Human Nature after Darwin

a philosophical introduction

janet radcliffe-richards

HUMAN NATURE AFTER DARWIN

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Human Nature after Darwin: A Philosophical Introduction is an original investigation of the implications of Darwinism for our understanding of ourselves and our situation. It casts new light on current Darwinian controversies, and in doing so provides an introduction to philosophical reasoning and a range of philosophical problems.

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HUMAN NATURE AFTER DARWIN

A philosophical introduction

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Introduction

One of the charms of coming with a Darwinian eye to the study of organisms is recognizing the mixture they display of astonishing adaptive sophistication and botched improvisation. For a long time one of the most persuasive arguments for the existence of God was the so-called Argument from Design: the idea that the finely tuned structures of organisms simply could not have come into existence by chance, and must therefore be evidence for the existence of an unimaginably powerful and intelligent creator. Once Darwin's theory of evolution by natural selection had proposed a mechanism by which such structures might result from purely natural and unplanned processes, what increasingly impressed biologists was the extent to which organisms turned out – despite being miracles of coordination and functioning – to be riddled with absurdities that no self-respecting designer would have allowed as far as the drawing board. Darwinian evolution does not work by planning from scratch with some end in view. The organisms produced by natural selection are merely the ones that happen to keep reproducing in the environments where they happen to be, and selection has nothing to work on but chance variations in structures that have previously been selected, often for quite different purposes. The result is that organisms carry with them fossils of their design history – which is why there has been so much success in tracing that history.

This fact provides a rather pleasing coincidence between this book and the Darwinian organisms that are its starting point. This is not, I hasten to say, in its being unplanned or the kind of thing any self-respecting designer would disown (an analogy need not work on all fronts), but in being rather different from what it would have been if it had been planned from scratch as an argument for its main thesis. And it is worth mentioning this because, as again Darwinians know very well, what looks odd or inexplicable if you approach it with one set of presuppositions may not only make perfect sense if you start from a different point, but also reveal elements that might otherwise have been invisible.

The book is, as its title implies, a contribution to the current Darwinian debate, whose main focus is the implications of the Darwinian revolution for our understanding of what we are and where we fit into the scheme of things. Everybody knows, because it is part of the legend, that Darwin's theory came as a horrible shock to the respectable Victorians on whom it was let loose, because this radically new account of their origins was so totally at odds with their own self-image. Everybody also knows – if only because of the recurring headlines about American schools that try to banish evolution from the curriculum, or insist that it is taught as 'only a theory' along with 'creation science' – that there are places where this horror is still felt, and where the Darwinian account of human origins is as strenuously resisted as ever. But it may be less clear, because there is such confusion in the public debate, that even where evolutionary theory is not resisted in its entirety, a modified version of the same controversy still continues. Many people who are by now resigned to the idea of our biological relationship with apes and fruit flies, and even yeast, are nevertheless alarmed by the way Darwinism seems increasingly to be getting ideas above its station, and encroaching on territory that at first looked as though it could be kept sacrosanct. Darwinian thinking is seeping through the intellectual landscape; and there is a general anxiety that the further it penetrates, the more we lose in the way of traditional ideas about the kind of thing we are or can hope to achieve. This anxiety about ourselves and our situation seems still to be, just as it always was, a large part of the reason why the battles over Darwinism are so fierce.

This book is about the extent to which these fears are justified, and it deals with topics that are familiar subjects of anxiety: free will and responsibility, the possibilities for change and improvement, ethics, altruism, and personal and political ideals and aspirations. It approaches the matter, however, not by joining in the battles about the extent to which our origins and nature can be understood in Darwinian terms, but by taking on the more fundamental – and relatively neglected – question of how much is really at stake in these battles. Its purpose is to work out the extent to which the more radical forms of Darwinism really do have the alarming implications they are alleged to have. Different problems appear in different places, but the overall conclusion is that for a variety of reasons – many connected with an insufficient appreciation of how radical Darwinian thinking is, and a failure to recognize philosophical problems for what they are – much less turns on the outcome of the battles than often seems to be assumed.

However – to return to the matter of design history – although the main purpose of the book is to investigate the implications of different degrees of Darwinian thinking, it started life with that as only its secondary purpose. It was originally written as part of an Open University course – *Philosophy and the Human Situation* – which was intended primarily to teach philosophy, and philosophical techniques, at an introductory level. Darwinism was chosen as the subject of this book partly for its intrinsic interest and its appropriateness for the course as a whole, but largely because it raised a wide range of relevant philosophical problems. A good deal of the original chalk has been dusted off this version of the book, but there is still no mistaking its origins as a teaching text. The design fossils, once you recognize them for what they are, are apparent everywhere, to the extent that the book is as much a Darwinian introduction to philosophical analysis as a philosophical analysis of problems raised by Darwinism.

I am not, however, intending this as an apology. For one thing, the fact that so much of the original teaching material remains means that the book can still be used as an introduction to philosophy by anyone who likes the idea of approaching the subject by way of this flourishing area of modern science and controversy. But also, and of direct relevance to the book as a contribution to current Darwinian debate, it probably does the job of explaining and defending its substantive thesis better in this form than it could otherwise have done. Much of the smoke of the Darwin wars is generated by widespread unfamiliarity with fairly basic techniques of philosophical argument and analysis, and making them explicit is just what is needed for clearing the air. This direction of approach, furthermore, also turns out to have given the book what amounts to a secondary thesis – a methodological one running in parallel with the substantial case – because the attempt to devise teaching techniques turned out (as it so often does) to be immensely helpful for getting to grips with the issues themselves. There were several points at which an obdurately amorphous tangle of problems actually began to cooperate when I tried to keep to the order of analysis and argument construction I had been trying to work out for students; and I think a good deal more progress could be made by means of this approach, given time, even with the subjects dealt with here. The detailed setting out of arguments also has the advantage of allowing anyone who disagrees with the conclusions reached – as many inevitably will, in an area as controversial as this – to be able to see exactly which part of the supporting argument they need to challenge.

All in all, it is difficult to know whether to count the book as a substantive thesis about the implications of Darwinism with a subsidiary methodological thesis, or a philosophical introduction to Darwinism, or a Darwinian introduction to philosophy. Still, that should not bother anyone except pre-Darwinians who are uncomfortable with anomalous forms that cannot be readily classified as existing species (though I wish this category did not include the proprietors of certain large bookshops who insist that any book can be classified under only one subject heading). It is all of those things, and readers with different interests can adjust their dosage of the different elements accordingly. If you know the biology, you will immediately recognize the sections you do not need to read; if you want the overall thesis without too much introductory philosophy, you will quickly see which explanations of techniques and discussions of texts can be skimmed or omitted. And, conversely, if you do want the book as an introduction to philosophy and its techniques, you will find that in many places the arguments are accumulated in ways that make the text easy to treat as a workbook, in which you pause to work out the next stage of the argument before reading on.

Anyway, I hope that for everyone who is – or is ripe for becoming – enchanted by the Darwinian view of life, or by philosophy, or ideally both, its being of no clear species will not matter. It can be counted as one of those Hopeful Monsters, setting out to find, in this vast and expanding subject, its own ecological niche. That, too, sounds appropriately Darwinian.

1 The theory

To understand the implications of the Darwinian revolution, it is necessary to understand the world view it replaced. This chapter provides a brief introduction to Darwin's theory of evolution by natural selection by presenting it as a successor to the scientific revolution of the sixteenth and seventeenth centuries, and as having the potential to complete the overthrow of the traditional ways of thinking that the earlier revolution had begun.

In particular, it distinguishes between teleological and non-teleological explanation, and shows Darwin's theory as relying on non-teleological explanation in contexts where teleological explanation had previously seemed essential.

The first scientific revolution

When *The Origin of Species* was published in 1859, it not only offered a radically different account of animal origins from anything there had been before, but also carried the unmistakable implication that most traditional beliefs about our own nature and our destiny would need equally radical reconsideration. The zoologist G. G. Simpson, writing in 1966, said that all attempts to answer questions about the nature of human beings and the meaning of life before 1859 had been worthless, and that we should be better off if we ignored them completely (Simpson (1966)).

This book is about the implications of the Darwinian revolution for our understanding of ourselves and our situation, and in particular about the extent to which it demands changes in traditional ideas about the kind of thing we are. But to understand the extent of any such changes it is necessary to know what they are changes from; and since many of the most deeply rooted ideas of human nature are of ancient origin, it will be useful to go back not just to the world into which *The Origin of Species* exploded, but further still, to the time before the first scientific revolution of the sixteenth and seventeenth centuries, and consider how the world seemed to Western people then.

This will also be useful for another reason. The scientific revolution that began in 1543 with the publication of Copernicus's idea that the earth was a planet in orbit around the sun, and reached its watershed with the publication of Newton's *Principia* in 1687, is now far enough in the past to allow us to see clearly what kind of change it involved and how much difference it made to people's understanding of themselves and their position. Since we are still in the thick of the Darwinian revolution the situation is much less clear, and the earlier revolution will provide some useful illustrations and analogies.

So, bearing in mind that this can be nothing more than the sketchiest of sketches, start by considering the situation before Copernicus (1473–1543), Galileo (1564–1642) and Newton (1643–1727).

Until this time, by far the most powerful and unified theory of the universe was that of Aristotle (384–322 BC). He thought of the cosmos as a series of concentric spheres, with the earth – itself spherical – at the centre. Enclosing the earth was a series of rotating solid, transparent ('crystalline') spheres which carried the sun, the moon, the planets and the fixed stars in their orbits, and, beyond them, the Empyreum, which enclosed them all.

These concentric layers differed in substance and nature, and there was, in particular, a radical difference between the heavens and the earth. The earth with its immediate surroundings – everything 'sublunary', below the moon – was made of the four earthly elements of earth, water, air and fire. Each of these had its own distinctive characteristics, and also its own natural position in the scheme of things, towards which it would move unless forcibly prevented and where it would remain until moved by external forces. Earth's natural position was at the centre of the universe, followed by a layer of water, then air, and then, just below the moon, fire. This was why stones fell and flames rose: they were trying to get back to their natural positions. The sublunary elements were, however, mixed together and kept in a perpetual state of turmoil by the power of the heavens, and things made of them were subject to generation, corruption and decay as the various elements came together and separated.

The heavens – the crystalline spheres, and the heavenly bodies they carried – were quite different. They were composed of a fifth element – the 'quintessence' – and because they were pure, rather than composed of separate elements that could mix and scatter, they were not corruptible. The only change they were capable of was that of position, and their natural motion was not up or down, but circular – constant and unending. They were also more powerful than anything in the sublunary sphere, with strong influences over the earth and everything on it. Then, finally, beyond the heavens, there lay the Empyreum. This was the purest and most powerful region of all, and unsusceptible to change of any kind.

Aristotle's universe became the basis of most intellectual ideas about cosmology after its reintroduction to the West through the Muslim world in the twelfth century, and it remained so until the scientific revolution of the seventeenth, for reasons that are not difficult to understand.

The first of these was that most of its foundations were intuitively plausible. If you think about the way things would seem to someone with no modern understanding of science, standing on the surface of the earth and watching what was going on around, you can easily see how this general view of things accorded with observation. The heavenly bodies do appear to move in circles round the earth; earth and water do appear to move naturally downwards unless prevented, and fire and air to move upwards. The heavens do seem far more powerful than the earth, and the main influence on what happens: people have always been at the mercy of climate and weather. Winds can devastate the land and churn up the seas; too much sun will burn you and shrivel your crops, too little will leave you and your plants to freeze. The only part of the scheme that does not look immediately plausible is the idea of a spherical earth, but this had also been recognized as in accordance with observation before the time of Aristotle. The curved shadow of the earth during lunar eclipses, the disappearance of ships over the horizon, and the extending of the horizon with altitude, were well-known phenomena.

Second, Aristotle fitted the elements of his scheme together into an impressive intellectual whole. The basis of the idea that the earth was a sphere at the centre of the universe, for instance, was not just that it was known to be spherical, and that everything else seemed to go round it; it also fitted the idea that the elements of which it was principally made – earth and water – naturally moved downwards unless positively prevented. This meant that matter would inevitably accumulate in the centre of the universe: if parts became separated from the centre, they would try to find their way back again. There could, therefore, be only one earth, and that must take the form of a sphere in the centre of things.

Of course the scheme was by no means complete or flawless, and the eventual development of modern science came about through persistent and determined attempts to deal with the many anomalies that appeared. The planets, for instance, always presented a problem, since they did not move in smooth circles ('planet' comes from the Greek for 'wanderer'): they kept interrupting their progress round the earth with little backward movements known as retrogressions. But no other scheme offered anything like such a systematic account of observation, and the Aristotelian cosmology became even more established when it was systematized further in the second century AD by the Greek astronomer Ptolemy, in his *Almagest*. The Ptolemaic system explained the retrograde movements of the planets without giving up the fundamental Aristotelian idea that it was the nature of heavenly bodies to move in circles. This involved a good deal of contrivance, with complicated sets of epicycles (circles revolving round moving points on the circumferences of other circles) and various other *ad hoc* devices for 'saving the appearances' (making the theory fit the observations); but the system gave good predictions of the positions of the planets into the indefinite future, and its success helped to entrench the Aristotelian view of the cosmos.

Finally, the basic Aristotelian idea became further entrenched – most strikingly in the work of Dante – by an overlay of Christian theology which integrated the universe of concentric spheres with a theological and moral order. Hell – Dante's inferno – was literally underground, at the centre of the universe, with Dante's nine circles of Hell reflecting deeper and deeper turpitude. Above the earth rose the spheres of the heavens of increasing power and purity, kept in their motions by 'intelligences', and the nine orders of angels. And finally, beyond them all, lay the throne of God in the unchanging Empyreum. Mankind was in the middle of this scheme of things: the only being that combined heavenly and earthly natures. Human beings consisted of immaterial souls, whose substance was that of the heavens, and material bodies that were animated by those souls. The souls were striving to reach their natural position among other heavenly things; their earthly bodies were bent on pulling them downwards, to

Hell. The cosmology both reflected and entrenched the Christian rejection of the material, and its conception of the bodily as sinful. It is one of the most striking ways in which these traditional ideas still linger.

This is only an impressionistic sketch, of course; and although it is useful in giving a sense of how the universe was regarded before the scientific revolution, and why it seemed so generally plausible, it must not be mistaken for a scheme that was uniform in detail, or accepted by everyone without much question. Most educated people took the fundamentals for granted, but everyone who considered the details was aware of problems. The crystalline spheres, for instance, raised problems both mechanical and theological. They needed to be solid, if they were to fulfil their purpose of pushing the planets around. But then how could the epicycles work? How could the planets move through the solid crystal? Similar problems arose for ascensions, which were the literal taking up of earthly bodies into the heavens. There were also persistent discrepancies between the geometrical models devised by astronomers and the observed motions of the heavenly bodies. The *ad hoc* contrivances for saving the appearances gradually proliferated into mechanisms of baroque complexity, in which epicycles were added to epicycles and joined by a menagerie of devices with names like 'equants' and 'hippopedes', in a never-quite-succeeding attempt to make the elements fit together. By the time of Copernicus, astronomy was widely recognized as being in a scandalous state; and it was the continuing failure to solve the problems of the Ptolemaic system that eventually led Copernicus to look for a more radical solution, and to suggest that the earth was itself a planet circling the sun.

We tend to think of the Copernican revolution as though it was Copernicus himself who gave us our present view of the solar system; and of course that is to some extent true. But Copernicus's original proposal, although obviously radical in one way, was still conservative in most others. Like his contemporaries, Copernicus still accepted as background much of the Aristotelian system. He still took it for granted that the motions of the heavenly bodies must be explained in terms of perfect circles and crystalline spheres, and by the time his scheme had been worked out in detail his arrangement of circles turned out to be about as convoluted with epicycles as the system he was trying to replace. He also still accepted Aristotle's ideas of mechanics, according to which things remained in their natural places unless there was a positive force moving them, and against this background the idea of a moving earth seemed simply incredible. If the earth was hurtling round the sun at high speed, why was there not a ferocious gale all the time? Why did loose objects not fly off into space? What force could possibly keep the earth moving? Some people were quickly persuaded by Copernicus's scheme, but those who resisted, or treated it simply as a geometrical device, had good reason to be sceptical.

What changed things was the revolution in mechanics that came first with Galileo – who also was the first person to use a telescope for astronomy and discover changes and imperfections in the perfect and unchanging heavens – and finally with the work of 'the incomparable Mr Newton' (as Locke called him).

The Aristotelian theory of distinct elements, each with its own natural motion and its own proper place in the universe, was replaced by Newton's theory of universal gravitation, which regarded matter as the same kind of thing throughout the universe; and Newton's laws of motion – according to which things remained at rest or continued in a straight line unless acted on by other forces – replaced the Aristotelian idea that force was needed to keep things moving. This removed the idea that it was the nature of the heavenly bodies to move in circles: the planets would (as it were) move in straight lines if they could, but were pulled into ellipses by the gravitational attraction of the sun. It also removed the need for a force to keep the earth moving, and accounted for our not being able to perceive its movements. The anomalies vanished, and the Copernican scheme – shorn of its encrustation of epicycles and unconstrained by requirements for circular motion – fell triumphantly into place.

All this was bound to make a considerable difference to people's understanding of their place in the universe, though this did not take quite the form that is commonly believed. It is often said that when the Copernican revolution began to unfold, making the earth only one planet among others, part of the reason for people's resistance was their losing a place of special privilege at the centre of things. But this mistakes the point. The earth was indeed at the centre of the Aristotelian universe, but human beings themselves were not; they were on the surface of the earth, which was some distance from the centre. And anyway, the Aristotelian view was that everything became *less* worthy, and less good, and less in every way, towards the centre – the lowest circle of Dante's Hell was utterly frozen and immobile – so there was nothing cosmically impressive about being in the middle. The good, powerful, important things were (as our traditional thinking leaves no doubt) above. The real change came in the disappearance of the orderly, layered, cosmos, in which everything had its proper place, and in which the moral and theological order corresponded with the physical. With the Newtonian revolution the universe suddenly became infinite, and therefore without any centre at all – not even the sun. And, most important of all, the laws of nature became in this conception the same throughout the universe. The earth was the same sort of thing as the heavenly bodies, and not radically different in kind. Newton had broken down the distinction between the heavens and the earth.

This change in conception is, incidentally, particularly strikingly shown in the rapid and complete abandonment of astrology by astronomers. Astrology had been a respectable (though not very successful) science for most of the history of astronomy, and most astronomers had also been astrologers; belief in astrology had, indeed, provided much of the original motivation for the study of astronomy. Since the heavens were quite reasonably thought to be very different in kind from the earth and to have powerful effects on it, and since the seasons do change with the movement of planets across the background of the fixed stars, it was plausible to try to find connections between what went on in the heavens and what happened on earth – just as it was plausible to wonder about the significance of comets and (what we now know as) supernovae. It was natural, therefore, that enquiring people should take to watching the planets closely, with a view to predicting their movements and influences. But the whole basis of astrology had been the idea of a radical difference in kind and in power between the heavens and the earth; and if the earth is just one planet among the others, the heavens have no more influence on it than it has on them. There is no reason to think of celestial happenings as having any particular significance for events on earth, and certainly not of the kind that formed the basis of astrology. All the reasons for thinking astrology plausible had vanished.

So the change brought about by Copernicus and Newton was indeed a revolution, and obviously made a considerable difference to people's conception of their place in the scheme of things. Spinning around in an infinite universe is decidedly less comfortable than being enclosed by spheres and angels and God; and if you disrupt the physics of a universe that also incorporates the moral and religious order, you are bound to cause some anxiety. Where, if there was no Empyreum, was the throne of God? Where was Hell? What if there were other inhabited planets in the universe; had it been necessary for them to have incarnations and salvations as well? If the Bible was not literally true in its account of heaven and earth, what did that imply for the rest of it? Obviously religious scepticism – which had always existed – found itself newly fuelled.

On the other hand, although the view of the world had radically and irrevocably changed, there was still a sense in which, from the point of view of people's understanding of their own nature, all this could be seen as detail. Although the earth and heavens had been pulled together into a single scheme, and so could no longer be seen as characterizing the two essential aspects of human beings, this did not as such threaten the traditional distinction between the material and the spiritual. The idea of an immaterial soul put into human bodies by God, and of human distinctness from animals, who had no soul (or at least, only 'souls of sense', not rational souls), could still be kept intact. And although the advance of science led more and more to the study of the human body as a kind of machine, that in itself did not raise any direct problems. The body had always been thought of as material.

Furthermore, in spite of problems about the location of God now that there was no Empyreum, the change did not seem to most people to make the slightest dent in the idea of God as creator and sustainer of the universe. It was still regarded as obvious that intelligence must lie at the root of things. Inanimate matter could not possibly fill that position, since matter could only transmit, not initiate, motion and change, and had no intelligence at all – let alone the amazing intelligence that seemed necessary for the complexity of design manifested in all aspects of the world, and for the creation of minds. For the world to be as it was, it still seemed essential to have mind, will and intention at its foundation.

This again is something that looks intuitively obvious from everyday experience. Here is John Locke (1632–1704) – who was himself in the thick of the scientific revolution, and caught up in its excitement – on the subject of what seemed obvious to everyone at the time, and probably still does to many people:

> If, then, there must be something eternal, let us see what sort of Being it must be. And to that it is very obvious to Reason, that it must necessarily be a cogitative Being. For it is as impossible to conceive that ever bare incogitative Matter should produce a thinking intelligent Being, as that nothing should of itself produce Matter.
>
> (Locke (1964 edn), p. 221)

This passage is quoted by Daniel Dennett in *Darwin's Dangerous Idea* (Dennett (1995), p. 26), as exemplifying what he calls the 'Mind First' view: the idea that intelligence must lie at the root of everything. A cogitative being is a thinking being: a being that has, or perhaps is, mind. Locke regards it as simply inconceivable that mind should emerge from 'bare, incogitative Matter'. This is a deeply rooted idea, and there was nothing in the Newtonian revolution to undermine it.

So although the first scientific revolution broke down the geographical distinction between the heavens and the earth, it still left unaffected the traditional belief that mind and matter were two distinct substances, and that it was mind that had the real power. The change called for greater sophistication in the interpretation of religious doctrine, but not for the abandonment of any essentials. God, as pure mind, or spirit, could still be seen as the creator and sustainer of the material universe, even though not occupying the heavens in the literal way that had been believed. And even though human beings could not be understood as combining heavenly and earthly substance in quite the way that had been thought in the pre-Newtonian era, they could still be regarded as of dual nature, with the spiritual aspect more powerful, and more worthy, than the material. The soul could still be thought of as giving us the capacities that distinguished us from 'bare incogitative matter'. The duty of people could still be understood as pressing the spiritual side of their nature towards God, even though no longer in the literal sense of trying to rise upwards.

So although the Newtonian revolution undermined many traditional ideas about people and their place in the universe, the most deeply rooted elements remained unaffected.

Exercise 1.1

1. Aristarchus of Samos, in the fifth century BC, had put forward the theory that the earth was a planet circling the sun. This was one of many early ideas about the nature of the cosmos, and indeed it was Copernicus's study of ancient ideas about the universe that led to his own proposal. On the basis of what has been said in this section, why do you think its truth was not accepted until more than two thousand years later?
2. Even Newton practised astrology early in his life. Why, on the basis of the account given, did scientists abandon it later?
3. To what extent did the Newtonian revolution leave intact the previous view of human nature?

(Answers on p. 273)

The Darwinian revolution

This is a useful vantage point from which to approach the Darwinian revolution, because the best way of understanding its significance is in terms of its apparent potential for completing the synthesizing process. Newton had broken down the distinction between the heavens and the earth, and brought them into a single explanatory scheme. Darwin's theory of evolution by natural selection has seemed to many people to hold out the threat (or promise) of breaking down the other distinction, and showing that it is, after all, possible for the workings of 'bare incogitative matter' to lie at the root of all complexity and consciousness, and for traditional dualism (the idea that there are two distinct substances, spirit and matter) to be replaced with monism (the idea that there is only one). Monism comes in two main forms: it may regard spirit as fundamental (as did the philosopher George Berkeley (1685–1753)), and see matter as explainable in terms of spirit, or it may regard matter as fundamental, and try to explain mind and consciousness in terms of matter. The Darwinian threat was to make plausible the idea of material monism, or materialism,[1] and in doing so to cast doubt on the Mind First view of the world. And if this threat could be fulfilled, its implications for our understanding of ourselves and our situation would presumably be far more radical than those of the Copernican/Newtonian revolution had been.

I say that the Darwinian revolution held out the *threat* of providing a justification for materialism, because from the point of view of a historical account it is important to realize how far some of Darwin's successors have moved from Darwin's own (at least published) position, and also how controversial some of these extensions and developments still are. We are still in the middle of the Darwinian revolution, arguing about how much of a revolution it really is and what its significance is. To understand this threat, and be in a position to reach some judgement about whether or not it can be fulfilled, it is necessary to see what the Darwinian theory is.

The next three sections try to explain this. The first gives an outline of the theory, the second explains what was significant about it, and the third shows why some people think it has the potential to complete the Newtonian synthesis and bring mind and matter together in a single explanatory scheme.

Natural selection

Everyone knows that Darwin's theory was about evolution. Ideas of evolution, however, go back to the ancient world, and cropped up many times, and in many forms, before Darwin. They were certainly current in Darwin's own time. Several other people – including Darwin's grandfather, Erasmus Darwin – were interested in the possibility of evolution, and the idea became more and more plausible with the advance of geology. Geological exploration was not only revealing large numbers of fossils, but also showing that particular kinds of fossil appeared in particular strata, and that the simpler forms appeared in the older rocks. It was beginning to seem likely that life forms had originally been simple and had gradually become more complex, rather than that all had been brought into existence at once, and also that the earth was very much older than had traditionally been thought. And, of course, this accumulating evidence was also beginning to undermine confidence in the biblical account of things, and open the way for the development of alternatives.

So the ideas were there; but there was a considerable stumbling block in the fact that nobody had any real idea of how evolution could possibly have worked. The situation just before Darwin was rather like the situation when Copernicus put forward the idea of an earth that moved round the sun. Even though Copernicus's idea did offer a solution to many astronomical puzzles, it was difficult for most people to take seriously because the earth showed no signs of movement, and there seemed to be no force to make it move or keep it moving. The early ideas of evolution had foundered in the same way as the early ideas of a heliocentric universe: they offered solutions to serious problems, but there seemed to be no real evidence for them, and a good deal against. But change came about in the same kind of way in both cases. Investigation revealed more and more problems in the traditional ways of thinking, which in turn led to attempts to generate new ones. And then, as with so many scientific advances, the real breakthrough came not in the idea itself – of evolution or a heliocentric system – but in the idea for a mechanism that would make it possible. The early evolutionists were like the astronomers who thought that Copernicus's account of the universe was interesting and promising, but could not see how to overcome the objections raised by Aristotelian mechanics. Darwin was like Newton, in proposing a mechanism that made the idea seem feasible.

The idea was in its essentials very simple, as revolutionary ideas often are. It was of evolution by natural selection. Here is Dennett's account of the matter.

> The idea of natural selection was not itself a miraculously novel creation of Darwin's but, rather, the offspring of earlier ideas that had been vigorously discussed for years and even generations … Chief among these parent ideas was an insight Darwin gained from reflection on the 1798 *Essay on the Principle of Population* by Thomas Malthus, which argued that population explosion and famine were inevitable, given the excess fertility of human beings, unless drastic measures were taken. The grim Malthusian vision of the social and political forces that could act to check human overpopulation may have strongly flavoured Darwin's thinking … but the idea Darwin needed from Malthus is purely logical. It has nothing at all to do with political ideology, and can be expressed in very abstract and general terms.
>
> Suppose a world in which organisms have many offspring. Since the offspring themselves will have many offspring, the population will grow and grow ('geometrically') until inevitably, sooner or later – surprisingly soon, in fact – it must grow too large for the available resources (of food, of space, of whatever the organisms need to survive long enough to reproduce). At that point, whenever it happens, not all organisms will have offspring. Many will die childless. It was Malthus who pointed out the mathematical inevitability of such a crunch in any

population of long-term reproducers – people, animals, plants (or, for that matter, Martian clone-machines, not that such fanciful possibilities were discussed by Malthus). Those populations that reproduce at less than the replacement rate are headed for extinction unless they reverse the trend. Populations that maintain a stable population over long periods of time will do so by settling on a rate of overproduction of offspring that is balanced by the vicissitudes encountered. This is obvious, perhaps, for houseflies and other prodigious breeders, but Darwin drove the point home with a calculation of his own: 'The elephant is reckoned to be the slowest breeder of all known animals, and I have taken some pains to estimate its probable minimum rate of natural increase … at the end of the fifth century there would be alive fifteen million elephants, descended from the first pair' [Darwin (1859), p. 64]. Since elephants have been around for millions of years, we can be sure that only a fraction of the elephants born in any period have progeny of their own.

So the normal state of affairs for any sort of reproducers is one in which more offspring are produced in any one generation than will in turn reproduce in the next. In other words, it is almost always crunch time. At such a crunch, which prospective parents will 'win'? Will it be a fair lottery, in which every organism has an equal chance of being among the few that reproduce? In a political context, this is where invidious themes enter, about power, privilege, injustice, treachery, class warfare, and the like, but we can elevate the observation from its political birthplace and consider in the abstract, as Darwin did, what would – must – happen in nature. Darwin added two further logical points to the insight he had found in Malthus: the first was that at crunch time, if there was significant variation among the contestants, then any advantages enjoyed by any of the contestants would inevitably bias the sample that reproduced. However tiny the advantage in question, if it was actually an advantage (and thus not absolutely invisible to nature), it would tip the scales in favour of those who held it. The second was that if there was a 'strong principle of inheritance' – if offspring tended to be more like their parents than like their parents' contemporaries – the biases created by advantages, however small, would become amplified over time, creating trends that could grow indefinitely. 'More individuals are born than can possibly survive. A grain in the balance will determine which individual shall live and which shall die, which variety or species shall increase in number, and which shall decrease, or finally become extinct' [ibid., p. 467].

What Darwin saw was that if one merely supposed these few general conditions to apply at crunch time – conditions for which he could supply ample evidence – the resulting process would necessarily lead in the direction of individuals in future generations who tended to be better equipped to deal with the problems of resource limitation that had been faced by the individuals of their parents' generation. This fundamental idea – Darwin's dangerous idea, the idea that generates so much insight, turmoil, confusion, anxiety – is thus actually quite simple. Darwin summarizes it in two long sentences at the end of chapter 4 of *Origin*:

> If during the long course of ages and under varying conditions of life, organic beings vary at all in the several parts of their organization, and I think this

> cannot be disputed; if there be, owing to the high geometric powers of increase of each species, at some age, season, or year, a severe struggle for life, and this certainly cannot be disputed; then, considering the infinite complexity of the relations of all organic beings to each other and to their conditions of existence, causing an infinite diversity in structure, constitution, and habits, to be advantageous to them, I think it would be a most extraordinary fact if no variation ever had occurred useful to each being's own welfare, in the same way as so many variations have occurred useful to man. But if variations useful to any organic being do occur, assuredly individuals thus characterized will have the best chance of being preserved in the struggle for life; and from the strong principle of inheritance they will tend to produce offspring similarly characterized. This principle of preservation, I have called, for the sake of brevity, Natural Selection.
>
> [Ibid., p. 127]
>
> This was Darwin's great idea, not the idea of evolution, but the idea of evolution by natural selection, an idea he himself could never formulate with sufficient rigour and detail to prove, though he presented a brilliant case for it.
>
> (Dennett (1995), pp. 40–2)

Here is a more succinct account of the same idea, from Stephen Jay Gould:

> 1 All organisms tend to produce more offspring than can possibly survive (Darwin's generation gave this principle the lovely name of 'superfecundity').
>
> 2 Offspring vary among themselves, and are not carbon copies of an immutable type.
>
> 3 At least some of this variation is passed down by inheritance to future generations. (Darwin did not know the mechanism of heredity, for Mendel's principles did not gain acceptance until early in our century. However, this third fact requires no knowledge of how heredity works, but only an acknowledgement that heredity exists. And its mere existence is undeniable folk wisdom. We know that black folks have black kids; white folks, white kids; tall parents tend to have tall children; and so on.)
>
> The principle of natural selection then emerges as a necessary inference from these facts:
>
> 4 If many offspring must die (for not all can be accommodated in nature's limited ecology), and individuals in all species vary among themselves, then on average (as a statistical statement, and not in every case), survivors will tend to be those individuals with variations that are fortuitously best suited to changing local environments. Since heredity exists, the offspring of survivors will tend to resemble their successful parents. The accumulation of these favourable variants through time will produce evolutionary change.
>
> (Gould (1997), p. 138)

This is the essence of Darwin's theory. Organisms produce more offspring than can survive. Offspring resemble their parents to some extent. If there are even slight differences between the organisms that do and the ones that do not reproduce successfully, the characteristics of the successful will persist while those of others die out. This is how evolutionary change comes about.

The most popular illustration of this idea comes from Darwin's own observations of finches in the Galapagos Islands. (As so often in the history of science, the popular version misrepresents and oversimplifies the historical truth, but since it catches the essential point it will do for this purpose.) Each of the various islands had its own species of finch, differing in various ways, and in particular in beak shape. Darwin's idea was that these finches were all descendants of a single kind of ancestral finch, but that the different environments of the different islands had given advantages to different characteristics in its finch population. If one island had an abundance of insect food, for instance, but relatively few seeds and nuts, finches that happened to be born with fine beaks that could pick out insects from small crevices would do better than birds with large, hard beaks. The fine-beaked birds would succeed in rearing more young than their coarse-beaked relatives, and as the offspring would tend to inherit their parents' characteristics, that beak shape would gradually spread through the finch population of the island. The reverse would happen on islands where there were more seeds than insects, and where the birds whose beaks were better adapted to seed-crushing would flourish. Eventually the separated populations would become too different to interbreed, and would be separate species.

Exercise 1.2

1 What was Malthus's main claim?
2 What was the significance of Darwin's adding to this the observation that organisms varied, and offspring tended to resemble their parents?

(Answers on p. 273)

Cranes and skyhooks

That is the essence of Darwin's theory; but what makes it so potentially radical? What is it about the idea of evolution by natural selection that threatens to break down the distinction between mind and matter, in the way that Newton broke down the distinction between the earth and the heavens?

The question of whether the theory can actually fulfil this potential is a matter of its scope: the question of *how much* can be explained in Darwinian terms. That will be discussed in the next section. But to understand the radical potential of the theory and the significance of questions about scope, it is necessary to consider in more detail the kind of theory it is. And the most important point is that it reverses the traditional order of explanation, by accounting for the higher in terms of the lower, rather than the other way round.

You can get a sense of what this means by thinking of what is often known as the Great Chain of Being. This is the traditional idea of the contents of the world as forming a natural hierarchy, ranging from inanimate matter at the bottom, through plants (which are living organisms), animals (which are sentient as well as living), and human beings (possessed of rationality as well as life and sentience), until finally, at the top, is God, who is pure reason.

This is an idea that began with Aristotle, and is obviously closely connected with the Aristotelian idea of a layered cosmos, where the physical layering reflected to a considerable extent the order of natural merit. The idea was modified and extended in the Christian interpretation, where nine orders of angels continued the chain of increasing perfection from the human soul to God, but it did not change the essential idea that mind, or spirit, was higher than matter, in natural position as well as in power and moral worth. Humans, although on earth like other material beings and partly material themselves, were superior to the others in their possession of a rational soul; other living creatures (according to Aristotle and some, but not all, later thinkers) had lesser kinds of soul. And, in the Christian way of thinking about these things, order in the material world must be explained in terms of the purposes of minds, and ultimately of God. Power worked hierarchically, from higher minds to lower minds and from lower minds to matter. It could not work the other way round.

Once again, as with Aristotle's account of the nature of mechanics and the cosmos, this traditional direction of explanation is the one that accords with common sense and familiar observation. We have experience of inanimate matter, and this experience suggests that there are some things it can do, but many that it cannot. Material objects can interact with each other in a limited, mechanical way: stones can fall and shatter, seas can wash away sand, wind can blow down branches. What emerges from these natural processes, however, is always random, and shows no signs of design. Stones do not naturally shatter into perfect shapes for building, or get swept by rivers into the shapes of palaces or cottages. Matter can transmit motion to other matter, but it can, as it were, only pass on what it has received: it cannot initiate motion from rest, or design itself into complex structures. The only beings capable of doing such things are ones with minds, like us. We can decide to put ourselves into motion without being pushed; we can plan designs and shape inanimate matter into them. You cannot see minds, but you can infer their existence because something is needed to account for the difference between animate and inanimate matter, and the otherwise inexplicable difference between a newly-dead body and a living one. Our own capacity for initiating movement, however, cannot account for the world's having got going in the first place: we are nothing like powerful enough, and anyway the world was here before we were. And, furthermore, we are not capable even of understanding the intricate designs and perfect adaptations of organic nature, let alone of creating them. It seemed obvious, therefore, that all the order of nature must result from the work of something like us in being mind or spirit, but unimaginably greater. There must be a supremely powerful Mind to bring about the marvels of the natural world.

It was this direction of explanation, from the higher to the lower, that

Darwin's idea began to upset. His concern was specifically with organic evolution – evolution from lower to higher organisms – and he did not venture, at least in public, beyond this limited territory. His theory did not extend to the development of life from inanimate matter, and he did not venture directly on to theological ground. But it was startling nevertheless, because he proposed a mechanism by which mindless processes might produce the kind of complexity that had previously seemed explicable only in terms of the intentions and power of what Locke called a cogitative Being. Darwin explained organic complexity as something that just happened over vast periods of time, when simple creatures with no aspirations at all, influenced by nothing but unconscious natural forces, reproduced more of their kind than could survive. Darwin's direction of explanation was from the bottom upwards, rather than from the top downwards. It began to explain the more powerful in terms of the less powerful.

Another way of putting this is that Darwin was offering a *non-teleological* explanation in a context where teleological explanation had always been presumed essential. 'Teleology' comes from the Greek *telos*, meaning 'end', or 'goal', or 'purpose', and teleological explanations are ones that explain what is happening in terms of something to be achieved, rather than in terms of mechanical causes. They pull from in front, rather than pushing from behind. If you say that you moved the car because you wanted to make space for your neighbour, you are giving a teleological explanation, in the sense that is relevant here, because it is in terms of what you are trying to bring about. Your intentions – what you want to achieve – as it were pull the course of events from in front. If you say that your car disappeared from outside your house because its brakes failed and it ran down the hill, you are giving a non-teleological explanation. Your explanation is in terms of existing states of affairs' pushing things into the future.

We tend naturally to think in terms of teleological explanations whenever we encounter complexity and the appearance of design. In our ordinary lives we are always drawing distinctions between things that seem just to have happened without any plan (accidents and coincidences), and things that people have intentionally done or brought about. Unplanned, natural happenings result in disorder (if a pile of rocks falls it remains a pile of rocks); human intentions can bring about order (piling the rocks into specific designs, for boundaries and shelters). When we find in the natural world an appearance of order and design that seems impossible to explain in terms of random configurations of inanimate matter, therefore, it is not surprising that we automatically think in the same terms.

This idea, that whenever there is any complexity or any appearance of design you need conscious intentions to explain it, is the intuitive basis of Dennett's Mind First view (Dennett (1995), pp. 26–8). It accounts for creation stories like the one in Genesis, where elements that were originally confused together in a primeval chaos were separated and made orderly by the power and intentions of God. It also accounts, incidentally, for the familiar allegation that science explains how but never why. The 'why' part is about reason and purpose, and to imply that science is missing something in leaving out this element is to *presuppose* that there must be a purpose at the root of things. What Darwin was proposing, in contrast, was a non-teleological account of how, among organisms, order and complexity could come about without any conscious planning at all.

The way Dennett expresses the difference between Darwinian and traditional explanations is to contrast those that involve only *cranes* (cranes being things that are rooted to the ground but are capable of lifting things above themselves from there), with those that invoke *skyhooks* (things that descend from above to pull up what cannot lift itself) (ibid., pp. 73ff.). What Darwin provided, within the range of organisms, was a wonderfully simple mechanism for bringing the higher out of the lower by means of nothing but cranes.

Dennett's terminology, it must be said, is decidedly tendentious, since 'skyhook' has connotations of illusoriness and pie in the sky, which is no doubt what he intends. Dennett thinks of skyhooks as an ancient mistake, which Darwinism has rightly shown us how to get rid of. Obviously, anyone who believed – or was anxious to believe – in what Dennett calls skyhooks would not use such a derogatory term. Still, the crane/skyhook contrast is so striking, and so effectively catches the essence of the difference between traditional and Darwinian kinds of explanation, that I shall keep to it.

Exercise 1.3

1 What is presupposed by the claim 'Science explains how, but never why', when this is intended as a criticism of science?

2 Which of the following explanations are entirely non-teleological, and which involve teleological elements? (Consider each statement in exactly the form given. In many of these cases it would be easy to rewrite the teleological claim in a non-teleological form, and vice versa.)

(a) She became a vegetarian because she wanted to help to stop the suffering of farm animals.

(b) She became a vegetarian because after a visit to an abattoir meat made her sick.

(c) She became a vegetarian because her brain operation caused a personality change.

(d) He painted the room green because psychologists had shown that it was soothing.

(e) He painted the room green because that was the only colour he had.

(f) She fell off the ladder because the rung broke.

(g) She fell off the ladder because she wanted some time off work.

(h) She fell off the ladder because someone shouted and interrupted her concentration.

(i) She fell off the ladder because someone had deliberately weakened one of the rungs.

(j) Trees in rain forests grow tall because they are struggling to reach the light.

(k) Trees in rain forests grow tall because the top parts get the most light, and this causes their development.
(l) Trees in rain forests grow tall because there are no grazing animals to stunt their growth.

3 (This part of the exercise goes beyond the text. It is intended to give further practice with teleological and non-teleological explanations, and at the same time to illustrate a general point that will be of particular relevance later.)

Different explanations of a phenomenon are often rivals, and cannot both be true. However, this is not necessarily the case. Sometimes different explanations of the same phenomenon are compatible. In the following pairs of explanations, the first is teleological and the second non-teleological. For each pair, say whether the two are compatible or competing explanations.

(a) She fainted because she wanted to cause a diversion.
She fainted because the room was stuffy.
(b) The ladder broke because a workmate had sawn halfway through the rung for revenge.
The ladder broke because he was heavy and the rung had been weakened.
(c) He stole the car because he wanted to impress his latest girlfriend.
He stole the car because he had had a deprived childhood.
(d) She failed the exam because she didn't want to seem cleverer than her friend.
She failed the exam because she wasn't clever enough to pass.
(e) He looked after his elderly mother because he cared about her happiness.
He looked after his elderly mother because he had been brought up to care about other people's happiness.

4 Even Darwinians frequently use teleological forms of explanation as shorthand in contexts where they are well aware that the real Darwinian explanation should be non-teleological. For example:

Teleological shorthand:

> Stoats used to moult and grow a white coat in winter, to be less conspicuous in the snow, and then change back to brown in the spring. Now there isn't so much snow it is safer for them to stay brown all year. That is why ermine is even rarer than it used to be.

Non-teleological Darwinian explanation:

> Stoats that happened to grow a white coat after their autumn moult were less conspicuous in the snow than the ones that stayed brown, and were less easily seen by predators. More of them therefore survived the winter, and produced offspring which also turned white in winter. But as the climate changed and

> winters were no longer snowy, the white stoats were more easily picked off by predators than the brown, and the brown ones became the ones that survived the winter and produced offspring afterwards. This is why white stoats are now rare, and ermine is even rarer than it used to be.

The teleological shorthand is convenient but potentially misleading, because it gives the impression that the stoats, or the designer of the stoats, planned this as a way of making sure that stoats kept going. Darwinian evolution has no plans at all, and it is important to remember what the full Darwinian form should be. Rewrite the following teleological explanations in Darwinian terms. (Do not bother about whether they are correct in detail, or indeed at all; this exercise concerns only the form of the explanation, and not its content.)

(a) The finches on the islands where there were lots of seeds developed strong, blunt beaks to crush them; the ones on the islands where there were more insects needed pointed beaks to get them out of cracks.
(b) The peppered moth used to be light brown, to conceal itself against the trunks of trees. But since industrial pollution has blackened the trees, the moth has changed its colouring to match.
(c) Some flowers mimic insects, to cheat insects into coming to pollinate them.

(Answers on p. 273–4)

Scope and potential

It is common knowledge – almost folklore – that Darwin's theory was horrifying to most of his contemporaries because, like Copernicus's, it presented a direct threat to received religious belief.

In early Victorian Britain most people – at least according to censuses and on Sundays – were Christian; and since their Christianity tended to fundamentalism, most would probably have claimed to believe in the literal truth of the Genesis creation story. According to this account, God had made the world in six days, and created animals as distinct species in (it was taken for granted) their modern forms. And although the Bible did not say anything directly about the age of the earth, Archbishop James Ussher in 1654 had done calculations on the basis of Old Testament genealogies, and his conclusion that the earth was created in 4004 BC – on 23 October – was generally accepted. By the nineteenth century these beliefs were already under threat from the work of geologists who were beginning to have ideas of evolution and of a much older earth. But nobody had any real idea how evolution could have occurred, and fundamentalists resisted the new ideas with explanations of their own – such as that fossils could be the remains of creatures who had died in Noah's Flood, or that there had been a series of creations and annihilations. The reason why Darwin's theory presented a serious threat to fundamentalism was that it made the heretical idea of evolution seem plausible and comprehensible for the first time.

Even so, there was a limit to how serious the theory was (and is) for established religion as a whole, because theology has always been ready to increase its sophistication in response to new problems. It had already coped with the collapse of the Aristotelian universe, and by Darwin's time many theologians were themselves already questioning literal interpretations of the Bible. Not much doctrinal upheaval was needed for a shift to the view (which many people hold now) that God could have arranged animal creation by the method Darwin described, and intended the Genesis account only as a metaphor for the unsophisticated. The idea of animal evolution did not, on its own, affect the fundamental conviction that only spirit could initiate change. It seemed to leave intact the need for God to create the world in the first place, to bring life from inanimate matter, and to make individual human souls.

But although the immediate effects of Darwin's theory were in some ways not all that radical, the fact remains that the intrusion of a theory of this type, with its inversion of the familiar pattern of explanation, was radical in itself, and made a profound difference to ways of thinking. The appearance of design in the animal world – the adaptation of creatures to their surroundings – had always been regarded as part of the evidence for the existence of God. The theory of evolution by natural selection did not in itself remove the apparent necessity for Mind to get life going in the first place – Darwin himself probably thought something of the kind was necessary – but God had traditionally been thought essential to explain not only the existence of life, but also the details of organic design. If Darwin's theory could explain the appearance of design without direct appeal to God for the details, might it not be able to do a great deal more? The real danger lay not in the immediate challenge to Genesis, but in the radical nature of Darwinian explanation, and its reliance on cranes in a context where skyhooks had previously seemed indispensable. It was this that was revolutionary; and revolutionary ideas have a habit of spreading.

Once again, Dennett's characteristically colourful account of the matter is too good to resist:

> Did you ever hear of universal acid? This fantasy used to amuse me and some of my schoolboy friends … Universal acid is a liquid so corrosive that it will eat through anything! The problem is: what do you keep it in? It dissolves glass bottles and stainless-steel canisters as readily as paper bags. What would happen if you somehow came upon or created a dollop of universal acid? Would the whole planet eventually be destroyed? What would it leave in its wake? After everything had been transformed by its encounter with universal acid, what would the world look like? Little did I realize that in a few years I would encounter an idea – Darwin's idea – bearing an unmistakable likeness to universal acid: it eats through just about every traditional concept, and leaves in its wake a revolutionized world view, with most of the old landmarks still recognizable, but transformed in fundamental ways.
>
> Darwin's idea had been born as an answer to questions in biology, but it threatened to leak out, offering answers – welcome or not – to questions in cosmology

> (going in one direction) and psychology (going in the other direction). If redesign could be a mindless, algorithmic process of evolution, why couldn't that whole process itself be the product of evolution, and so forth, all the way down? And if mindless evolution could account for the breathtakingly clever artefacts of the biosphere, how could the products of our own 'real' minds be exempt from an evolutionary explanation? Darwin's idea thus also threatened to spread all the way up, dissolving the illusion of our own authorship, our own divine spark of creativity and understanding.
>
> (Ibid., p. 63)

You can see what he means by this by thinking again in terms of the Great Chain of Being. What Darwin did was to take some links in the middle of this chain – the links containing the various levels of organism – and invert the traditional order of explanation for those links. The range of animals was to be explained not by a skyhook's coming down and creating it all at once, but by the development of the higher animals through natural, unplanned processes among simpler ones. But once this kind of bottom-up rather than top-down explanation starts to seem feasible at all – once the acid has begun its work of dissolving traditional assumptions – why should it stay comfortably in the middle, confined to change among animals? Might it not work just as effectively on other parts of the chain?

Nobody could miss the potential for Darwin's own next step, which was to extend the account of evolution to include human beings, in *The Descent of Man* (1871). This was much more serious, as everyone knew. Tradition had presented animals as created specifically for us to have dominion over, and not as, literally, our relations. It had also explained our nature by our possession of a rational soul, directly created by God. People could still resist the most radical implications of this extension of the theory – again, as many now do – by claiming that even if human *bodies* evolved from animal beginnings, that still allowed for a specifically human soul with an origin and nature of the traditional, immaterial, kind. But the Darwinian approach obviously raised the possibility that the kind of rationality possessed by human beings was just another step in the evolution of intelligence among animals, and that there was no need to think that souls existed at all. The acid was threatening to leak out in the upward direction.

A similar kind of possibility also applied to the lower links in the chain. If there is no good reason to think that explanation of a Darwinian kind must stop with the higher animals, might it not also start before the lower animals, and account for the emergence of life from inanimate matter? Even though Darwin did not pursue this idea, the possibility is obviously there; and if this bridge can be crossed, the full danger of the Darwinian inversion becomes clear. If the unplanned interactions of 'bare incogitative matter' really can account for the emergence of life, and simple life for the emergence of complex life and intelligence, then we may literally have risen from the dust, without any assistance from anything higher.

Of course, that would still leave the problem of accounting for the existence of the world itself, and although (as Dennett implies) some enterprising physicists are busy trying to use Darwinian principles to explain the existence of our universe, it is not at all clear – at least yet – how this could work. But whether or not that can be done, the problems in understanding how matter could have arisen from nothing are not obviously more serious than those involved in explaining how God could have arisen from nothing; so if Darwinism could get as far as explaining how human capacities could have resulted from the ordinary characteristics of matter, it might have done all the damage necessary.

This is all obviously extremely serious, because if the inverted order of explanation can get this far, there no longer seems any reason to believe in the existence of skyhooks at all. If God and the angels are no longer needed to explain anything, there may be no reason to believe they exist. And if that stage is reached, human beings appear not in the middle of the Great Chain of Being, a little lower than the angels, but (as far as we know) at the top: the highest point yet reached by mindless cranes toiling upwards out of the mud. This is a very long way indeed from the traditional view of our own situation.

So although Darwin himself did not venture far beyond this middle ground of animal and human evolution, at least in public, and seems to have had doubts about whether skyhooks could be eliminated entirely from the scheme of things, the idea of natural selection at least raised as a serious possibility the idea that the animate and the conscious, together with all the ideas and culture we have traditionally regarded as inspired by higher things, could have developed from the inanimate without the intervention or addition of anything else. It raised, more seriously than ever before, the idea that no supernatural life breathed into matter to make it animate, and that no soul was infused to make it conscious. Consciousness and all that goes with it – culture, art, science, philosophy, moral ideas – are just things that appear when matter gets into these arrangements, and the idea of natural selection shows in principle how these arrangements are possible.

And since it has traditionally been these outside elements – intelligent, immaterial, and unreachable by science – that have been thought to distinguish us from the lesser creation, the threat of their being taken up into a Darwinian synthesis opens the way for the scientific explanation of all that we regard as most distinctive about ourselves. It may mean that what we tend to think of as our most essential characteristics are ultimately to be explained as devices that exist only because they have been successful in achieving our evolutionary survival. It is hardly surprising, therefore, that Darwinism has seemed to threaten everything traditionally regarded as most fundamental about our nature.

The question of the extent to which these threats are all that they seem is the subject of this book.