum mechanics is how one gets from the quantum level of subatomic particles to the classical level of cricket balls. It is in the jump from the quantum superposition of states to the single classical state that Penrose feels the mechanism of consciousness is to be revealed. And if this is the process which leads to conscious mental states, Penrose is prepared to hazard a guess as to the location of this process. He suggests that microtubules, phylogenetically ancient structures forming the cytoskeleton of all of our cells, may be the place where quantum processing giving rise to conscious mental states resides. In part he is forced into this because he has to admit that neurons can be discussed 'in entirely classical terms' (p. 368). To put it bluntly, they are too big! He then has to explain why, apparently, only brains, composed of neurons, and not livers, composed of hepatocytes, exhibit consciousness because the cells of the liver certainly contain, and depend on, microtubules. He freely admits that 'a great deal, in addition to properly functioning cytoskeletons . . . is needed to evoke a conscious state.' (p. 370). What this might be he does not make clear.

In this book Penrose executes what John Searle has called 'the heroic age-of-science maneuver'. Only science will be able to explain what clearly, at the minute, is a mystery. What science does not eventually explain either doesn't really exist, or

isn't worth knowing about. In an odd way it is also all a bit 'science of the gaps'. Quantum mechanics is not yet complete so it is in this 'gap' that the answer to consciousness will be found. There is not much known about microtubules and their role in neuronal function, so it is here that we should look for quantum coherence. This aspect of the book is deeply unsatisfying. For those interested in Turing and Gödel, computing and mathematics, quantum mechanics and how it relates to classical physics, the first three quarters of *Shadow of the Mind* is well worth reading. For those interested in brains and minds, consciousness and mental states, the last quarter of the book is a long time coming and a bit disappointing when it arrives.

P. C. Knox

**Dr Knox is Vision Research Fellow,
Centre for Neuroscience University of
Edinburgh.**

David J. Chalmers
*The Conscious Mind. In search of
a fundamental theory*
Oxford University Press, 1996, 414
pages, hb US\$29.95, ISBN 0 19
510553 2

'What is the place of consciousness in the natural order?' (p. 32). The philosopher David Chalmers answers not only that our subjective awareness is indeed a natural phenomenon but also that it completely depends on physical reality; yet, he argues, what it is like to be an experiencer is totally outside the scope of physics.

'Consciousness is the biggest mystery' are the first words of the book. Chalmers assumes that this is a challenge for scientific investigation assisted by philosophical analysis, rather than for revealed theology. Some Christians might still follow Descartes and his scholastic predecessors closely enough to question such a

naturalistic preconception of the human soul, though maybe not among this Journal's readers. Chalmers is happy to consider what a hypothetical God could create in or out of nature but this is merely a tactic in conceptual analysis.

This book in the new Philosophy of Mind Series from OUP New York is well regarded as an exposition of the view that consciousness is a 'Hard Problem', not solvable by a little more science and/or philosophy. Chalmers argues for his own approach in the course of lucid overviews of what other philosophers have written in recent decades about the nature of the conscious mind. He leaves technical argument to some of the end notes but he is not afraid to spend a whole chapter on the conceptual ins and outs of an issue basic to the approach.

Such a careful dissection of options from nonsense will be of no avail, however, if the problem is fundamentally misconstrued. There are signs that Chalmers sets off on his search on the wrong direction. The quotations above and the book's subtitle suggest that 'consciousness', 'phenomenal experience' or subjective awareness is treated as something unitary, albeit with variants. Many different senses of the word 'conscious' were characterised in a paper in the *American Psychologist* in 1978 by the philosopher Natsoulas which is mentioned in a note to Chapter 1 but the implications are not considered there or elsewhere in the book. Pain is said to be 'a paradigm of consciousness' but no account is taken of consequences of Wittgenstein's very different analyses in the *Philosophical Investigations* of being in pain, introspecting, knowing the next step in a number series, and so on. Allport (1988) provides a recent psychological view of the varieties of subjective experience and cites philosophers in the same book who challenge the assumption that there is a single core to the contents of all forms of consciousness.

Even more serious than treating disparities as unitary, though, would be an assumption that consciousness is any sort of *thing* at all. Chalmers is not a substance dualist or Two Worlds theorist but he does profess a form of 'property dualism'. He argues that phenomenal qualities (subjective appearances) are entirely distinct from the space-time manifold of physics. His key doctrine is that consciousness is naturally or empirically supervenient but not logically or conceptually supervenient: roughly speaking, this means that consciousness can never be explained away by physics but one day it might be accounted for in physical terms.

Such a handing over of the whole natural world to physics (or Physicalism) is common among philosophers and not unknown among the physicists and theologians who discuss the human mind. However, to most psychologists and indeed some biologists, the move seems disastrously underinformed about one and a half centuries of scientific investigation of the natural phenomena of active and sensitive individuals participating in a social culture of embodied persons, i.e. the life of human beings (and perhaps a few other species), Chalmers suggests.

Chalmers illustrates natural supervenience by the statement, 'If two creatures are physically identical, then differences in environmental or historical context will not prevent them from having identical experience.' Yet he grants that physically identical animals in different habitats may differ in fitness to survive. Similarly, identical twins reared in quite distinct cultures and then introduced to each other after their brains had been 'magicked' into identical states could well feel different emotions at seeing each other for the first time. Their different upbringings could give one physical movement (such as a nod of the head) two different social roles for each twin and hence quite different

personal meanings despite physically identical brains and bodies.

Much of the mystery may be generated by this physicalist ontology, especially if it is as crass as atomic materialism. It would be more realistic to acknowledge from the start that there are several sorts of empirical reality, quite apart from other aspects of reality such as what logicomathematical truths are about, the existence of moral facts and the actual beauty in some objects, ideas, human bodies and people's characters. *Pace* the former Prime Minister, besides the basic forces, molecules, cells, organisms and geosphere involved, there are also the hard facts of the cultural and economic activities of human society, like a vote in Parliament or appointing a minister to a church congregation. Then again, distinct from but depending on both nature and society, there are an individual's mental achievements, from seeing, hearing, tasting and so on, through reasoning and feeling an emotion, to forming intentions, acting sociably and communicating verbally. Chalmers rightly makes a sharp distinction between such cognitive processes and the awareness that usually goes with them. Yet in doing so he neglects the social character of the sense of self (as distinct from others), the vividness of images (in terms of a public world) and conviction of truths (resting on intersubjective agreement).

Consciousness is not depersonalised functions: an awareness is mine or yours. These nouns do not refer to items of furniture in our minds either: they refer to how this and that situation or decision appears to each of us, discounting how this and that actually are. That is, the content of my awareness is how things seem to me. This does not imply the existence of another reality of 'seemings' or that phenomenal qualities are a non-physical property of nature. 'It seems to me' is merely the language by which I express my own viewpoint (and you

yours) without commitment to objectivity, as distinct from claiming to see what is really there or to intend what is actually done. So, Chalmers is right to assert that the viewpoint of a perceiver or an agent is not explicable by the performance of the perception or the action but wrong to make a hard problem merely out of our ability to distinguish appearances from reality.

Reading Chalmers would correct any idea that the academic world only (re)discovered consciousness in the late 1980s or that the problem can be dismissed as worthlessly vague or easy. There *is* a Hard Problem of Consciousness but one may doubt that these are the tools to crack it. Our understanding of subjectivity is more likely to be improved by a lot of increasingly tight experiments on individuals' distinctions between what they feel and what they do, informed by a rich variety of informally expressed experiences. The findings might in turn equip us better to tackle Hard Cases such as persistent vegetative syndrome, personality disorders and, in the late 21st century, the first robot to hire a solicitor to act for her/him/em!

David Booth is a Professor of Psychology at the University of Birmingham.

Keith Ward

God, Chance and Necessity

One World (Oxfam) 1996 212pp. pb.
£9.99. ISBN 1 85168 116 7

In many ways this is an extraordinary book. The publicity given to the views of Stephen Hawking and Richard Dawkins in the media and the book pages of the national press have been sufficient to guarantee them an authority within popular culture. Keith Ward, Regius Professor of Divinity at University of Oxford, tackles both these celebrated writers head on and for good measure and for the sake of

completeness, adds scathing critiques of Peter Atkins' *Creation Revisited* and Michael Ruse's *Evolutionary Naturalism*.

Ward himself is a theistic evolutionist: he believes that the world and all living creatures came about as a result of the evolutionary process described within the scientific literature. The argument is not about whether evolution took place, or will continue to take place, but about whether evolution can plausibly be thought of as the means by which God is achieving purposes of ultimate value or whether, on the contrary as Dawkins and Co maintain, evolution kills the credibility of God stone-dead. Ward argues with great force and clarity that the process of evolution is just the sort of process God would have chosen for purposes implicitly within the created order and that the process of evolution itself, with all its inherent improbabilities, is far better accounted for by the existence of God than by God's non-existence. The traditional humanistic attack on religion, then, is turned on its head: evolution points towards and not away from God's existence.

This is bare-knuckle debate. Although Ward retains an academic politeness towards his fellow Oxford academic (Dawkins, Atkins) professors, there is no mistaking the sharp dismissal of what he takes to be their philosophical ineptitude. They are guilty of logical blunders, tricks and non-sequiturs.

Atkins 'espouses the fallacy of misplaced concreteness in a grand manner' by arguing that the abstractions of mathematics are real while those things to which the abstractions refer are unreal. The confusion is between what something *is* and what it is *about*. Further fallacies follow. Atkins argues that the net content of the universe is nothing and does so by arguing that this is because there is an

equilibrium between equal and opposite electrical forces and charges. Everything cancels itself out. Once the universe has been reduced to nothing in this way, there is nothing for God to create. But, as Ward points out, if there exists a set of perfectly balanced positive and negative forces, then it is a mistake to say that there is absolutely nothing. Moreover, to propose that nothing can fluctuate and thus produce the universe is to say that nothing is a 'rich realm of possibilities' that is best located in the mind of God. In any case, before the quantum fluctuations occur that make the universe come into existence one must have the probabilistic laws that govern them. Since many arrays of laws are possible, it seems that the universe is highly contingent after all.

Furthermore, and using an alternative scenario, the Hartle/Hawking cosmological model does not assume a background space-time in which the universe arises. This leads to enormous difficulties in speaking about fluctuations since no state can follow any other. It also leads to difficulties in speaking about causation since the mathematical ideas that delineate the early stages of this model are not physical entities but belong to the realm, the Platonic realm, of numbers and relationality. Hawking's assertion that the universe, in his model, is completely 'self-contained' is untrue, since it remains to ask why the quantum laws are as they are.

Both Atkins and Dawkins repeatedly claim that there is no purpose to the universe. 'Everything' says Atkins grandiosely, 'is driven by motiveless, purposeless decay', a statement which Ward has no difficulty in burying. If I go to a concert, he suggests, I do so for definite purposes, for the pleasure the music gives and because the activity is evaluated by me as being worthwhile, and though I may know that my body is subject to decay, this does not in any way prevent my purpose

having a reality. Similarly, the universe itself, while it may be subject to eventual entropic disintegration, may still have a purpose that is quite detached from its eventual end point.

These considerations lead Ward on to an elegant variant of the ontological argument. If Atkins is suggesting that, in infinite time, even the present extraordinary universe would come into existence, he is hoist on the petard of his own logic since there is no 'before' the existence of space-time. Time is not infinite after all. But leaving this on one side, if there is sufficient time for the development of *this* universe, there is sufficient time for the development of all other possible universes, but not all possible universes can come into existence because some preclude the existence of others. A universe without God might come into existence, but would be precluded by a universe with God since the God spoken of by theologians is a God of all possibilities, of all universes.

Turning his attention to evolution, Ward is equally forthright. Dawkins also employs the 'given infinite time, anything is possible' argument and Ward again shows that this is fallacious for the reasons given above and also that the extremely improbable emergence of self-replicating molecules is rendered much more probable by the existence of a God who designs all basic physical laws and elements. Repeatedly Ward returns to this point. The laws themselves make almost inevitable the universe and the world we now have. If this is so, how can the laws have been so perfectly, harmoniously and presciently framed without God?

More pointed, however, is Ward's discussion of mutations since the atheistic evolutionary assumption is that these carry no general bias towards bodily improvement. Mutations may improve or handicap an offspring and it is, according to Dawkins, 'selection and only selection' that directs evolution. Ward questions

both the randomness of mutation and the unique role of selection. He does so partly by pointing out that Dawkins' biomorph computer programme that simulates evolution only works because it has been intelligently designed to do so. The intelligent design plays exactly the role that God takes in the theistic scheme. But he also explores the interaction between living things and their environment suggesting that there is more than randomness at work here.

Each of the seven steps within the evolutionary story of life given in Dawkins' *River out of Eden* is examined by Ward. The first step is the emergence of the universe, the second the emergence of self-replicating molecules, the third the formation of more complex life forms that incorporate the capacity to self-replicate, the fourth the emergence of DNA as a unique construction-code, the fifth is a co-ordination between the millions of cells making up larger bodies to allow each cell to develop appropriately for its place within the whole organism, the sixth the emergence of consciousness and the seventh the appearance of cultural transmission. Each of these steps can be shown to be improbable without God and much more probable with God.

Probability is not the only issue, though. The purpose of atheistic evolution, so far as there is one, is the survival of DNA, a proposition that makes little or no sense. The DNA codes determine the shape and function of the bodies whose blueprint they are. To say that the purpose of evolution is the survival of the codes is like saying that the purpose of cooking is the recipe and not the cake. This is Ward's simile and it counters Dawkins' description of us as 'robot vehicles blindly programmed to preserve selfish molecules known as genes'. It also allows Ward to show the ridiculousness of Dawkins' inversion since it is the genes that are personified and the humans who are depersonalised. It

also leads him to take Ruse's evolutionary ethics, which are an extension of the selfish game argument, to pieces and stamp on the fragments.

The emergence of consciousness, while it is a profound mystery to atheistic evolution, makes perfect sense to theist since it enables the product of evolution to share a conscious relationship with the one source of 'all being that first formed its character and always sustained its development'. It also enables the values realised by the process of evolution to be preserved 'for ever in the mind of God, and the conscious agents it has generated'.

Ward's book does one of the things theology ought to do: it engages with the issues of the day from a position of profound and rational faith and deserves to be widely read and discussed within the senior common rooms, chat shows, book pages and student unions of modern culture. I hope that, like DNA, it will replicate itself in many minds and hearts.

William K. Kay

Dr Kay is Senior Research Fellow at the Centre for Theology and Education at Trinity College, Carmarthen.

Richard H. Bube
Putting It All Together: Seven Patterns for Relating Science and the Christian Faith

University Press of America, 1995.
pp.213. £. ISBN 0 8191 9756 4

Richard Bube is a retired Professor of Materials Science and Electrical Engineering at Stanford University, and senior figure in the American Scientific Affiliation. He identifies seven distinct patterns in which the relationship between science and Christian theology might be configured. Five of them correspond to different kinds of conflict. Because Bube defines conflict as arising when science

and theology are believed to 'tell us the same kinds of things about the same things', these patterns include various attempts at synthesis as well as the head-on collisions of physicalism and naive creationism. Bube believes that the redefinitions involved in too easy a unification threaten to subvert the authenticity of both science and theology. He also rejects the pattern of compartmentalism: 'science and theology tell us different kinds of things about different things'. For example, both disciplines surely have significant insights to offer about human beings. Therefore Bube endorses the seventh pattern, complementarity, in which the two subjects 'tell us different kinds of things about the same things'.

The writing is sober and careful. Some shrewd things are said about the shortcomings of both creationists and New Agers. The tone is ironic. Bube is anxious to woo those whose stance he rejects back to a more adequate understanding of the interrelationship of science and theology. His notion of theology is very strongly biblical, whilst acknowledging that there are questions of interpretation which require careful discussion if we are to use scripture aright. Bube discusses inerrancy, distinguishing between 'errors' which arise from common parlance ('the sun rose') and theological errors. It seems to me that a candid discussion of the authority of scripture requires more extensive and more subtle nuancing than that.

Certain important themes recur: the distinction between Chance (a Dawkinseque world devoid of meaning) and chance (probabilistic science); the need to look to see how God has actually chosen to act in creation; the recognition that neither science nor theology can *prove* the validity of their interpretations, but that this does not mean that these understandings should not command our intellectual respect.

Many will find the discussion helpful, with its sane and sensible style. Yet, others will feel that more needs to be said. The account of theology lacks richness and depth, as exemplified by the passing and somewhat dismissive reference to mysticism. The favoured option of complementarity raises many questions which receive insufficient attention. At one time Bube writes as if all that is involved is the addition of partial models to each other, but the quantum mechanical analogy, properly discussed, shows that something much more interesting might be involved. In summary: a useful way to start thinking but not the end of the matter.

J.C. Polkinghorne

John Polkinghorne has recently retired from being President of Queens' College, Cambridge.

Robert Pollack
Signs of Life: The Language and Meanings of DNA

Viking, 1994, 212 pp., £16.00.

ISBN 0-670-85121-3

Penguin, 1995, 212 pp. PB £6.99.

ISBN 014-023060-6

Genetic engineering is a boom industry for many writers whether in books, broadsheets, tabloids or tracts. It is grist to the mill for science fiction, and features elsewhere either as the greatest threat to humanity in the next millennium or its salvation in the face of a galloping population crisis. Where lies the truth?

What a delight to find a highly readable and erudite book written by a long-term educator. Robert Pollack worked as a molecular biologist for several years with Nobel Laureate Dr James Watson, the co-discoverer of DNA's structure, at the world famous Cold Spring Harbor Laboratory in the USA. He is a recent winner of the Guggenheim writing fellowship.

The stimulus for the book is of interest because it came from the notion that Pollack could help his father suffering from Alzheimer's disease if only he unravelled the pattern hidden in published research. From this exercise, which is not unprecedented, he became persuaded that we can understand how the natural world works through science, but he found its limits were as interesting as its powers. Scientific discoveries could not protect him from the pain of loss.

The author argues that DNA is nature's most wondrous chemical and the work of great natural literature, a three-billion-year-old continuously-evolving text. The way that we have now learned to transmute DNA (and atoms) for our own purpose means that life on earth 'will never again be entirely constrained by random mutation nor entirely protected from self-induced catastrophe'. Using metaphorical language to great effect the reader is given a lucid exposition of how it is that DNA can function as the template of living and replicating organisms.

The statement that 'nothing alive is perfect' launches the reader into why the information within DNA can change by accident at any time. Parallels are drawn between how various versions of genes arise and coexist and how variations arise in scriptural texts from translation and retranslation of the New Testament.

Many of the themes of *Signs of Life* are predictable but they are written about in a refreshing and knowledgeable way. One is persuaded that here is an author who really knows the subject and has faced the issues from a position of laboratory experience and thoughtful reflection. There are few blemishes of scientific accuracy and certainly no 'hype', common problems among many writers in this field and, sadly, even among Christians who sometimes raise hopes and risks beyond what is reasonable. An

obvious theme of great current importance is the prospect of repairing genetic anomalies, a step not far removed from improving the genetic qualities of individuals for non-medical reasons. The author helpfully, if briefly, reminds us of the historical development of eugenics and Hitler's frightening slogan of 1933 that 'politics is biology'. The science behind our new understanding about genes gained from studies where they are modified so that they can no longer work ('knock-out'), or function much better, or perform in places different from usual, is presented in a way that is readily accessible for the non-specialist.

What is abundantly clear from this excellent book is that we are not far from asking fundamental questions about the human genome in a manner that was hitherto notional rather than experiential. Revelation of the genome's complete text is well underway, and Pollack shows how many of its components have been played out in laboratory cell lines, and some of the most difficult passages have been translated in transgenic animals. Questions are being asked not just about our earliest stages of development but about our humanity, if not our souls. The pressure to use this new knowledge for utilitarian reasons has become a dominant force in those twin pillars of economic progress—wealth creation and improving the quality of life. Yet the opportunity for scientists to become actively engaged in the public debate about the political, economic and social consequences of their work has never been greater. This book is compulsory reading for all who are moved to enter the fray!

R. B. Heap

Professor Heap is the Master of St Edmunds College, Cambridge.

Steve Jones

In the Blood: God, Genes and Destiny

Harper Collins 1996. 301pp. £20.
ISBN 0 00 255511 5

This book is the companion of the recent television series with the same title. It is not clear which came first, the book or the series but from the introduction it seems that the material in the book to some extent at least, was gathered for the television series. This perhaps explains why I found the book to compare badly with the author's previous book '*The Language of the Genes*', in which the basics of genetics and inheritance patterns were described alongside the development of language in a refreshing manner. Like the previous one this new book has again as its underlying message the fact that genetically speaking all people on earth are closely related irrespective of skin colour or social circumstances, but the focus here tends to be on the bizarre for illustrations and examples.

The first chapter dwells on the Mormons and their system of baptizing their ancestors and shows how by tracing back sufficient genealogies most of us can claim a well-known historical figure in our ancestry. Despite this, as chapter 2 shows, our financial well-being can be dependent on political interpretations of our genetic status. The way American Indians have used their territory to their financial advantage by developing gambling halls which are banned elsewhere is a good story used to contrast the inheritance of riches with that of genes. A full chapter is devoted to the importance (or rather unimportance) of skin pigmentation and the difficulties inherent in any scientific study of racial differences. We have to be ashamed of the way Western Civilization has handled racial issues over the centuries but are shown how the French Musée de l'Homme attempts to redress this.

More disturbing is the chapter entitled Original Sin. This centres on criminals with a strong family history of criminal behaviour, the possibility for there being genes that predispose to criminal behaviour and whether this is related to the 'attention deficit disorder' label currently being given to so many children with unruly behaviour. Although there well may be genes which predispose to poor concentration, impulsive and perhaps aggressive behaviour, the molecular genetic evidence is still quite preliminary. If we are to maintain the dignity of human beings then it is essential that we do not see ourselves as simply programmed by our genes but as having a degree of autonomy and an inherent capacity to make moral choices. This is easy to believe in theory but less so when faced with a hyperactive 5 year old! My favourite sound-bite from the television programme was the reformed criminal stating firmly that his son, who seemed to be following his father's criminal footsteps, had free-will and was therefore not bound by any inherited genetic predisposition. However this nugget appears to be missing from the book.

The final chapter 'Death and Resurrection' considers mutations and the mechanisms of DNA repair.

From the title through to the chapter headings and biblical quotes prefacing many chapters there is a religious thread running through the book. Christians it has to be said get a bad press and the church's historic blunders are not unreasonably pilloried. Sadly there is no recognition of the part played by Christians in social reform and opposition to error over the centuries.

The book is excellently illustrated with a wide variety of historical prints, state-of-the-art scientific diagrams and current photographs. Two pictures of an electric chair seem excessive and perhaps highlight a tendency to display the ghoulish. There is a good index and suggestions for further reading for each chapter.

Overall this is an easy book to read as the author writes delightfully, but Christians will find that his cynical humanism grates from time to time.

Caroline Berry

Dr Berry is Consultant Medical Geneticist, Guy's Hospital, London, U.K.

Editors' Note: Many book reviews have been held over to the next issue through lack of space. We apologise to those who have returned their reviews for this delay in publication.