# Four

## Evidence

### 1. SCIENCE AND GOD

Darwin framed the first edition of the *Origin* with two epigraphs, both from people who are probably best known now for their contributions to the study of scientific method. One is from Francis Bacon (1561–1626), a man famous for his insistence on scrupulous and exhaustive observation if scientific knowledge is to be acquired, and who, it is said, died from a cold following an experiment in which he stuffed a chicken with snow:

> To conclude, therefore, let no man out of a weak conceit of sobriety, or an ill-applied moderation, think or maintain, that a man can search too far or be too well studied in the book of God's word, or in the book of God's works; divinity or philosophy; but rather let men endeavour an endless progress or proficience in both.
>
> (Bacon: *The Advancement of Learning*)

Bacon was a highly regarded figure among many of Darwin's most influential contemporaries. They thought of him as the father of the 'inductive method' in science; that is, a method that places great store on the meticulous gathering of numerous experimental results before confidence is placed in any hypothesis. More specifically, this method warns against leaping to general theoretical positions simply because they are consonant with some small number of observations.

The 'Baconian' method is sometimes caricatured as one that exhorts the scientist to begin their work by accumulating diverse facts, thereby allowing observations to speak for themselves without the distorting bias that theoretical presuppositions might bring. Darwin claimed, rather unconvincingly, to have fashioned his theory in this way: 'I worked on true Baconian principles, and without any theory collected facts on a wholesale scale' (*Autobiography*: 72). But thoroughly Baconian science of this kind is almost impossible to conceive, and hardly seems commendable. The philosopher of science Karl Popper is particularly well-known for deriding it. He was fond of going into classrooms full of students and asking them to 'observe'. Unsurprisingly, the students were confused – how could they observe unless they had some idea of what they were supposed to be observing? Popper used this baffling request to make the point that naive observation, unclouded by any theoretical assumptions, is impossible, for we need some kind of theory to tell us where to look, and how to interpret what we see. Darwin's notebooks make it clear that he was no naive Baconian of this sort: he designed experiments in order to test the presuppositions of his transmutationist views. But it was important for him to be seen to credit Bacon, in order to signal to Bacon's Victorian admirers that Darwin's theory was built on a firm empirical foundation, and that unlike Lamarck and Chambers, he should not be viewed as one prone to wild flights of fancy.

The *Origin*'s other epigraph comes from one such influential Victorian Baconian – William Whewell:

> But with regard to the material world, we can at least go so far as this—we can perceive that events are brought about not by insulated interpositions of Divine power, exerted in each particular case, but by the establishment of general laws.
>
> (Whewell: *Bridgewater Treatise*)

As we saw in chapter one, Darwin knew Whewell from his days in Cambridge. Philosophers and historians invariably describe Whewell as a polymath: his work on the philosophy of science will be of particular concern to us here, but he also wrote on an array of subjects from astronomy to law, from architecture to mineralogy. The quotation comes from Whewell's *Bridgewater Treatise*. The *Bridgewater Treatises* were a series of works commissioned from different authors by the Earl of Bridgewater to demonstrate the existence of God, as evidenced by the natural world. Whewell's comments show that, at least as far as the physical sciences went, he did not believe that God intervenes directly to influence individual events; rather, he thought that God had set up natural laws (such as Newton's laws of motion), and those laws dictated the patterns of the Universe. As we saw in chapter one, Darwin's general view of the natural world at the time he wrote the *Origin* was of the same type. He did not believe that an intelligent God was directly responsible for creating individual species, nor for fitting species to their environments. Darwin thought that natural laws alone (primarily the law of natural selection) were responsible for these phenomena. But Darwin did not intend natural selection to rule out a God ultimately responsible for natural laws themselves.

Darwin's epigraphs raise two interrelated themes, which we will address in sequence in this chapter. First, we will look at what Darwin understood by scientific method. Specifically, we will look at what Darwin and some of his contemporaries thought it took for a theory to be well supported by evidence. We will then look at today's debate between the theory of intelligent design and the theory of evolution by natural selection. Armed with a good understanding of what it takes for a theory to have a good base of evidence, what should we make of the claim that both natural selection and intelligent design have claims to be taught alongside each other in biology classrooms? Is there really good evidence in favour of the intelligent design hypothesis?

## 2. INFERENCE TO THE BEST EXPLANATION

Darwin gives a strong hint in the *Origin* of his view about what makes a theory a good one. In the final chapter he summarises the varied facts his theory is able to explain – facts about anatomy, embryology, the distribution of species around the globe, even about the characteristic arguments had by natural historians – and he notes how ill-equipped are rival theories for explaining the same facts. In the *Origin*'s sixth edition he adds that:

> It can hardly be supposed that a false theory would explain, in so satisfactory a manner as does the theory of natural selection, the several large classes of facts above specified. It has recently been objected that this is an unsafe method of arguing; but it is a method used in judging of the common events of life, and has often been used by the greatest natural philosophers.
>
> (Darwin 1959: 748)

In other words, the fact that a theory is able to successfully explain diverse phenomena is, Darwin thinks, strongly indicative of the theory's truth. This mode of reasoning has become known today as *Inference to the Best Explanation*, often abbreviated to IBE (Lipton 2004). Darwin is right that this is a highly intuitive conception of how theories of all kinds are supported by data. Why do we think it is likely that the butler killed the Earl of Wensleydale? Because if the butler did kill him, then this would best explain our data – the Earl's blood on the butler's jacket, the Earl's blood on the knife found under the butler's bed, the sighting of the butler running away from the crime scene just after the Earl died. When a hypothesis explains the data better than its rivals, we often think the hypothesis is true.

The *Origin* is full of arguments which seek to show how much better our understanding is of diverse phenomena if we assume common ancestry rather than special creation. Consider this example, where Darwin explains the different distributions of species in the Galapagos Islands (in the Pacific, nearest continent South America) and the Cape de Verde Archipelago (in the Atlantic, nearest continent Africa):

> The naturalist, looking at the inhabitants of these volcanic islands in the Pacific, distant several hundred miles from the continent, yet feels that he is standing on American land. Why should this be so? why should the species that are supposed to have been created in the Galapagos Archipelago, and nowhere else, bear so

> plain a stamp of affinity to those created in America? There is nothing in the conditions of life, in the geological nature of the islands, in their height or climate, or in the proportions in which the several classes are associated together, which resembles closely the conditions of the South American coast: in fact there is considerable dissimilarity in all these respects. On the other hand, there is a considerable degree of resemblance in the volcanic nature of the soil, in climate, height, and size of the islands, between the Galapagos and Cape de Verde Archipelagos: but what an entire and absolute difference in their inhabitants! The inhabitants of the Cape de Verde Islands are related to those of Africa, like those of the Galapagos to America. I believe this grand fact can receive no sort of explanation on the ordinary view of independent creation; whereas on the view here maintained, it is obvious that the Galapagos Islands would be likely to receive colonists, whether by occasional means of transport or by formerly continuous land, from America; and the Cape de Verde Islands from Africa; and that such colonists would be liable to modifications;—the principle of inheritance still betraying their original birth place.
>
> (*Origin*: 385–86)

The hypothesis that an intelligent God produced each species individually to suit its surroundings leads us to expect that similar habitats will contain similar species, and different habitats will contain different species. This is not what we see. Compared with Darwin's hypothesis of common ancestry, special creation is a poor explanation of our data, and using IBE it is far less likely to be true.

We are undoubtedly prone to think theories true when they have explanatory power. But some explanations have lots of attractive attributes – they tie disparate phenomena together, they show us that the events we have witnessed are ones we should have anticipated – yet they are, in spite of all this, false. Conspiracy theories are often like this. So although 'Inference to the Best Explanation' is an attractive slogan, ideally one would want to flesh it out with an account of what makes an explanation good, and an account of why, when a hypothesis ties up some body of facts in a neat, explanatory way, it is therefore likely to be true. One cannot solve the first problem by insisting that only true explanations are good ones. IBE's defender needs to pinpoint characteristics of good explanations, and then show that explanations with these characteristics are more likely to be true than bad ones. Requiring that an explanation does not count as good unless it is true misses the point of IBE.

As a first pass, we might understand a good explanation to be one that cites factors which would raise the probability of the event we are trying to explain. The more the probability is raised, the more satisfying the explanation (Mellor 1976). The most satisfying explanations are the ones that show that what happened had to happen, with 100% probability. On this view, we do not define a good explanation as one that is true, we define it as one that, were it true, would make the facts we seek to understand probable. We can explain a fire by reference to a short-circuit because in the circumstances (a ready supply of oxygen, a warehouse without sprinklers), a short circuit would make a fire highly probable.

When a hypothesis makes some set of observations very probable, philosophers and statisticians say that the hypothesis has a high *likelihood*. I will use italics throughout this chapter to refer to this technical notion of *likelihood*. It is important to remember that the *likelihood* of a hypothesis is a function of how probable the hypothesis makes some set of observations, not of how probable the observations make the hypothesis. So, for example, given the observation that there is clear liquid dripping down my kitchen walls, the hypothesis that there is a flooded bath upstairs has high *likelihood*. This hypothesis makes my observation likely. The proposal we have been considering is that good explanations of observations are hypotheses with high *likelihoods* in the light of those observations. Are explanations that are good in this sense also generally true? They are not, as the philosopher Elliott Sober often reminds us (e.g. Sober 1993). For any given set of data, there are typically numerous alternative hypotheses that make those data probable. They all have high *likelihoods*, but we must choose which is true. The drips on my walls are made likely by the flooding bath, but could also have been made by spilled vodka, errant guttering, a burst pipe and so forth. Some hypotheses with high *likelihoods* are patently absurd. If I hear a drumming noise coming from my ceiling, then I can explain this either by hypothesising that it is raining, or by hypothesising that tiny fairies are having a disco on the roof. Both hypotheses make my observations probable – if there were a fairy disco on the roof, then I would hear a drumming noise – but I do not regard the fairy hypothesis as probably true in virtue of this, even though that hypothesis has a high *likelihood*, and is, by the criterion we are currently discussing, a good explanation.

This teaches us an important lesson. We should not accept hypotheses merely on the grounds that they make some body of data highly probable. This does not mean that the *likelihood* of a hypothesis is irrelevant to its truth, but it does show that *likelihood* is not sufficient to justify belief in a hypothesis.

## 3. HERSCHEL AND WHEWELL

The methodologists of science who influenced Darwin most heavily – especially John Herschel – insisted that scientific theories should appeal only to what they called *verae causae*, or 'true causes'. Darwin read Herschel's major methodological work – *A Preliminary Discourse on the Study of Natural Philosophy* – during his student days:

> During my last year at Cambridge I read with care and profound interest Humboldt's *Personal Narrative*. This work and Sir J. Herschel's *Introduction to the Study of Natural Philosophy* stirred up in me a burning zeal to add even the most humble contribution to the noble structure of natural science. No one or a dozen other books influenced me nearly so much as these two.
>
> (*Autobiography*: 36)

We can understand adherence to the *vera causa* ideal as a recognition of the point we made in the last section. High *likelihood* does not by itself constitute serious evidence in favour of a theory. A theory must do more than explain some narrow class of phenomena if it is to command our confidence. There is no evidence in favour of the fairy hypothesis beyond the fact that it fits with our observation of noise from the roof. Rain, on the other hand, is something we have plenty of additional evidence for. 'True causes' are causes like the rain, rather than dancing fairies.

What, precisely, does it take for us to have 'additional evidence', of a kind that might begin to warrant our believing an explanatory theory? Equivalently, we can ask what it takes for a theory to meet the *vera causa* ideal (for details see Ruse 1975; Hodge 1977). Herschel gives various different answers to this question in his *Preliminary Discourse on the Study of Natural Philosophy*. At some points he adopts a proposal consonant with a more plausible version of IBE: *verae causae* are those which, in addition to explaining the phenomena that initially lead to their invocation, are also able to explain many other phenomena. They are causes 'competent, under different modifications, to the production of a great multitude of effects, besides those which originally led to a knowledge of them' (Herschel 1996: 144). Maybe we should believe in fairy discos if such discos also explained phenomena beyond the drumming noise on the roof (if, for example, they explained the appearance of tiny ethereal beer cans, left discarded on the mornings after drumming is heard). At this point, Herschel says, the scientist can be fairly certain that he has found 'causes recognized as having a real existence in nature, and not being mere hypotheses or figments of the mind' (ibid.). Best of all is when, once we have posited some cause, we are then able to form further explanations we had not expected, as well as explanations of phenomena that, at first glance, seem opposed to our theory:

> The surest and best characteristic of a well-founded and extensive induction, however, is when verifications of it spring up, as it were, spontaneously, into notice, from quarters where they might be least expected, or even among instances of that very kind which were at first considered hostile to them. Evidence of this

> kind is irresistible, and compels assent with a weight which scarcely any other possesses.
>
> (Ibid.: 170)

In these respects, Herschel is close in his methodological stance to Whewell, who claims in his *Philosophy of the Inductive Sciences* that:

> . . . the evidence in favour of our induction is of a much higher and more forcible character when it enables us to explain and determine cases of a *kind different* from those which were contemplated in the formation of our hypothesis. The instances in which this has occurred, indeed, impress us with a conviction that the truth of our hypothesis is certain.
>
> (Whewell 1996: 230, emphasis in original)

Both men recommend confidence in hypotheses that explain many diverse phenomena. When a hypothesis does this we have what Whewell calls the *Consilience of Inductions*. One difference between the two men, and it is a mild one, is that while Herschel puts the stress on explanations of phenomena in domains initially thought hostile to the theory, Whewell stresses explanations of kinds of phenomena which the theory was not designed to accommodate (Laudan 1981).

At times Herschel makes an even stronger demand on a theory, namely that we should be able to *directly perceive* either the causes it refers to, or something closely analogous to them. At this point, Herschel's demands go well beyond Whewell's, because a cause that was unlike anything humans could ever perceive could still explain diverse phenomena, including phenomena theretofore unanticipated. It is tempting to say that Whewell, not Herschel, got it right here, for Herschel's strong requirement would seem to disqualify successful theories in fundamental physics, which posit causes wholly alien to anything we might perceive. This conclusion is a little too hasty, however, for even in more recent years some philosophers have argued that a scientific theory cannot be understood, let alone believed, unless its claims can somehow be linked, by analogy, with systems we are familiar with (e.g. Hesse 1966).

Herschel insisted on the requirement of direct perception because he regarded Newton's explanation of the orbits of the planets as a paragon of solid science:

> For instance, when we see a stone whirled round in a sling, describing a circular orbit round the hand, keeping the string stretched, and flying away the moment it breaks, we never hesitate to regard it as retained in its orbit by the tension of the string, that is, by *a force* directed to the centre; for we feel that we do really exert such a force. We have here *the direct perception* of the cause. When, therefore, we see a great body like the moon circulating round the earth and not flying off, we cannot help believing it to be prevented from so doing, not indeed by a material tie, but by that which operates in the other case through the intermedium of the string,—a *force* directed constantly to the centre.
>
> (Herschel 1996: 149, emphasis in original)

Herschel believed that the key to Newton's success lay in his appeal to a notion of gravitational force whose existence, and whose ability to explain orbital motion, were already experienced in analogous form by human observers.

## 4. HERSCHEL AND THE *ORIGIN*

Let us spell out Herschel's view in more detail. He thinks a theory should command our assent only when the causes it appeals to pass three tests. They must be: (1) shown to *exist*; (2) shown to be *capable* of producing the phenomena we seek to account for; and (3) shown to be *responsible* for producing the phenomena we seek to account for (Hodge 1977). Fairies fail the first test of existence, because beyond the fact that fairies might explain the drumming noise on the roof, we have no reason to think there are fairies. Do fairies pass the capability test? That is not clear, for it is hard to decide whether they could produce a drumming noise unless we have information about what kinds of things fairies are. That we have no such information is partly a symptom of their failure to pass the existence test. This shows that in some cases it is hard to pull the existence test and the capability test apart. Many competing hypotheses will pass both of these tests: the drumming noise on the ceiling might be produced by rain, or by hailstones, and both of these factors we know to exist and to be capable of producing a drumming noise. One establishes that rain, rather than hail, is responsible for the noise on a particular occasion (one shows it alone passes the third test) by cataloguing further phenomena that rain is better able to explain than hail (the flow of water down gutters, for example).

Darwin's structuring of the *Origin* seems to answer each of Herschel's three requirements in turn, as the historian Jonathan Hodge has argued (ibid.). First, Darwin tries to demonstrate that natural selection exists, and that it is capable of producing new species and adaptation. He does this in a way that very closely parallels Herschel's reconstruction of the proper Newtonian method (Ruse 1975). Whirling a stone in a sling gives us direct perception of a force capable of producing circular motion. This, says Herschel, should increase our confidence in the existence of an analogous force exerted by the Earth on the Moon. Darwin tries to establish natural selection as a *vera causa* in a similar way, by appealing to our direct experience of an analogous force in artificial selection.

As we saw in chapter two, Darwin uses the success of animal breeders to make his case for the existence of an abundant supply of natural variation that is not under human control, and which provides raw materials suitable for adaptive modification. If natural selection is to produce adaptation in the wild, Darwin also needs to show that these variations can be preserved and added up without the conscious hand of a breeder. Darwin uses artificial selection to establish this claim, too.

First, he points to cases where humans, as part of the natural environment of a species, cause considerable adaptive modification merely by looking after their most valuable animals, rather than by intentionally instituting a breeding programme to modify them:

> If there exist savages so barbarous as never to think of the inherited character of the offspring of their domestic animals, yet any

> one animal particularly useful to them, for any special purpose, would be carefully preserved during famines and other accidents, to which savages are so liable, and such choice animals would thus generally leave more offspring than the inferior ones; so that in this case there would be a kind of unconscious selection going on.
>
> (*Origin*: 94)

To say that Darwin makes a case for the existence and capability of natural selection by drawing an *analogy* with artificial selection is slightly misleading here; rather, Darwin shows that some cases of artificial selection are cases of natural selection.

Second, Darwin tries to establish that natural selection is capable of producing complex adaptations, by suggesting that natural selection is far more powerful than artificial selection:

> As man can produce and certainly has produced a great result by his methodical and unconscious means of selection, what may nature not effect? Man can only act on external and visible characters: nature cares nothing for appearances, except in so far as they may be useful to any being. She can act on every internal organ, on every shade of constitutional difference, on the whole machinery of life . . . How fleeting are the wishes and efforts of man! how short his time! and consequently how poor will his products be, compared with those accumulated by nature during whole geological periods.
>
> (ibid.: 132–33)

In brief, we can see the argument of the *Origin* as a Herschellian one. The case relating to the existence of natural selection and its capability of producing new species and adaptation takes up the first eight chapters of the *Origin*. Here Darwin is particularly keen to address, for example, those phenomena that one might think his theory could not possibly account for, such as 'organs of extreme perfection' (exquisitely designed adaptations like the eye), behaviours that appear to be of no value to the individual organism, and so forth. Chapters nine to thirteen then seek to show that natural selection is not merely capable of effecting organic change, but is actually responsible for it, by showing how Darwin's theory makes far better sense of diverse phenomena than do competing theories, especially the theory of special creation.

### 5. DARWIN, WHEWELL AND GEMMULES

The case for reading the *Origin* as a long Herschellian argument is, I think, very strong. But in later works Darwin appears to toy with relaxing Herschel's strong standards, and moving more closely in line with Whewell (Ruse 2000a). This is particularly true of the case that Darwin builds for his theory of inheritance – *pangenesis* – which he defends in *The Variation of Animals and Plants under Domestication*. In the *Origin*, the fact that offspring generally resemble their parents is taken largely for granted, and Darwin simply admits his ignorance regarding why this should be the case. Darwin was not content with this, and sought to put forward a theory that would account for these resemblances. He believed this theory should be able to explain the recognised phenomena of inheritance. So, for example, the theory should be able to explain not only why offspring resemble parents, but why traits sometimes 'jump' a generation, appearing in grandchildren and not children. Darwin also believed that alterations to a parent during his or her lifetime could sometimes appear in children. His theory should be able to explain this, too. Finally, the theory should be able to explain the special role of the sex cells (sperm and eggs) in inheritance.

Darwin argued that each part of the body produced particles, called 'gemmules', which were of a character specific to that part. He thought that gemmules specific to each part of the body gathered in the sex cells, with the result that an embryo formed from the union of sperm and egg would contain a full set of different types of gemmules from each parent. Once an embryo is formed, gemmules can either develop to produce traits resembling those which produced them, or they can remain dormant for several generations. In these last respects gemmules are not entirely unlike genes. But Darwin's theory sought to explain many phenomena whose reality we no longer acknowledge. Darwin proposed that gemmules migrated from organs to the sex cells in order to explain how alterations to an organ during the life of an individual could result in alterations to the gemmules in that organ, ultimately changing the character of the gemmules transmitted to future generations. This was how the blacksmith's son would come to inherit the smith's biceps. The problem, of course, is that we no longer believe that acquired variations of these kinds are passed on to offspring.

Darwin's Herschellian instincts show themselves in his description of the hypothesis of pangenesis as 'provisional'. He was reluctant to claim a firm conviction in his ideas, for no one had directly perceived gemmules, or anything analogous to them. On the other hand, Darwin begins to wonder if Herschel's demand for direct perception of one's explanatory posits may be too strong. He suggests that the explanatory power of a theory alone may be justification enough to warrant belief.

Most of Darwin's contemporaries accepted the view that light was a wave, travelling via undulations in an invisible medium called the *luminiferous ether*. The luminiferous ether was, in principle, imperceptible. In one of Darwin's longer reflections on method, he flirts with a Whewellian consilience of inductions as the evidential foundation for the natural selection theory:

> In scientific investigations it is permitted to invent any hypothesis, and if it explains various large and independent classes of facts it rises to the rank of a well-grounded theory. The undulations of the ether and even its existence are hypothetical, yet every one now admits the undulatory theory of light. The principle of natural selection may be looked at as a mere hypothesis, but rendered in some degree probable by what we already know of the variability of organic beings in a state of nature,—by what we positively know of the struggle for existence, and the consequent almost inevitable preservation of favourable variations,—and from the analogical formation of domestic races. Now this hypothesis may be tested,—and this seems to me the only fair and legitimate manner of considering the whole question,—by trying whether it explains several large and independent classes of facts; such as

> the geological succession in organic beings, their distribution in past and present times, and their mutual affinities and homologies. If the principle of natural selection does explain these and other large bodies of facts, it ought to be received.
>
> (*The Variation of Animals and Plants under Domestication,* quoted in Gayon 1998: 32)

Darwin asserts, in conformity with Whewell's notion of consilience, that natural selection's explanation of not just one, but 'several large and independent classes of facts', counts strongly in its favour. But a quasi-Herschellian addition to Darwin's case remains: that natural selection exists as a force competent to produce adaptation and speciation is 'rendered in some degree probable' by the fact that species vary, and by the fact that conditions in nature are demanding (Hodge 2000).

Let us step back from the case of Darwin, and ask what we should make of the dispute between Herschel and Whewell. Should we insist on the 'direct perception' of the causes posited by some theory, or is explanatory power enough? One problem is that it is hard to know what 'direct perception' means. Do I directly perceive the postman when I hear him knock on the door? Do I directly perceive atomic nuclei on the screen of an electron microscope? At the same time, it is not clear why 'direct perception' should be important for confirmation of a theory. There are many cases where we claim to have perceived something directly that is in fact a figment of the imagination. This is what happens when we experience vivid hallucinations. It is no use replying that direct perception is important because one cannot perceive something unless it exists: this simply transforms the problem into how to tell that you really are perceiving something when it seems that you are.

The work of the philosopher Ian Hacking contains resources that might help solve both problems at once. He describes a striking encounter with modern scientists who do not merely talk of their good reasons for believing in subatomic particles, but casually mention the uses to which they put those particles. How do they change the charge on a microscopic ball of niobium? By spraying it with positrons (Hacking 1983: 23). These scientists do not only posit positrons in order to make sense of diverse phenomena, they take it that they can use and manipulate positrons. When an entity is thought to be 'manipulable' in this way, our confidence in its existence is certainly increased. Whether we 'directly perceive' positrons is moot, but Herschel is clearly onto something when he claims that the strongest evidence in favour of a theory comes from intimate familiarity with the causes it posits, a familiarity that we can perhaps understand through Hacking's concept of manipulability.

On close inspection, it may be that Whewell can incorporate the special significance of manipulation into his concept of consilience. To appear able to manipulate an entity is to act in various ways as though the entity exists, and for one's actions to have the results predicted by the alleged properties of that entity. Successful manipulation thus consists in a series of events of different kinds (different types of interactions and their results), which the theoretical properties of the posited entity are jointly able to explain. The proponent of consilience can understand manipulation in terms of the ability of a theory of what a scientific entity is like to explain a series of events associated with our interventions and their consequences. So Whewell, too, can explain why manipulation is so important for the confirmation of a theory, by reference to his idea that a good theory is one that explains a diverse set of phenomena. Darwin may be right to keep his feet in both Herschellian and Whewellian camps, for it is not clear that we need to choose between them.

## 6. NATURAL SELECTION AND COMMON ANCESTRY

As I have emphasised, it is one thing to claim that species are descended from common ancestors to form a genealogical tree, another thing to say that natural selection is the specific process responsible for this state of affairs. When Darwin talks about 'my theory', even when he talks about 'the principle of natural selection', he is often ambiguously situated between these two claims. So when Darwin tells us that 'his theory' is able to successfully explain a host of diverse phenomena in consilient fashion, is he talking about common ancestry, natural selection, or both?

The early parts of the *Origin* focus on establishing that natural selection exists, and that it is capable of producing adaptation and speciation. But the philosopher Kenneth Waters points out that many of the phenomena which, in the second half of the *Origin*, Darwin argues are best explained in terms of 'his theory', are explained in terms of common ancestry alone (Waters 2003). It is common ancestry that explains why species are similar in the Galapagos and the American mainland, yet different in the Galapagos and the Cape Verde Islands. The same is true for many of the other sets of facts Darwin accounts for, such as the strong resemblances we see between organs with different functions:

> What can be more curious than that the hand of a man, formed for grasping, that of a mole for digging, the leg of the horse, the paddle of the porpoise, and the wing of the bat, should all be constructed on the same pattern, and should include the same bones, in the same relative positions? . . . On the ordinary view of the independent creation of each being, we can only say that so it is;—that it has so pleased the Creator to construct each animal and plant.
>
> The explanation is manifest on the theory of the natural selection of successive slight modifications,—each modification being profitable in some way to the modified form, but often affecting by correlation of growth other parts of the organisation.
>
> (*Origin*: 415–16)

The arguments Darwin mounts in the *Origin* leave special creation – the view that species are individually created by an intelligent agent – dead and buried. It is baffling why an intelligent God should choose to build the horse, the mole and the bat on the same anatomical plan when their environments make such different demands on them. But although Darwin tells us in this passage that it is the theory 'of the natural selection of successive slight modifications' that explains these observations, it is not clear from what he says that these observations can only be explained by the specific mechanism of natural selection. Might other transmutationist theories – such as Lamarck's, or his grandfather's – also be able to accommodate the phenomena Darwin describes here? We saw in chapter two that Darwin failed to address some 'populational' worries about the capability of natural selection to produce adaptation. When we add to this the fact that in the second half of the *Origin* Darwin is mainly concerned with exposing the explanatory inadequacies of special creation, rather than natural selection's specific strengths, we understand better why almost all of Darwin's contemporaries were quick to accept his case for evolution, but fewer were moved by the argument for natural selection.

## 7. THE NATURAL SELECTION/INTELLIGENT DESIGN DEBATE

A group of vocal and politically influential critics of Darwin continues to argue not merely that natural selection remains in doubt as the means by which species have become adapted to their environments, but that intelligent design offers us a better hypothesis to account for adaptation (e.g. Behe 1996; Dembski 2004). They also use IBE to defend their view. We are now in a good position to examine their argument, and to expose its failings.

The biochemist Michael Behe uses a structure present in bacteria called the *flagellum* as the basis for the case for intelligent design (Behe 1996). The flagellum is a whip-like filament that twirls around, thereby propelling the bacterium. Behe thinks the flagellum is better explained by intelligent design than by natural selection, and as a result he argues that the intelligent design hypothesis is likely to be true. He does not claim that the flagellum will show all by itself that a god of the kind Christians believe in exists, but he does think the flagellum points to a designer of some kind.

Here are the four main steps in the intelligent design argument, as it is usually phrased today. In this section, I will assess each one in turn.

Tim Lewens

# Darwin

Routledge
Taylor & Francis Group
LONDON AND NEW YORK

First published 2007
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

Simultaneously published in the USA and Canada
by Routledge
270 Madison Ave, New York, NY 10016

This edition published in the Taylor & Francis e-Library, 2006.

"To purchase your own copy of this or any of Taylor & Francis or Routledge's collection of thousands of eBooks please go to www.eBookstore.tandf.co.uk."

*Routledge is an imprint of the Taylor & Francis Group, an informa business*



*British Library Cataloguing in Publication Data*
A catalogue record for this book is available from the British Library

*Library of Congress Cataloging in Publication Data*
Lewens, Tim.
Darwin / Tim Lewens.
p. cm. -- (Routledge philosophers)
Includes bibliographical references.
ISBN-13: 978-0-415-34637-5 (hardback : alk. paper)
ISBN-10: 0-415-34637-1 (hardback : alk. paper)
ISBN-13: 978-0-415-34638-2 (pbk. : alk. paper)
ISBN-10: 0-415-34638-X (pbk. : alk. paper) 1. Darwin, Charles, 1809-1882.
I. Title. II. Series.
B1623.L49 2006
192--dc22
2006014463

ISBN 10: 0-415-34637-1 (hbk)
ISBN 10: 0-415-34638-X (pbk)
ISBN 10: 0-203-59713-3 (ebk)

ISBN 13: 978-0-415-34637-5 (hbk)
ISBN 13: 978-0-415-34638-2 (pbk)
ISBN 13: 978-0-203-59713-2 (ebk)