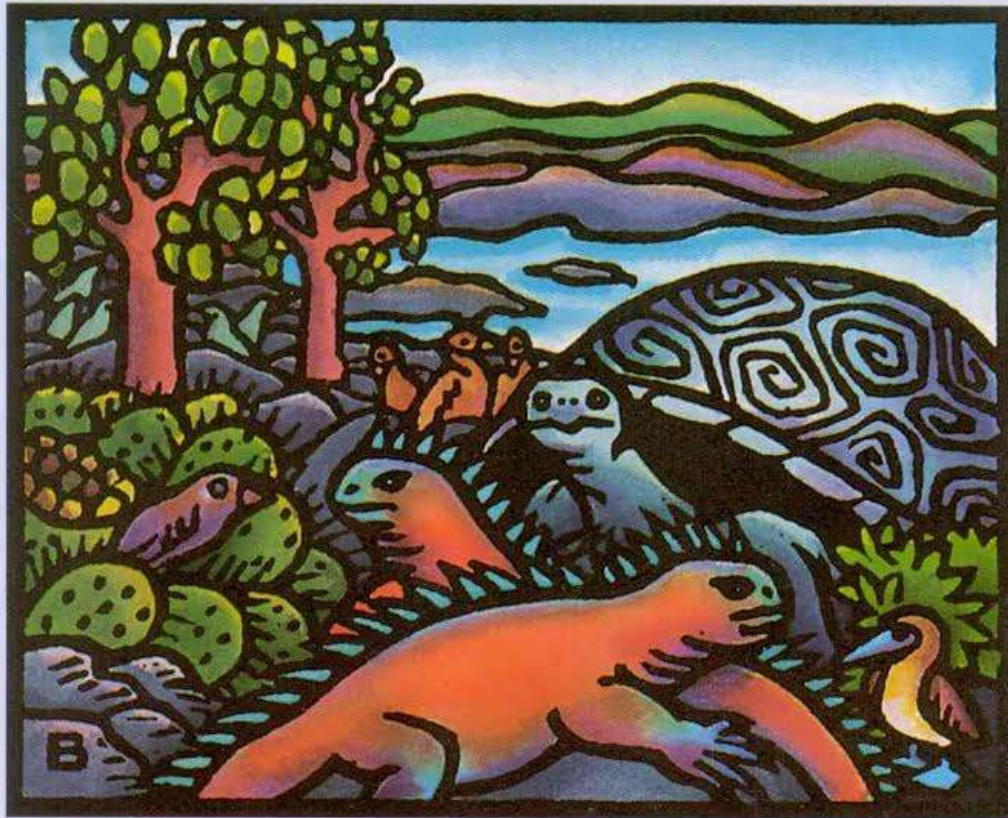


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Evolution: A Theory in Crisis

By: Michael Denton

MICHAEL DENTON **EVOLUTION:** **A THEORY IN CRISIS**



NEW DEVELOPMENTS IN
SCIENCE ARE CHALLENGING
ORTHODOX DARWINISM

Preface

- It is not hard to understand why the question of evolution should attract such attention. The idea has come to touch every aspect of modern thought; and no other theory in recent times has done more to mould the way we view ourselves and our relationship to the world around us. The acceptance of the idea one hundred years ago initiated an intellectual revolution more significant and far reaching than even the Copernican and Newtonian revolutions in the sixteenth and seventeenth centuries. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p15.]
- The triumph of evolution meant the end of the traditional belief in the world as a purposeful created order - the so-called teleological outlook which had been predominant in the western world for two millennia. According to Darwin, all the design, order and complexity of life and the eerie purposefulness of living systems were the result of a simple blind random process - natural selection. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p15.]
- Any suggestion that there might be something seriously wrong with the Darwinian view of nature is bound to excite public attention, for if biologists cannot substantiate the fundamental claims of Darwinism, upon which rests so much of the fabric of twentieth century thought, then clearly the intellectual and philosophical implications are immense. Small wonder, then, that the current tumult in biology is arousing such widespread interest. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p16.]
- In this book I have adopted the radical approach. By presenting a systematic critique of the current Darwinian model, ranging from paleontology to molecular biology, I have tried to show why I believe that the problems are too severe and too intractable to offer any hope of resolution in terms of the orthodox Darwinian framework, and that consequently the conservative view is no longer tenable. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p16.]

1 Genesis Rejected

- Biology in the early decades of the nineteenth century was dominated by the

idea that the organic world was a fundamentally discontinuous system in which all the major groups of organisms were unique and isolated and unlinked by transitional forms. Species were held to breed true to type, generation after generation, without ever undergoing any significant sort of change. Where there was variation, it was only trivial variation within the clearly defined limits of the species or type. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p17, 18.]

- As William Coleman, an authority on Georges Cuvier, points out:1 The organism, being a functionally integrated whole each part of which stood in close relation to every other part, could not, under pain of almost immediate extinction, depart significantly from the norms established for the species by the first anatomical rule. A major change, for example, a sharp increase in the heart beat or the diminution by half of the kidney and thus a reduction in renal secretion, would by itself have wrought havoc with the general constitution of the animal. In order that an animal might persist after a change of this magnitude it would be necessary that the other organs of the body be also proportionally modified. In other words, an organism much change en bloc or not at all. Only salutatory modification could occur, and this idea was to Cuvier, as it is to most modern zoologists, but for very different reasons, unverified and basically absurd. Transmutation by the accumulation of alterations, great or small, would thus be impossible. [Coleman, W. (1964) *Georges Cuvier: Zoologist*, Harvard University Press, Cambridge, Mass. pp 172-73.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p18.]
- But there were an increasing number of observations, particularly geological, that were difficult to reconcile with the Mosaic account. It was increasingly obvious to most geologists that none of the known natural processes, such as water or wind erosion, could have shaped the Earth's surface in a mere six thousand years. These processes cause virtually no perceptible change even over centuries, yet the book of Genesis implied that the Earth had been created in the relatively recent past, only six thousand years ago, according to some biblical chronologists. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p21.]
- Darwin was a Bible-quoting fundamentalist and a believer in the special

creation and fixity of each species: . . . I did not then in the least doubt the strict and literal truth of every word in the Bible , .. 9 Whilst on board the Beagle I was quite orthodox, and I remember being heartily laughed at by several of the officers (though themselves orthodox) for quoting the Bible as a unanswerable authority on some point of morality. 10 [Darwin, F. (1888) ed, *The Life and Letters of Charles Darwin*, 3 vols, John Murray, London.] [9. *ibid*, vol 1, p45.] [10. *ibid*, vol 2, p307.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p25.]

- For Darwin the Beagle proved the turning point of his life, a liberating journey through time and space which freed him from the constraining influence of Genesis. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p25.]
- It was Darwin's geological observations on the Beagle which first sowed seeds of doubt in his mind as to the historicity of the Genesis account of creation. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p25.]
- Whether Darwin himself made the transition while on board the Beagle is difficult to assess from his own writings. Precisely when he came to believe in evolution, whether it was a gradual dawning, or a sudden realization, we will probably never know. What is certain, however, is that the biological observations he made on the voyage, particularly those relating to geographical variation, played a crucial role in the development of his evolutionary thinking. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p27.]
- It was the existence of so many distinct, yet intimately related, species scattered on the islands of the Archipelago which planted the idea of organic evolution in Darwin's mind. As he noted in his journal: 16 The distribution of the tenants of this archipelago would not be nearly so wonderful, if, for instance, one island had a mocking-thrush, and a second island some other quite distinct genus; - if one island had its genus of lizard, and a second island another distinct genus, or none whatever- or if the different islands were inhabited, not by representative species of the same genera of plants, but by totally different genera But it is the circumstance, that several of the islands possess their own species of the tortoise, mocking-thrush, finches,

and numerous plants, these species having the same general habits, occupying analogous situations, and obviously filling the same place in the natural economy of this archipelago, that strikes me with wonder. [Darwin, C. (1845) *The voyage of the Beagle*, new ed (1959) by J.M. Dent, London, p382.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p29.]

- The Beagle revealed to Darwin a new world, one that bore no trace of the supernatural drama that Genesis implied, and one which seemed impossible to reconcile with the miraculous biblical framework he himself had accepted when he left England. All the new evidence seemed to point to an immensely long geological past, and nowhere could he see evidence of supernatural catastrophes or interventions interrupting the course of nature. The doctrine of the fixity of species was contradicted by the sorts of observations he had made on the Galapagos Islands which suggested strongly that species did in fact change under the agency of entirely natural processes. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p35.]
- Although nothing that Darwin had witnessed on the Beagle implied that evolution on a grand scale had occurred, that the major divisions of nature had been crossed by an evolutionary process, the old typological discontinuous view of nature seemed far less credible. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p35.]

2 The Theory of Evolution

- The core idea of the Origin, the idea that living things have originated gradually as a result of the interplay of chance and selection, has a long pedigree. It can be traced back from the views of current advocates of Darwinian orthodoxy such as Huxley, Mayr and Simpson to Darwin and from Darwin via Hume in the eighteenth century right back to the materialistic philosophers of classical times. The idea is clearly expressed in the philosophies of Democritus and Epicurus and by many of the even older Ionian nature philosophers such as Empedocles. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p37.]
- Hume's explanation to account for the design of living things, which he gives in his famous dialogue concerning natural religion, is basically the same. He proposed that the world was composed of a finite number of particles which

were in perpetual random motion. In unlimited time the particles enter into every combination possible. Occasionally they enter into stable conformations which tend to persist. 3 A finite number of particles is only susceptible of finite transpositions, and it must happen in an eternal duration that every possible order or position must be tried an infinite number of times ... the continual motion of matter, therefore, in less than infinite transpositions must produce this economy or order and by its very nature that order, when once established supports itself for the many ages. [Hume D. (1779) *Dialogues Concerning Natural Religion*, Fontana Library cd (1963), Collins, London, pp 155-56.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p40.]

- So, according to Hume, the random juggling of matter must eventually produce ordered forms adapted to their environment and possessing an intrinsic coherence in their components which gives the appearance of design. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p40.]
- Lamarck proposed that improvements acquired by an individual during its lifetime could be passed on to its offspring and so gradually, as each successive generation strove to improve its characteristics, adaptive perfection was achieved. Hence, according to Lamarck, the long neck of the giraffe evolved because the original ancestors of the modern giraffe, endowed with necks no longer than a cow, in attempting to reach leaves high above the ground managed to stretch their necks to make them longer. This acquired characteristic was then passed on to their offspring who were born with slightly lengthened necks. And so the process continued until after many generations of striving by the animals to reach ever higher leaves the long neck of the giraffe evolved, perfectly adapted for grazing on the leaves of the tallest trees. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p41.]
- It is important at this stage to be clear about Darwin's view of variation, the raw material of evolution. Although the mechanism of heredity was not understood in Darwin's day, it was self evident that individual organisms were not identical but varied in a number of different ways: some individuals were slightly taller than others, some had slightly different colours and so on.

Darwin believed, and we now know that he was correct, that the mechanism responsible for these genetic variations was entirely blind to the adaptive needs and requirements of the organism. If a beneficial variation occurred which conferred upon an organism some slight adaptive advantage or improvement this was entirely fortuitous. In other words the changes were undirected and as likely to be detrimental or neutral to the organism's survival as beneficial. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p43.]

- Darwin's theory implied that all evolution had come about by the interactions of two basic processes, random mutation and natural selection, and it meant that the ends arrived at were entirely the result of a succession of chance events. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p43.]
- Evolution by natural selection is therefore, in essence, strictly analogous to problem solving by trial and error, and it leads to the immense claim that all the design in the biosphere is ultimately the fortuitous outcome of an entirely blind random process - a giant lottery. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p43.]
- Thus Darwin was proposing, as Jacques Monod has put it:⁵ ... that chance alone is at the source of every innovation, of all creation in the biosphere. Pure chance, absolutely free but blind, at the very root of the stupendous edifice of evolution. [Monod, J. (1972) *Chance and Necessity*, Collins, London, p 110.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p43.]
- It was a revolutionary claim. Where once design had been the result of God's creation, it was now put down to chance. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p43.]
- If the Origin had dealt only with the evolution of new species it would never have had its revolutionary impact. It was only because it went much further to argue the general thesis that the same simple natural processes which had brought about the diversity of the Galapagos finches had ultimately brought forth all the diversity of life on earth and all the adaptive design of living things that the book proved such a watershed in western thought. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986,

p46.]

- Darwin never claimed his theory could explain the origin of life, but the implication was there. Thus, not only was God banished from the creation of species but from the entire realm of biology. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p53.]
- There is no doubt that as far as his macroevolutionary claims were concerned Darwin's central problem in the Origin lay in the fact that he had absolutely no direct empirical evidence in the existence of clear-cut intermediates that evolution on a major scale had ever occurred and that any of the major divisions of nature had been crossed gradually through a sequence of transitional forms. Over and over, he returns to the same problem, confessing that:²⁶ ... the distinctness of specific forms and their not being blended together by innumerable transitional links is a very obvious difficulty. [Darwin, C. (1872) *The Origin of Species*, 6th ed, 1962, Collier Books, New York, p307.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p56.]
- Not only was he unable to provide empirical evidence for evolution in the existence of intermediate forms, there was in many cases a real difficulty in imagining the hypothetical paths through which evolution had occurred. This was particularly true of various highly specialized organisms and organs, and Darwin concedes:²⁷ It is no doubt difficult even to conjecture by what gradations many structures have been perfected although in many cases it is most difficult even to conjecture by what transitions organs have arrived at their present state ... ²⁸ [Darwin, C. (1872) *The Origin of Species*, 6th ed, 1962, Collier Books, New York, p459 & p192.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p56.]
- Moreover, Darwin's theory required not just one or two intermediates of dubious status but 'innumerable' transitional forms and the fossil record provided no evidence for believing that this infinitude of connecting links had ever existed. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p58.]
- Even if Darwin had been able to provide clear evidence for continuity on a grand scale, this would have still left him with the tremendous task of justifying the second great axiom of his evolutionary theory, the radical

claim, that the driving force behind the whole of evolution was the purely random mechanism of natural selection. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p60.]

- To begin with, even by Darwin's own admission, evolution by natural selection is bound to be a relatively slow process and the question obviously arises, has there been sufficient time for all the enormous changes that must necessarily have occurred during the course of evolution? [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p60.]
- Each new advantageous mutation or innovation, (...) must first occur, and then spread by interbreeding to all the members of the species and the rate at which this occurs, the substitution rate, depends on a number of factors, including mutation rate, generation time and total population number. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p60.]
- Moreover, it is one thing to show that an evolutionary route is possible in the time available, quite another to show that it is also probable. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p60.]
- Darwin himself was often prone to self doubt over the sheer enormity of his own claims:³⁶ Although the belief that an organ so perfect as the eye could have been formed by natural selection, is enough to stagger any one ... I have felt the difficulty far too keenly to be surprised at others hesitating to extend the principle of natural selection to so startling a length.³⁷ [Darwin, C. (1872) *The Origin of Species*, 6th ed, 1962, Collier Books, New York, p459 & p181.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p61.]
- Altogether the problems that Darwin faced in defending his general theory are underlined by the fact that he was forced to devote a large portion of the book to attempting to explain away much evidence which was on the face of it and by his own admission hostile to the whole evolutionary picture. Even the chapter titles in the *Origin* (titles such as "Difficulties of the Theory", .. The Imperfections of the Fossil Record" and "Miscellaneous Objections to the Theory of Natural Selection") illustrate how seriously he took the problems he faced. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler

Publishers 1986, p62.]

- It was not only his general theory that was almost entirely lacking in any direct empirical support, but his special theory was also largely dependent on circumstantial evidence. A striking witness to this is the fact that nowhere was Darwin able to point to one bona fide case of natural selection having actually generated evolutionary change in nature, let alone having been responsible for the creation of a new species. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p62.]
- Neither Darwin nor any other nineteenth-century biologist had any idea of the true nature of the gene and of the mechanism of inheritance. It was only in the first decade of the twentieth century, with the founding of classical Mendelian genetics and the so-called 'bean-bag' theory of heredity (as opposed to the paint pot theory), that the fundamental units of heredity, the genes, were first shown to be quite discrete elements (the beans in the bean bag) which act separately and are inherited essentially unchanged. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p64.]
- The Origin was revolutionary and shocking to Victorians because nineteenth-century England was steeped in biblical fundamentalism and creationist biology. The thesis Darwin had developed implied an end to the traditional and deeply held teleological and anthropocentric view of nature. Instead of being the pinnacle and end of creation, humanity was to be viewed ultimately as a cosmic accident, a produce of a random process no more significant than any one of the myriads of other species on earth. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p66.]
- As far as Christianity was concerned, the advent of the theory of evolution and the elimination of traditional teleological thinking was catastrophic. The suggestion that life and man are the result of chance is incompatible with the biblical assertion of their being the direct result of intelligent creative activity. Despite the attempt by liberal theology to disguise the point, the fact is that no biblically derived religion can really be compromised with the fundamental assertion of Darwinian theory. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p66.]
- It was because Darwinian theory broke man's link with God and set him adrift

in a cosmos without purpose or end that its impact was so fundamental. No other intellectual revolution in modern times (with the possible exception of the Copernican) so profoundly affected the way men viewed themselves and their place in the universe. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p67.]

3 From Darwin to Dogma

- There can be no question that Darwin had nothing like sufficient evidence to establish his theory of evolution. Neither speciation nor even the most trivial type of evolution had ever actually been observed directly in nature. He provided no direct evidence that natural selection had ever caused any biological change in nature and the concept was in itself flawed because it was impossible to reconcile with the theory of heredity in vogue at that time. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p69.]
- Yet despite the weakness of the evidence, Darwin's theory was elevated from what was in reality a highly speculative hypothesis into an unchallenged dogma in a space of little more than twenty years after the publication of the Origin. To understand how this came about we have to look beyond the facts of biology. As is so often the case and as the history of science so amply testifies, the acceptance of new ideas is often dependent on the influence of non-scientific factors of a social, psychological and philosophical nature and the Darwinian revolution was no exception. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p70.]
- To begin with, the concepts of continuity and gradualism which were basic to the whole Darwinian model of evolution were in keeping with a general tendency towards political and social conservatism which was prevalent in nineteenth-century Victorian society and deeply ingrained in modern western societies. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p70.]
- Stephen Jay Gould and Niles Eldredge comment: 2 The general preference that so many of us hold for gradualism is a metaphysical stance embedded in the modern history of Western cultures: it is not a high-order empirical observation, induced from the objective study of nature. The famous statement attributed to Linnaeus - nature non facit saltum (nature does not

make leaps) - may reflect some biological knowledge, but it also represents the translation into biology of the order, harmony and continuity that European rulers hoped to maintain in a society already assaulted by calls for fundamental social change. [Gould, S.J. and Eldrige, N. (1977) "Punctuated Equilibria: The Tempo and Mode of Evolution Reconsidered", *Paleobiology*, 3: 115-51, see p 145.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p70.]

- Another social factor which probably eased the way for Darwin was the Victorian belief in the inevitability of progress. This optimistic view of the unlimited possibilities for human progress and the belief in the perfectability of man may seem naive today but such a social evolutionary philosophy could hardly have hindered the spread and acceptance of the idea of biological evolution. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p70.]
- God came to be viewed increasingly as a distant and remote first cause, the architect of a clockwork universe which had continued from its creation to operate automatically without any need for further divine intervention. Explanations in terms of natural causes were also having increasing success in chemistry and physiology. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p71.]
- Philosophers and historians of science will probably be debating the nature of the Darwinian revolution for years to come, but whatever their final verdict on this event, the facts themselves were not sufficient to compel belief in the continuity of living nature or to establish beyond reasonable doubt that the whole drama of life on earth was generated by the sorts of simple random processes responsible for microevolution on the Galapagos Islands. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p74.]
- It is not surprising that, in the context of such an overwhelming social consensus, many biologists are confused as to the true status of the Darwinian paradigm and are unaware of its metaphysical basis. As the following quote from Julian Huxley at a conference in 1959 makes clear:⁶ The first point to make about Darwin's theory is that it is no longer a theory but a fact ... Darwinianism has come of age so to speak. We are no longer having to bother

about establishing the fact of evolution. [Huxley, J. (1960) "The Emergence of Darwinism" in *Evolution of Life*, ed Sol Tax, University of Chicago Press, Chicago, pp 1-21, sec p1.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p75.]

- Richard Dawkins, author of *The Selfish Gene*, is even more emphatic, for him:⁷ The theory is about as much in doubt as the earth goes round the sun. [Dawkins, R. (1976) *The Selfish Gene*, Oxford University Press, p1.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p75.]
- Now of course such claims are simply nonsense. For Darwin's model of evolution is still very much a theory and still very much in doubt when it comes to macro-evolutionary phenomena. Furthermore, being basically a theory of historical reconstruction, it is impossible to verify by experiment or direct observation as is normal in science. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p75.]
- Philosophers such as Sir Kari Popper have raised doubts as to whether evolutionary claims, by their very nature incapable of falsification, can properly be classed as truly scientific hypotheses. Moreover, the theory of evolution deals with a series of unique events, the origin of life, the origin of intelligence and so on. Unique events are unrepeatable and cannot be subjected to any sort of experimental investigation. Such events, whether they be the origin of the universe or the origin of life, may be the subject of much fascinating and controversial speculation, but their causation can, strictly speaking, never be subject to scientific validation. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p75.]
- Although it is nonsense to claim that Darwin's theory is a fact, ironically both Huxley and Dawkins are right in the sense that, once a community has elevated a theory into a self-evident truth, its defence becomes irrelevant and there is no longer any point in having to establish its validity by reference to empirical facts. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p76.]
- Once a theory has become petrified into a metaphysical dogma it always holds enormous explanatory power for the community of belief. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p76.]

- The raising of the status of Darwinian theory to a self-evident axiom has had the consequence that the very real problems and objections with which Darwin so painfully labored in the Origin have become entirely invisible. Crucial problems such as the absence of connecting links or the difficulty of envisaging intermediate forms are virtually never discussed and the creation of even the most complex of adaptations is put down to natural selection without a ripple of doubt. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p77.]
- The fact is that the evidence was so patchy one hundred years ago that even Darwin himself had increasing doubts as to the validity of his views, and the only aspect of his theory which has received any support over the past century is where it applies to microevolutionary phenomena. His general theory, that all life on earth had originated and evolved by a gradual successive accumulation of fortuitous mutations, is still, as it was in Darwin's time, a highly speculative hypothesis entirely without direct factual support and very far from that self-evident axiom some of its more aggressive advocates would have us believe. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p77.]

4 A Partial Truth

- It is clear, then, that Darwin's special theory was largely correct. Natural selection has been directly observed and there can be no question now that new species do originate in nature; furthermore, it is now possible to explain in great detail the exact sequence of events that lead to species formation. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p85.]
- However attractive the extrapolation, it does not necessarily follow that, because a certain degree of evolution has been shown to occur, therefore any degree of evolution is possible. There is obviously an enormous difference between the evolution of a colour change in a moth's wing and the evolution of an organ like the human brain, and the differences among the fruit flies of Hawaii, for example, are utterly trivial compared with the differences between a mouse and an elephant, or an octopus and a bee. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p87.]
- There is no doubt that the success of the Darwinian model in explaining

microevolution invites the hope that it might be applicable also to macro-evolutionary phenomena. Perhaps in the end this might prove to be the case; but, on the other hand, there is the depressing precedent, as the history of science testifies, that over and over again theories which were thought to be generally valid at the time proved eventually to be valid only in a restricted sphere. Newtonian physics, for example, which accounted perfectly for all the empirical data available in the eighteenth and nineteenth centuries and is still used for calculating the trajectory of a space rocket, is absolutely inapplicable to phenomena at the subatomic and cosmological levels. Theories are seldom infinitely extendible. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p92.]

5 The Typological Perception of Nature

- Evidence for evolution exists in nature wherever a group of organisms can be arranged into a lineal or sequential pattern, in which case the idea of evolution becomes almost irresistible. The circumpolar overlaps and the chromosomal pattern of the fruit flies of Hawaii are compelling evidence for evolution because in each case the sequential arrangement corresponds to an almost perfect continuum. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p93.]
- Obviously, the more perfect the sequence the more convincing it is as evidence for evolution, but even when there is no perfect continuum of forms, just as long as there is a clear sequential order to the patterns of diversity, the conclusion of evolution is still very difficult to resist. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p93.]
- A classic case is the series of fossil horses. This series is nothing like a perfect continuum of forms, the breaks are distinct and clear, but the overall sequential pattern is so obvious that no one seriously doubts that the modern horse has evolved from the primitive horses of the Eocene era sixty million years ago. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p93.]

7 The Failure of Homology

- Since 1859 the phenomenon of homology has been traditionally cited by

evolutionary biologists as providing one of the most powerful lines of evidence for the concept of organic evolution. As in so many other areas of evolutionary thought, no one has ever presented the argument with greater clarity than Darwin himself. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p143.]

- Homology provided Darwin with apparently positive evidence that organisms had undergone descent from a common ancestor. Furthermore, the evolutionary explanation of homology appeared to be one instance where evolution seemed far more plausible than its creationist alternative. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p143, 144.]
- On the face of it, it would appear very difficult to explain by a creationist theory the persistence of the so-called pentadactyl pattern in the limbs of all the major terrestrial vertebrates from the first amphibian up to present day forms. Why should a creator be restricted to the same basic Penta-dactyl design in designing the flipper of a whale or the wing of a flying reptile? [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p144.]
- The validity of the evolutionary interpretation of homology would have been greatly strengthened if embryological and genetic research could have shown that homologous structures were specified by homologous genes and followed homologous patterns of embryological development. Such homology would indeed be strongly suggestive of "true relationship; of inheritance from a common ancestor". But it has become clear that the principle cannot be extended in this way. Homologous structures are often specified by non-homologous genetic systems and the concept of homology can seldom be extended back into embryology. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p145.]
- The development of the vertebrate kidney appears to provide another challenge to the assumption that homologous organs are generated from homologous embryonic tissues. In fish and amphibia the kidney is derived directly from an embryonic organ known as the mesonephros, while in reptiles and mammals the mesonephros degenerates towards the end of embryonic life and plays no role in the formation of the adult kidney, which

is formed instead from a discrete spherical mass of mesodermal tissue, the metanephros, which develops quite independently from the mesonephros. Even the ureter, the duct which carries the urine from the kidney to the bladder, is formed in a completely different manner in reptiles and mammals from the equivalent duct in amphibia. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p146.]

- A further example is provided by the development of the two unique membranes, the amniotic and allantoic, which surround the growing embryo in reptiles, birds and mammals. These membranes are considered to be strictly homologous in all the vertebrate groups in which they occur, but in mammals the processes which lead to their formation and the cells from which they are derived differ completely from those in reptiles and birds. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p146, 147.]
- It appears then that Darwin's usage of the term "homology", which he defines in the Origin as that "relationship between parts which results from their development from corresponding embryonic parts", is, as De Beer emphasizes, just what homology is not. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p149.]
- We seem forced to propose that during the course of evolution the gradual accumulation of tiny independent and random changes in two independent structures - the pectoral and pelvic fins of a fish - hit on an identical yet apparently arbitrary ground plan for the design of the fore- and hindlimbs of a tetrapod. The problem is even more perplexing considering that neither the initial structures - the pelvic and pectoral fins of a fish - nor the end products of the process - the fore- and hindlimbs of a tetrapod - are in any strict sense identical. How this complex and seemingly arbitrary pattern was arrived at twice independently in the course of evolution is mystifying. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p152.]
- Such examples of convergence led Carter to comment:20 There are many problems in evolution for which our present explanations are inadequate or incomplete. This is certainly one place in which this is so. It is clear that much more work must be done before we have a complete understanding of

the process of evolution. [Caner, G. S. (1967) Structure and Habit in Vertebrate Evolution, Sidgwick and Jackson, London, p493.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p153.]

- Is it possible that many cases of resemblance in nature which are today classed as homologous, and taken by evolutionary biologists as implying descent from a common origin, may turn out to be merely analogous? There is certainly a long term historical trend which tends to bear this possibility out. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p153.]
- It turns out, then, that the problem of unity of type is not nearly as readily explicable in terms of evolution theory as is generally assumed. Darwin's jibe at Owen now seems increasingly hollow. There is still no satisfactory biological explanation for the phenomenon. Like so much of the other circumstantial "evidence" for evolution, that drawn from homology is not convincing because it entails too many anomalies, too many counter-instances, far too many phenomena which simply do not fit easily into the orthodox picture. The failure of homology to substantiate evolutionary claims has not been as widely publicised as have the problems in paleontology. Comparative embryology is a less glamorous pursuit than the biology of dinosaurs. Nonetheless, it fits into the general theme that advances in knowledge are not making it easier to reduce nature to the Darwinian Paradigm. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p154.]
- The discussion in the past three chapters indicates that the facts of comparative anatomy and the pattern of nature they reveal provide nothing like the overwhelming testimony to the Darwinian model of evolution that is often claimed. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p154.]

8 The Fossil Record

- The overall picture of life on Earth today is so discontinuous, the gaps between the different types so obvious, that, as Steven Stanley reminds us in his recent book Macroevolution, if our knowledge of biology was restricted to those species presently existing on Earth, "we might wonder whether the

doctrine of evolution would qualify as anything more than an outrageous hypothesis."1 Without intermediates or transitional forms to bridge the enormous gaps which separate existing species and groups of organisms, the concept of evolution could never be taken seriously as a scientific hypothesis. [Stanley, S. (1979) *Macroevolution*, W.H. Freeman and Co, San Francisco, p2.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p157, 158.]

- Curiously, the problem is compounded by the fact that the earliest representatives of most of the major invertebrate phyla appear in the fossil record over a relatively short space of geological time, about six hundred million years ago in the Cambrian era. The strata lain down over the hundreds of millions of years before the Cambrian era, which might have contained the connecting links between the major phyla, are almost completely empty of animal fossils. If transitional types between the major phyla ever existed then it is in these pre-Cambrian strata that their fossils should be found. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p163.]
- The story is the same for plants. Again, the first representatives of each major group appear in the fossil record already highly specialized and highly characteristic of the group to which they belong. Perhaps one of the most abrupt arrivals of any plant group in the fossil record is the appearance of the angiosperms in the era known to geologists as the Cretaceous. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p163.]
- Again, just as in the case of the absence of pre-Cambrian fossils, no forms have ever been found in pre-Cretaceous rocks linking the angiosperms with any other group of plants. According to Daniel Axelrod¹⁵: The ancestral group that gave rise to angiosperms has not yet been identified in the fossil record, and no living angiosperm points to such an ancestral alliance. In addition, the record has shed almost no light on relations between taxa at ordinal and family level. [Axelrod, D. (1960) "The Evolution of Flowering Plants" in *The Evolution of Life*, op cit, p227-306, see p230.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p163.]

- The same pattern is true of the vertebrate fossil record. The first members of each major group appear abruptly, unlinked to other groups by transitional or intermediate forms. Already at their first appearance, although often more generalized than later representatives, they are well differentiated and already characteristic of their respective classes. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p164.]
- No fish group known to vertebrate paleontology can be classed as an ancestor of another; all are related as sister groups, never as ancestors and descendants. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p164.]
- The pattern repeats itself in the emergence of the Amphibia. (...) The same pattern is evident as the various reptile and mammalian groups make their first appearance in the fossil record. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p164.]
- The overall character of the fossil record as it stands today was superbly summarized in an article by G. G. Simpson prepared for the Darwin Centenary Symposium held in Chicago in 1959. Simpson is a leading paleontologist whose testimony to the reality of the gaps in the fossil record has considerable force. As he points out, it is one of the most striking features of the fossil record that most new kinds of organisms appear abruptly:16 They are not, as a rule, led up to by a sequence of almost imperceptibly changing forerunners such as Darwin believed should be usual in evolution. A great many sequences of two or a few temporally intergrading species are known, but even at this level most species appear without known immediate ancestors, and really long, perfectly complete sequences of numerous species are exceedingly rare. Sequences of genera immediately successive or nearly so at that level (not necessarily from one genus to the next), are more common and may be longer than known sequences of species. But the appearance of a new genus in the record is usually more abrupt than the appearance of a new species; the gaps involved are generally larger, that is, when a new genus appears in the record it is usually well separated morphologically from the most nearly similar other known genera. This phenomenon becomes more universal and more intense as the hierarchy of categories is ascended. Gaps among known species are sporadic and often

small. Gaps among known orders, classes and phyla are systematic and almost always large. [Simpson, G.G. (1960) "The History or Life" in *The Evolution of Life*, ed Sol Tax, University of Chicago Press, Chicago, pp 117-180, seep 149.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p164, 165.]

- The virtual complete absence of intermediate and ancestral forms from the fossil record is today recognised widely by many leading paleontologists as one of its most striking characteristics, so much so that those authorities who have adopted the cladistic framework now take it as axiomatic, that, in attempting to determine the relationships of fossil species, in the words of a recent British Museum publication: "we assume that none of the fossil species we are considering is the ancestor of the other." 17 [British Museum (Natural History) (1980) *Man's Place in Evolution*, p20.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p165.]
- The fossils have not only failed to yield the host of transitional forms demanded by evolution theory, but because nearly all extinct species and groups revealed by paleontology are quite distinct and isolated as they burst into the record, then the number of hypothetical connecting links to join its diverse branches is necessarily greatly increased. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p165, 166.]
- The absence of transitional forms from the fossil record is dramatically obvious (even to a non-specialist without any knowledge of comparative morphology) where a group possesses some significant skeletal specialization or adaptation which is absent in its presumed ancestral type. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p166.]
- It would be pointless to continue citing examples to illustrate the discontinuous nature of the fossil record. Anyone who doubts the reality of the gaps may either take the word of leading paleontologists or simply open one of the standard works on paleontology such as Romer's *Vertebrate Paleontology* or Schrock and Twenhofel's *Invertebrate Paleontology* and examine any of the stratigraphic charts showing the abundance of various groups during different geological eras and dotted lines suggesting their hypothetical phylogenetic relationships (see Figure 8.3). Even a cursory

glance shows clearly that profound and undoubted discontinuities do in fact exist. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p172.]

- There is no doubt that as it stands today the fossil record provides a tremendous challenge to the notion of organic evolution, because to close the very considerable gaps which at present separate the known groups would necessarily have required great numbers of transitional forms. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p172.]
- Darwin's insistence that gradual evolution by natural selection would require inconceivable numbers of transitional forms may have been something of an exaggeration but it is hard to escape concluding that in some cases he may not have been so far from the mark. Take the case of the gap between modern whales and land mammals. All known aquatic or semi-aquatic mammals such as seals, sea cows (sirenians) or otters are specialized representatives of distinct orders and none can possibly be ancestral to the present-day whales. To bridge the gap we are forced therefore to postulate a large number of entirely extinct hypothetical species starting from a small, relatively unspecialized land mammal like a shrew and leading successively through an otter-like stage, seal-like stage, sirenian-like stage and finally to a putative organism which could serve as the ancestor of the modern whales. Even from the hypothetical whale ancestor stage we need to postulate many hypothetical primitive whales to bridge the not inconsiderable gaps which separate the modern filter feeders (the baleen whales) and the toothed whales. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p173, 174.]
- To demonstrate that the great divisions of nature were really bridged by transitional forms in the past, it is not sufficient to find in the fossil record one or two types of organisms of doubtful affinity which might be placed on skeletal grounds in a relatively intermediate position between other groups. The systematic status and biological affinity of a fossil organism is far more difficult to establish than in the case of a living form, and can never be established with any degree of certainty. To begin with, ninety-nine per cent of the biology of any organism resides in its soft anatomy, which is

inaccessible in a fossil. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p177.]

- The only sort of evolution documented in the fossil record are several instances where a relatively minor morphological transformation can be traced through a convincing series of fossil forms. The best known case is probably that of the horse, which starts with the original dog-sized horse, Eohippus, which lived about sixty million years ago and leads gradually to the modern horse of today. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p182.]
- Considering that the total number of known fossil species is nearly one hundred thousand, the fact that the only relatively convincing morphological sequences are a handful of cases like the horse, which do not involve a great deal of change, and which in many cases like the elephant may not even represent phylogenetic sequences at all, serves to emphasize the remarkable lack of any direct evidence for major evolutionary transformations in the fossil record. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p185.]
- A great deal has been made of the horse series and other similar cases. The traditional view is that they provide powerful evidence of the reality of evolution; and that what has happened in the case of the horse happened in all other cases, but the fossil links were not preserved or have not yet been discovered. In other words, the horse is the exception which proves the rule. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p185.]
- It is possible to view such series in a very different light and read the fossil evidence directly as it stands; and infer that what is exceptional about such sequences is not their preservation but rather the fact that they occurred. They may be exceptions which prove a very different rule: that in general, nature cannot be arranged in terms of sequences and that where sequence does exist it is exceptional or relatively trivial. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p185.]
- Basically, three explanations have been put forward to explain the gaps in the fossil record: Firstly, insufficient search, ie that not all fossil bearing strata have been examined. Secondly, the imperfection of the record, ie that only a

fraction of the species that lived in the past have left fossil remains. Thirdly, saltational evolution, ie that the gaps are real and that evolution occurred in a series of jumps. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p186.]

- It is particularly difficult to accept insufficient search as an explanation for the gaps between the major invertebrate phyla. As we have seen, all the main invertebrate types appear already clearly differentiated very abruptly in early Cambrian rocks. An enormous effort has been made over the past century to find missing links in these rocks which might bridge the deep divisions in the animal kingdom. Yet no links have ever been found and the relationships of the major groups are as enigmatic today as one hundred years ago. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p186.]
- It is significant in this respect that many professional paleontologists, those actually familiar with the facts, have always regarded the appeal to imperfection as a way of explaining away the absence of transitional forms with a good deal of skepticism. This was even true in the nineteenth century. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p190, 191.]
- Whatever view one wishes to take of the evidence of paleontology, it does not provide convincing grounds for believing that the phenomenon of life conforms to a continuous pattern. The gaps have not been explained away. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p194.]

9 Bridging the Gaps

- Just as in biological evolution where transitional organisms which would bridge the gaps and provide firm evidence of gradual evolutionary descent are missing, so also in linguistics, historical and documentary evidence of the origin and development of language groups is often absent. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p¹⁹⁹.]
- if detailed and plausible reconstructions of the presumed evolutionary pathway can be provided, then the assumption of an evolutionary relationship becomes almost inescapable. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p²⁰⁰.]

- The trouble with reconstructing hypothetical organisms is that, compared with, say, languages, organisms are tremendously complex objects and reconstructing an unknown organism, or even merely a hypothetical organ, in sufficient detail so that we could be sure it could function and survive, is a task beyond any biologist at present. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p201.]
- It is almost universally accepted by evolutionary biologists that birds evolved from reptiles, and that the feather evolved from a reptile's scale. Birds are certainly closely related to reptiles and it is difficult to see what other group of living organisms could possibly serve as hypothetical ancestors. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p203, 204.]
- It seems particularly doubtful that "feathers" evolving to form an insect net would provide the basis for an impervious aero foil. A net must be (as anyone who has tried to swat a mosquito will have discovered) pervious to the air. If a reptile's scale ever did evolve in this direction (and no other living organism has ever possessed such a remarkable structure), it would surely be pervious to air and unsuitable for any sort of flight. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p209.]
- The evolution of birds is far more complex than the above discussion implies. In addition to the problem of the origin of the feather and flight, birds possess other unique adaptations which also seem to defy plausible evolutionary explanations. One such adaptation is the avian lung and respiratory system. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p210.]
- In addition to the feather and the avian lung there are many other unique features in the biology of the birds, in the design of the heart and cardiovascular system, in the gastrointestinal system and in the possession of a variety of other relatively minor adaptations such as, for example, the unique sound producing organ, the syrinx, which similarly defy plausible explanation in gradualistic terms. Altogether it adds up to an enormous conceptual difficulty in envisaging how a reptile could have been gradually converted into a bird. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p213.]

- What we seem to have, then, is a very interesting coincidence - a great empirical discontinuity in nature between reptiles and birds which seems to coincide with a major conceptual discontinuity in our ability to conceive of functional intermediates through which the gap might have been closed. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p213.]
- The difficulty of envisaging how evolutionary gaps were closed does not stop with birds: Take the case of the bats. The first known bat which appeared in the fossil record some sixty million years ago had as completely developed wings as modern forms. As in the case of birds, how could the development of the bats' wings and capacity for powered flight have come about gradually? [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p213.]
- The large marine aquatic vertebrates such as the ichthyosaurs (the fish reptiles), the seals and the whales, etc. appear suddenly in the fossil record already fully differentiated, and once again only the most general explanations of how such transitions occurred are offered. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p216.]
- Every textbook of evolution asserts that reptiles evolved from amphibia but none explains how the major distinguishing adaptation of the reptiles, the amniotic egg, came about gradually as a result of a successive accumulation of small changes. The amniotic egg of the reptile is vastly more complex and utterly different to that of an amphibian. There are hardly two eggs in the whole animal kingdom which differ more fundamentally. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p218.]
- The evolution of the amniotic egg is baffling. It was this decisive innovation which permitted for the first time genuinely terrestrial vertebrate life, freeing it from the necessity of embryological development in an aquatic environment. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p218.]
- The origin of the amniotic egg and the amphibian - reptile transition is just another of the major vertebrate divisions for which clearly worked out evolutionary schemes have never been provided. Trying to work out, for example, how the heart and aortic arches of an amphibian could have been

gradually converted to the reptilian and mammalian condition raises absolutely horrendous problems. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p219.]

- The living world is full of innumerable other systems, particularly among the insects and invertebrates, for which gradual evolutionary explanations have never been provided. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p219.]
- In the case of many of the more dramatic invertebrate metamorphoses not even the vaguest attempts have been made to provide hypothetical scenarios explaining how such an astonishing sequence of transformations could have come about gradually as a result of a succession of small beneficial mutations. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p221.]
- The bacterial flagellum and the rotary motor which drives it are not led up to gradually through a series of intermediate structures and, as is so often the case, it is very hard to envisage a hypothetical evolutionary sequence of simpler rotors through which it might have evolved gradually. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p225.]
- The adaptations by which certain insectivorous plants, such as the venus fly trap or the pitcher plant, first lure, then trap and digest their insect prey are perhaps even more incredible. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p226.]
- Until recently, despite the severity of the problem of reconstructing transitional stages, few biologists have been prepared to reject gradualism altogether. However, over the past few years a number of biologists and students of evolution theory have begun to raise serious doubts about the validity of orthodox Darwinian gradualism. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p228.]
- As Stephen Jay Gould put it in *The Panda's Thumb*:49 can we invent a reasonable sequence of intermediate forms - that is, viable, functioning organisms - between ancestors and descendants in major structural transitions? I submit, although it may only reflect my lack of imagination, that the answer is no. [Gould, S. j. (1980) *The Panda's Thumb*, W.W. Norton

and Co, New York, p189] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p228, 229.]

- Ultimately there is, of course, absolutely no reason why functional organic systems should form the continuum that evolution by natural selection demands. In the world of physics and chemistry many phenomena are discontinuous. One cannot gradually convert one molecular species into another, neither can one convert gradually one type of atom into another. Between such entities there are jumps. Might not functional organic systems be similarly separated by discontinuities? [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p²²⁹.]

10 The Molecular Biological Revolution

- The laws governing inheritance are for the most part unknown. No one can say why the same peculiarity in different individuals of the species is sometimes inherited and sometimes not so ... why a peculiarity is often transmitted from one sex to both sexes or to one sex alone. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p233.]
- Protein molecules are the ultimate stuff of life. If we think of the cell as being analogous to a factory, then the proteins can be thought of as analogous to the machines on the factory floor which carry out individually or in groups all the essential activities on which the life of the cell depends. Each protein is a sort of micro-miniaturized machine, so small that it must be magnified a million times before it is visible to the human eye. The structure and functioning of these fascinating work horses of the cell was a complete mystery until the 1950s. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p²³⁴.]
- We now know that each of these tiny molecular machines consists fundamentally of a long chain-like molecule, or polymer, made up of a linear sequence of simple organic compounds called amino acids. Of the hundreds of amino acids known to science only twenty are utilized by living systems in the construction of proteins. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p234.]
- The linear sequence of amino acids in a protein can be thought of as a sentence made up of a long combination of the twenty amino acid letters. Just as different sentences are made up of different sequences of letters, so different

proteins are made up of different sequences of amino acids. In most proteins the amino acid chain is between one hundred and five hundred amino acids long. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p235.]

11 The Enigma of Life's Origin

- We now know not only of the existence of a break between the living and non-living world, but also that it represents the most dramatic and fundamental of all the discontinuities of nature. Between a living cell and the most highly ordered non-biological system, such as a crystal or a snowflake, there is a chasm as vast and absolute as it is possible to conceive. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p249, 250.]
- Molecular biology has shown that even the simplest of all living systems on earth today, bacterial cells, are exceedingly complex objects. Although the tiniest bacterial cells are incredibly small, weighing less than 10^{-12} gms, each is in effect a veritable microminiaturized factory containing thousands of exquisitely designed pieces of intricate molecular machinery, made up altogether of one hundred thousand million atoms, far more complicated than any machine built by man and absolutely without parallel in the nonliving world. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p250.]
- Molecular biology has also shown that the basic design of the cell system is essentially the same in all living systems on earth from bacteria to mammals. In all organisms the roles of DNA, mRNA and protein are identical. The meaning of the genetic code is also virtually identical in all cells. The size, structure and component design of the protein synthetic machinery is practically the same in all cells. In terms of their basic biochemical design, therefore no living system can be thought of as being primitive or ancestral with respect to any other system, nor is there the slightest empirical hint of an evolutionary sequence among all the incredibly diverse cells on earth. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p250.]
- In the words of Monod:1 .. we have no idea what the structure of a primitive cell might have been. The simplest living system known to us, the bacterial

cell ... in ... its overall chemical plan is the same as that of all other living beings. It employs the same genetic code and the same mechanism of translation as do, for example, human cells. Thus the simplest cells available to us for study have nothing "primitive" about them. vestiges of truly primitive structures are discernible. [Monod, J. (1972) *Chance and Necessity*, Collins, London, p 134] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p^{२००}.]

- In the Origin Darwin made no claim that his model of evolution could be extended to explain the origin of life, but the implication was there and was soon taken up by some of his contemporaries like Thomas Huxley. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p251.]
- As American astronomer Carl Sagan remarks in his book *Intelligent Life in the Universe*: 3 ... the discovery of life on one other planet - e.g. Mars - can, in the words of the American physicist Philip Morrison, of the Massachusetts Institute of Technology, "transform the origin of life from a miracle to a statistic." [Sagan, C. (1977) *Intelligent Life in the Universe*, Picador by Pan Books Ltd, London, p358] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p^{२०२}.]
- At issue was the fundamental question as to whether life is unique to Earth. Science can only deal with repeatable or recurrent events. A unique or very improbable event can never be the subject of scientific investigation. If life is unique to Earth then this means that it has only arisen once in all cosmic history, which would essentially exclude any sort of scientific approach to the problem of its origin. Before the study of the origin of life can be put on a serious scientific footing, the possibility that life is unique to Earth has to be excluded. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p255.]
- The absence of life on Mars means that, as it is probably the only planet in the solar system capable of harbouring any sort of life, further planetary exploration is unlikely to establish the existence of extraterrestrial life. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p258.]
- The existence of a prebiotic soup is crucial to the whole scheme. Without an

abiotic accumulation of the building blocks of the cell no life could ever evolve. If the traditional story is true, therefore, there must have existed for many millions of years a rich mixture of organic compounds in the ancient oceans and some of this material would very likely have been trapped in the sedimentary rocks lain down in the seas of those remote times. Yet rocks of great antiquity have been examined over the past two decades and in none of them has any trace of abiotically produced organic compounds been found. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p260, 261.]

- On top of the failure to find empirical evidence of abiotically produced organic compounds there are theoretical difficulties as well. In the presence of oxygen any organic compounds formed on the early Earth would be rapidly oxidized and degraded. For this reason many authorities have advocated an oxygen-free atmosphere for hundred of millions of years following the formation of the Earth's crust. Only such an atmosphere would protect the vital but delicate organic compounds and allow them to accumulate to form a prebiotic soup. Ominously, for believers in the traditional organic soup scenario, there is no clear geochemical evidence to exclude the possibility that oxygen was present in the Earth's atmosphere soon after the formation of its crust. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p261.]
- But even if there was no oxygen, there are further difficulties. Without oxygen there would be no ozone layer in the upper atmosphere which today protects the Earth's surface from a lethal dose of ultraviolet radiation. In an oxygen-free scenario, the ultraviolet flux reaching the Earth's surface might be more than sufficient to break down organic compounds as quickly as they were produced. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p261.]
- There is another twist to the problem of the ultraviolet flux. Nucleic acid molecules, which form the genetic material of all modern organisms, happen to be strong absorbers of ultraviolet light and are consequently particularly sensitive to ultraviolet-induced radiation damage and mutation. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p262.]

- The level of ultraviolet radiation penetrating a primeval oxygen-free atmosphere would quite likely have been lethal to any proto-organism possessing a genetic apparatus remotely resembling that of modern organisms. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p262.]
- The oxygen-ultraviolet conundrum is only one of several such theoretical objections which can be raised against the idea of an accumulation of abiotically-produced compounds on the early Earth. In the absence of empirical evidence, the existence of additional serious theoretical objections further compounds the weakening of the traditional framework. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p262.]
- The existence of a prebiotic soup is an absolute prerequisite for the evolutionary emergence of life on Earth, but even if good evidence for the soup had been found the problem of the origin of life would still be far from solved. The most difficult aspect of the origin of life problem lies not in the origin of the soup but in the stages leading from the soup to the cell. Between the basic building blocks, amino acids, sugars and other simple organic compounds used in the construction of the cell, and the simplest known types of living systems there is an immense discontinuity. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p263.]
- To explain the origin of the cell in evolutionary terms it is necessary to postulate a series of far simpler cell systems, leading gradually from a solution of organic compounds through more complex aggregates of matter to the typical cell system today. The only possible precursor to the existing cell system with its wonderfully efficient translational apparatus would be one that was less perfect. This is conceded in nearly every discussion of the origin of the cell. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p264.]
- The protein synthetic system of all modern cells requires the integrated activities of nearly one hundred different proteins, all carrying out different, very specific steps in the assembly of a new protein molecule. If only a small proportion of these were .. crudely made" or "statistical" it is practically impossible to accept that any protein would ever be manufactured, let alone

one with a specific molecular configuration capable of performing a specific function in the cell. It is precisely because the translation system is critically dependent on accurately made proteins that an imperfect protein synthetic system is so difficult to envisage. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p265, 266.]

- Another Nobel Prize winner, biochemist Francis Crick, in his recent book, *Life Itself*, concedes:30 An honest man, armed with all the knowledge available to us now, could only state that in some sense, the origin of life appears at the moment to be almost a miracle, so many are the conditions which would have had to have been satisfied to get it going. [Crick, F. (1981) *Life Itself*, Simon and Schuster, New York, p88] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p268.]
- In considering the origin of the translational system, evolution theory seems to have reached a sort of nemesis, for the problem is to all intents and purposes insoluble in terms of modern biochemical knowledge. That the profundity of the problem of the origin of translational systems has stretched the evolutionary framework to breaking point is conceded by Monod:29 The development of the metabolic system which as the primordial soup thinned must have "learned" to mobilize chemical potential and to synthesize the cellular components poses Herculean problems. So does the emergence of a selectively permeable membrane without which there can be no viable cell. But the major problem is the origin of the genetic code and of its translational mechanism. Indeed it is not so much a problem as a veritable enigma. [Monod, J. (1972) *Chance and Necessity*, Collins, London, p 135.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p268.]
- The origin of life is actually far more difficult to envisage than the above discussion implies. There is much more to the cell than the "mere" origin of the protein synthetic apparatus. In fact, the protein synthetic mechanism cannot function in isolation but only in conjunction with other complex subsystems of the cell. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p268.]
- The difficulty that is met in envisaging how the cell system could have originated gradually is essentially the same as that which is met in attempting

to provide gradual evolutionary explanations of all the other complex adaptations in nature. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p269.]

- The failure to give a plausible evolutionary explanation for the origin of life casts a number of shadows over the whole field of evolutionary speculation. It represents yet another case of a discontinuity where a lack of empirical evidence of intermediates coincides with great difficulty in providing a plausible hypothetical sequence of transitional forms. It therefore tends to reinforce the possibility that the discontinuities of nature may be much more fundamental than merely the artefactual result of random sampling that evolution implies. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p271.]
- Moreover, the seemingly intractable difficulty of explaining how a living system could have gradually arisen as a result of known chemical and physical processes raises the obvious possibility that factors as yet undefined by science may have played some role. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p271.]
- On the whole, the new biochemical picture has not had the effect that evolutionary theorists might have hoped. It has not blurred the distinction between living and non-living objects. The recently revealed world of molecular machinery, of coding systems, of informational molecules, of catalytic devices and feedback control, is in its design and complexity quite unique to living systems and without parallel in non-living nature. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p271.]

12 A Biochemical Echo of Typology

- However, no matter how much the diversity of nature may appear to conform to the theory of types at a morphological level, no matter how much all cats, all birds, all angiosperms, all mammals or all vertebrates may seem to be equally representative of their respective groups, there is no way of quantifying such conclusions. Judging relationships in terms of morphological characteristics is bound to involve an element of subjectivity. On purely morphological grounds there is no way of measuring the exact distance between two organisms in strictly mathematical terms. We cannot,

for example, quantify the difference between a cat and a dog and compare it with, say, the difference between a cat and a mouse. We assume that a cat and a dog are closer than a cat and a mouse, but how secure are such judgments? [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p274.]

- What sort of mutational mechanism might have generated uniform rates of evolution over vast periods of time in vastly dissimilar types of organisms? Basically, there are only two types of changes that can occur to the sequence of the genes specifying for functional proteins: neutral mutations which have no effect on function and are substituted by drift; and advantageous mutations which have a positive effect on function and are substituted by selection. Unfortunately, neither evolution by genetic drift nor evolution by positive selection is likely to have generated anything remotely resembling a uniform rate of evolution in a family of homologous proteins. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p297.]
- What has been revealed as a result of the sequential comparisons of homologous proteins is an order as emphatic as that of the periodic table. Yet in the face of this extraordinary discovery the biological community seems content to offer explanations which are no more than apologetic tautologies. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p306.]

13 Beyond the Reach of Chance

- According to the central axiom of Darwinian theory, the initial elementary mutational changes upon which natural selection acts are entirely random, completely blind to whatever effect they may have on the function or structure of the organism in which they occur. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p308.]
- Thus it follows that every adaptive advance, big or small, discovered during the course of evolution along every phylogenetic line must have been found as a result of what is in effect a purely random search strategy. The essential problem with this "gigantic lottery" conception of evolution is that all experience teaches that searching for solutions by purely random search procedures is hopelessly inefficient. [Michael Denton: *Evolution, A Theory*

in Crisis, Adler & Adler Publishers 1986, p308.]

- Living organisms are complex systems, analogous in many ways to non-living complex systems. Their design is stored and specified in a linear sequence of symbols, analogous to coded information in a computer program. Like any other system, organisms consist of a number of subsystems which are all co-adapted to interact together in a coherent manner: molecules are assembled into multi-molecular systems, multi-molecular assemblies are combined into cells, cells into organs and organ systems finally into the complete organism. It is hard to believe that the fraction of meaningless combinations of molecules, of cells, of organ systems, would not vastly exceed the tiny fraction that can be combined to form assemblages capable of exhibiting coherent interactions. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p315.]
- Given the close analogy between living systems and machines, particularly at a molecular level, there cannot be any objective basis to the assumption that functional organic systems are likely to be less isolated or any easier to find by chance. Surely it is far more likely that functional combinations in the space of all organic possibilities are just as isolated, just as rare and improbable, just as inaccessible to a random search and just as functionally immutable by any sort of random process. The only warrant for believing that functional living systems are probable, capable of undergoing functional transformation by random mechanisms, is belief in evolution by the natural selection of purely random changes in the structure of living things. But this is precisely the question at issue. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p315.]
- If complex computer programs cannot be changed by random mechanisms, then surely the same must apply to the genetic programmes of living organisms. The fact that systems in every way analogous to living organisms cannot undergo evolution by pure trial and error and that their functional distribution invariably conforms to an improbable discontinuum comes, in my opinion, very close to a formal disproof of the whole Darwinian paradigm of nature. By what strange capacity do living organisms defy the laws of chance which are apparently obeyed by all analogous complex systems? [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers

1986, p315, 316.]

- There is no way that a purely random search could ever have discovered the design of an aerodynamically feasible flying machine from a random assortment of mechanical components - again, the space of all possibilities is inconceivably large. All such analogies are false because in all such cases the search for function is intelligently guided. It cannot be stressed enough that evolution by natural selection is analogous to problem solving without any intelligent guidance, without any intelligent input whatsoever. No activity which involves an intelligent input can possibly be analogous to evolution by natural selection. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p317.]
- At present we are very far from being able to construct such a space of all organic possibilities and to calculate the probability of functional living systems. Nevertheless, for some of the lower order functional systems, such as individual proteins, their rarity in the space can be at least tentatively assessed. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p320.]
- The impossibility of gradual functional transformation is virtually self-evident in the case of proteins: mere casual observation reveals that a protein is an interacting whole, the function of every amino acid being more or less (like letters in a sentence or cogwheels in a watch) essential to the function of the entire system. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p321.]
- The likely impossibility of major functional transformation through individual amino acid steps was raised by Brian Hartley, a specialist in this area, in an article in the journal Nature in 1974. From consideration of the atomic structure of a family of closely related proteins which, however, have different amino acid arrangements in the central region of the molecule, he concluded that their functional interconversion would be impossible:10 It is hard to see how these alternative arrangements could have evolved without going through an intermediate that could not fold correctly (i.e. would be non functional). [Rigby, P.W.J., Burleigh, B.D. Jnr, and Hartley, B.S. (1974) "Gene Duplication in Experimental Enzyme Evolution", Nature, 251: 200-204, sec p200] [Michael Denton: *Evolution, A Theory in Crisis*, Adler &

Adler Publishers 1986, p321.]

- The Darwinian claim that all the adaptive design of nature has resulted from a random search, a mechanism unable to find the best solution in a game of checkers, is one of the most daring claims in the history of science. But it is also one of the least substantiated. No evolutionary biologist has ever produced any quantitative proof that the designs of nature are in fact within the reach of chance. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p324.]
- Neither Darwin, Dawkins nor any other biologist has ever calculated the probability of a random search finding in the finite time available the sorts of complex systems which are so ubiquitous in nature. Even today we have no way of rigorously estimating the probability or degree of isolation of even one functional protein. It is surely a little premature to claim that random processes could have assembled mosquitoes and elephants when we still have to determine the actual probability of the discovery by chance of one single functional protein molecule! [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p324.]

14 The Puzzle of Perfection

- Nothing at first can appear more difficult to believe than that the more complex organs and instincts have been perfected, not by means superior to, though analogous with, human reason, but by the accumulation of innumerable slight variations, each good for the individual possessor. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p326.]
- While Darwin was attempting to convince the world of the validity of evolution by natural selection he was admitting privately to friends to moments of doubt over its capacity to generate very complicated adaptations or "organs of extreme perfection", as he described them. In a letter to Asa Gray, the American biologist, written in 1861, just two years after the publication of *The Origin of Species*, he acknowledges these doubts and admits that "The eye to this day gives me a cold shudder."¹ [Darwin, C. (1860) in letter to Asa Gray in *Life and Letters of Charles Darwin* (1888) 3 vols., ed. F. Darwin, John Murray, London, vol2, p273.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p326.]

- Aside from any quantitative considerations, it seems intuitively, impossible that such self-evident brilliance in the execution of design could ever have been the result of chance. For, even if we allow that chance might have occasionally hit on a relatively ingenious adaptive end, it seems inconceivable that it could have reached so many ends of such surpassing "perfection". [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p327.]
- The intuitive feeling that pure chance could never have achieved the degree of complexity and ingenuity so ubiquitous in nature has been a continuing source of scepticism ever since the publication of the Origin; and throughout the past century there has always existed a significant minority of first-rate biologists who have never been able to bring themselves to accept the validity of Darwinian claims. In fact, the number of biologists who have expressed some degree of disillusionment is practically endless. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p327.]
- Perhaps in no other area of modern biology is the challenge posed by the extreme complexity and ingenuity of biological adaptations more apparent than in the fascinating new molecular world of the cell. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p328.]
- We would see that nearly every feature of our own advanced machines had its analogue in the cell: artificial languages and their decoding systems, memory banks for information storage and retrieval, elegant control systems regulating the automated assembly of parts and components, error fail-safe and proof-reading devices utilized for quality control, assembly processes involving the principle of prefabrication and modular construction. In fact, so deep would be the feeling of deja-vu, so persuasive the analogy, that much of the terminology we would use to describe this fascinating molecular reality would be borrowed from the world of late twentieth-century technology. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p329.]
- What we would be witnessing would be an object resembling an immense automated factory, a factory larger than a city and carrying out almost as many unique functions as all the manufacturing activities of man on earth.

However, it would be a factory which would have one capacity not equalled in any of our own most advanced machines, for it would be capable of replicating its entire structure within a matter of a few hours. To witness such an act at a magnification of one thousand million times would be an awe-inspiring spectacle. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p329.]

- In terms of complexity, an individual cell is nothing when compared with a system like the mammalian brain. The human brain consists of about ten thousand million nerve cells. Each nerve cell puts out somewhere in the region of between ten thousand and one hundred thousand connecting fibers by which it makes contact with other nerve cells in the brain. Altogether the total number of connections in the human brain approaches 10^{15} or a thousand million million. Numbers in the order of 10^{15} are of course completely beyond comprehension. Imagine an area about half the size of the USA (one million square miles) covered in a forest of trees containing ten thousand trees per square mile. If each tree contained one hundred thousand leaves the total number of leaves in the forest would be 10^{15} , equivalent to the number of connections in the human brain! [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p330.]
- Undoubtedly, the complexity of biological systems in terms of the sheer number of unique components is very impressive; and it raises the obvious question: could any sort of purely random process ever have assembled such systems in the time available? As all the complexity of a living system is reducible ultimately to its genetic blueprint, the really crucial question to ask is what is the sum total of all the unique adaptive genetic traits necessary for the specification of a higher organism like a mammal? In effect, how many genes are there in the genomes of higher organisms? And how many unique adaptive features are there in each individual gene? [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p331.]
- But it is not just the complexity of living systems which is so profoundly challenging, there is also the incredible ingenuity that is so often manifest in their design. Ingenuity in biological design is particularly striking when it is manifest in solutions to problems analogous to those met in our own

technology. Without the existence of the camera and the telescope, much of the ingenuity in the design of the eye would not have been perceived. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p332.]

- Although the anatomical components of the eye were well known by scientists in the fifteenth century, the ingenuity of its design was not appreciated until the seventeenth century when the basic optics of image formation were first clearly expressed by Kepler and later by Descartes. However, it was only in the eighteenth and nineteenth centuries, as the construction of optical instruments became more complicated, utilizing a movable iris, a focusing device, and corrections for spherical and chromatic aberration, all features which have their analogue in the eye, that the ingenuity of the optical system could at last be appreciated fully by Darwin and his contemporaries. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p332.]
- There are dozens of examples where advances in technology have emphasized the ingenuity of biological design. One fascinating example of this was the construction of the Soviet lunar exploratory machine, the lunakod, which moved by articulated legs. Legs, rather than wheels, were chosen because of the much greater ease with which an articulated machine could traverse the uneven terrain likely to be met on the lunar surface. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p333.]
- A chemical solution to the problem of information storage has, of course, been solved in living things by exploiting the properties of the long chain-like DNA polymers in which cells store their hereditary information. It is a superbly economical solution. The capacity of DNA to store information vastly exceeds that of any other known system; it is so efficient that all the information needed to specify an organism as complex as man weighs less than a few thousand millionths of a gram. The information necessary to specify the design of all the species of organisms which have ever existed on the planet, a number according to G. G. Simpson of approximately one thousandmillion,⁷ could be held in a teaspoon and there would still be room left for all the information in every book ever written. [Simpson, G. G. (1960) "The History of Life" in *Evolution of Life*, ed. Sol Tax, University of

Chicago Press, Chicago, pp 117-180, see p135.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p334.]

- The genius of biological design is also seen in the cell's capacity to synthesize organic compounds. Living things are capable of synthesizing exactly the same sorts of organic compounds as those synthesized by organic chemists. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p334.]
- Each of the chemical operations necessary to construct a particular compound is carried out by a specific molecular machine known as an enzyme. Each enzyme is a single large protein molecule consisting of some several thousand atoms linked together to form a particular spatial configuration which confers upon the molecule the capacity to carry out a unique chemical operation. When a number of enzymes are necessary for the assembly of a particular compound, they are arranged adjacent to each other so that, after each step in the operation, the partially completed compound can be conveniently passed to the next enzyme which performs the next chemical operation and so on until the compound is finally assembled. The process is so efficient that some compounds can be assembled in less than a second, while in many cases the same synthetic operations carried out by chemists, even in a well-equipped lab, would take several hours or days or even weeks. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p334.]
- It is astonishing to think that this remarkable piece of machinery, which possesses the ultimate capacity to construct every living thing that ever existed on Earth, from a giant redwood to the human brain, can construct all its own components in a matter of minutes and weigh less than 10^{-10} grams. It is of the order of several thousand million million times smaller than the smallest piece of functional machinery ever constructed by man. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p338.]
- Human intelligence is yet another achievement of life which has not been equalled in our technology, despite the tremendous effort and some significant advances which have been made in the past two decades towards the goal of artificial intelligence - a goal which may still be further away than

is often assumed. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p338, 339.]

- As David Waltz points out in a recent article in the Scientific American, no machines have yet been constructed which can in any significant way mimic the cognitive capacities of the human brain. The most telling criticism of current work in artificial intelligence is that it has not been successful in modelling what is called common sense. As Waltz explains, we still do not understand how the human brain thinks:10 substantially better models of human cognition must be developed before systems can be designed that will carry out even simplified versions of common-sense tasks. I expect the development of such models to keep me and many others fascinated for a long time. [Waltz, D.L. (1982) "Artificial Intelligence", Scientific American, 247(4), ppl01-122.] [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p339.]
- How would stone age man have judged a motor car or a pocket calculator? Incapable of manufacturing anything other than a crudely shaped flint tool, so primitive that it could hardly be distinguished from a natural piece of rock, the inside of a pocket calculator would seem a purposeless tangle of strings - a random maze of straw trapped inside a leather bag. Even megalithic monuments like Stonehenge or the Pyramids, artefacts which are primitive from our twentieth century standpoint, would cause considerable confusion to a Paleolithic man. How would an ancient Egyptian have judged an airplane or a submarine? Only if our ancestors had seen a man in the cockpit of the airplane would they have grasped the incredible, that it was an artefact. It would, of course, be an artefact beyond their comprehension - an artefact of the gods. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p340.]
- It is interesting to speculate how the theory of natural selection might have fared in the nineteenth century had the analogy between the living and mechanical worlds been as apparent then as it is today. The depth of the machine-organism analogy would have more than satisfied William Paley, and would certainly have provided Darwin's antagonists with powerful ammunition with which to resist the idea of natural selection. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986,

p341.]

- It is the sheer universality of perfection, the fact that everywhere we look, to whatever depth we look, we find an elegance and ingenuity of an absolutely transcending quality, which so mitigates against the idea of chance. Is it really credible that random processes could have constructed a reality, the smallest element of which - a functional protein or gene - is complex beyond our own creative capacities, a reality which is the very antithesis of chance, which excels in every sense anything produced by the intelligence of man? Alongside the level of ingenuity and complexity exhibited by the molecular machinery of life, even our most advanced artefacts appear clumsy. We feel humbled, as Neolithic man would in the presence of twentieth century technology. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p342.]
- It would be an illusion to think that what we are aware of at present is any more than a fraction of the full extent of biological design. In practically every field of fundamental biological research ever-increasing levels of design and complexity are being revealed at an ever-accelerating rate. The credibility of natural selection is weakened, therefore, not only by the perfection we have already glimpsed but by the expectation of further as yet undreamt of depths of ingenuity and complexity. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p342.]

15 The Priority of the Paradigm

- Since 1859, a vast amount of evidence has accumulated which has thoroughly substantiated Darwin's views as far as microevolutionary phenomena are concerned. Evolution by natural selection has been directly observed in nature, and it is beyond any reasonable doubt that new reproductively isolated populations - species - do in fact arise from pre-existing species. Although some of the details of the process are still controversial, and certain aspects of the modern view of speciation differ slightly from Darwin's, it is clear that the process involves a gradual accumulation of small genetic changes guided mainly by natural selection. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p344.]
- But while his special theory has been confirmed, its general application, the grand claim (...) remains as unsubstantiated as it was one hundred and twenty

years ago. The very success of the Darwinian model at a micro-evolutionary level, and particularly the mode of its success - by rigorous empirical documentation of actual evolutionary events and thoroughly worked out models showing precisely how the process of speciation and microevolution occurs - only serves to highlight its failure at a macro-evolutionary level. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p344, 345 .]

- Neither of the two fundamental axioms of Darwin's macro-evolutionary theory - the concept of the continuity of nature, that is the idea of a functional continuum of all life forms linking all species together and ultimately leading back to a primeval cell, and the belief that all the adaptive design of life has resulted from a blind random process - have been validated by one single empirical discovery or scientific advance since 1859. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p345.]
- One hundred and twenty years ago it was possible for a sceptic to be forgiving, to give Darwinism the benefit of the doubt and to allow that perhaps future discoveries would eventually fill in the blanks that were so apparent in 1859. Such a position is far less tenable today. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p345.]
- There are only two ways to justify the idea of chance as the author of biological design: to calculate the probability of the discovery by chance of functional organic systems, or to test the creative efficiency of random searches in systems which are in every way analogous to living organisms. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p347.]
- To the sceptic, the proposition that the genetic programmes of higher organisms, consisting of something close to a thousand million bits of information, equivalent to the sequence of letters in a small library of one thousand volumes, containing in encoded form countless thousands of intricate algorithms controlling, specifying and ordering the growth and development of billions and billions of cells into the form of a complex organism, were composed by a purely random process is simply an affront to reason. But to the Darwinist the idea is accepted without a ripple of doubt - the paradigm takes precedence! [Michael Denton: *Evolution, A Theory in*

Crisis, Adler & Adler Publishers 1986, p351.]

- The anti-evolutionary thesis argued in this book, the idea that life might be fundamentally a discontinuous phenomenon, runs counter to the whole thrust of modern biological thought. The infusion with the spirit of continuity has been so prolonged and so deeply imbibed that for most biologists it has become quite literally inconceivable that life might not be a continuous phenomenon. Like the centrality of the Earth in medieval astronomy, the principle of continuity has come to be considered by most biologists as a necessary law of nature. It is unthinkable that it might not hold. To question it is an offence to all our basic intuitions about the nature of biological reality. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p353.]
- In fact, of course, the principle of continuity, however much it may appear an unbreakable axiom, is not a necessary law of nature. The axiom has never been proved and there is nothing in all the realm of biology, nor in the more fundamental realm of physics, which calls for the continuity of life on earth to be a necessary law of nature. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p353.]
- There is still a possibility that living systems could possess some novel, unknown property or characteristic which might conceivably have played a role in evolution. Who would have believed until a few years ago that migrating birds can sense the magnetic field of the Earth? We still have no idea how this is done, nor has anyone any idea which cells in the bird are responsive to those forces. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p355.]
- Whatever view we wish to take of the current status of Darwinian theory, whatever the reasons might be for its undoubted appeal, whether we wish to view it as being in a classic state of crisis as described by Kuhn, there can be no doubt that after a century of intensive effort biologists have failed to validate it in any significant sense. The fact remains that nature has not been reduced to the continuum that the Darwinian model demands, nor has the credibility of chance as the creative agency of life been secured. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p357.]

- The entire scientific ethos and philosophy of modern western man is based to a large extent upon the central claim of Darwinian theory that humanity was not born by the creative intentions of a deity but by a completely mindless trial and error selection of random molecular patterns. The cultural importance of evolution theory is therefore immeasurable, forming as it does the centerpiece, the crowning achievement, of the naturalistic view of the world, the final triumph of the secular thesis which since the end of the middle ages has displaced the old naive cosmology of Genesis from the western mind. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p357, 358.]
- The twentieth century would be incomprehensible without the Darwinian revolution. The social and political currents which have swept the world in the past eighty years would have been impossible without its intellectual sanction. It is ironic to recall that it was the increasingly secular outlook in the nineteenth century which initially eased the way for the acceptance of evolution, while today it is perhaps the Darwinian view of nature more than any other that is responsible for the agnostic and sceptical outlook of the twentieth century. What was once a deduction from materialism has today become its foundation. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p358.]
- The influence of evolutionary theory on fields far removed from biology is one of the most spectacular examples in history of how a highly speculative idea for which there is no really hard scientific evidence can come to fashion the thinking of a whole society and dominate the outlook of an age. Considering its historic significance and the social and moral transformation it caused in western thought, one might have hoped that Darwinian theory was capable of a complete, comprehensive and entirely plausible explanation for all biological phenomena from the origin of life on through all its diverse manifestations up to, and including, the intellect of man. That it is neither fully plausible, nor comprehensive, is deeply troubling. One might have expected that a theory of such cardinal importance, a theory that literally changed the world, would have been something more than metaphysics, something more than a myth. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p358.]

- Ultimately the Darwinian theory of evolution is no more nor less than the great cosmogenic myth of the twentieth century. Like the Genesis based cosmology which it replaced, and like the creation myths of ancient man, it satisfies the same deep psychological need for an all embracing explanation for the origin of the world which has motivated all the cosmogenic myth makers of the past, from the shamans of primitive peoples to the ideologues of the medieval church. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p358.]
- The truth is that despite the prestige of evolutionary theory and the tremendous intellectual effort directed towards reducing living systems to the confines of Darwinian thought, nature refuses to be imprisoned. In the final analysis we still know very little about how new forms of life arise. The "mystery of mysteries" - the origin of new beings on earth - is still largely as enigmatic as when Darwin set sail on the Beagle. [Michael Denton: *Evolution, A Theory in Crisis*, Adler & Adler Publishers 1986, p358, 359.]

الحمد لله الذي بنعمته تتم الصالحات