Darwinian Evolution

There are some people in the legal world who would have you believe that the secret to being a good lawyer is to convince your client that you are one, even if you're not. I'm not entirely sure how seriously this is supposed to be taken, but it is certainly true that however good a lawyer actually is, it counts for nothing if his client loses confidence in him.

Once lawyers realise the importance of gaining and keeping their clients' confidence they have two choices. Either they dedicate themselves to study and continuing development so that after many years they can unquestionably demonstrate to their clients that they are good lawyers, or they find a way of fooling their clients into thinking they are good lawyers. It may surprise you to learn that some choose the latter.

A client wants to know that his lawyer is on top of the case. A sure fire way for a lawyer to lose the confidence of his client is to get key facts wrong or to fail to read a document containing important information. Clearly, if failing to read a document makes a client lose confidence, it follows that demonstrating to a client that a document has been read may well increase his confidence. But that simply brings lawyers back to the sometimes unpalatable option of hard work; having to spend lots of time reading lots of documents in order to impress a client. Keen to avoid that option, at some unknown point in history a lawyer somewhere worked out the secret of achieving the result without having to do the work, and there are still some lawyers today who put that secret into practice!

I suspect that in the not too distant future lawyers will move to an almost paperless world. Until that time comes, however, clients will continue to turn up at their lawyers' offices with files (often carrier bags) full of paper. An experienced lawyer will quickly be able to identify the small number of documents that are actually relevant, thus avoiding the need to spend hours reading all the papers. An appointment can then be made to see the client and provide advice on the case. And it is at this appointment that an opportunity will arise to take a shortcut to impressing

the client by demonstrating how thorough he has been in reading all the paperwork.

The method is very simple. First, the lawyer arranges the papers in lever arch files, the more files the better. The final lever arch file is then selected and one piece of paper is removed from the file, preferably one which is paginated or which very obviously follows on from the preceding page. The lawyer then familiarises himself with that preceding page before either destroying the removed page or filing it away elsewhere. The client is then invited into the office. After pleasantries are over and the real advice begins, the lawyer informs the client that when he was preparing for the meeting by reading the papers he discovered a page was missing from the final lever arch file and he asks the client if they have a copy of the missing document. The client may or may not have a copy, but they cannot fail to be impressed with the fact their lawyer has read all those papers and has noticed a page was missing in the very last file of all those papers!

There are of course variations on this original method, the easiest of which is where the lawyer identifies the same piece of paper in the final file, but rather than removing it simply memorises one or two lines from it and the page number. Then, in the meeting with the client, the lawyer quotes from that page and states the page number, which sounds very impressive to the client.

And that brings me to page 146 of my copy of 'The Origin of Species' where Darwin wrote:

> *'If it could be demonstrated that any complex organ existed, which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down.'*

The book was published in 1859 and contains Darwin's arguments in support of his theory; his explanation for how all living things we see around us came to be. Entitled 'On the Origin of Species by Means of Natural Selection' (more commonly known by its abbreviated title 'The Origin of Species') the book was, amongst many things, a master class in the art of rhetoric.

At the time of publication the prevailing view among scientists and non-scientists alike was that some form of special creation (supernatural) had

been involved in the origin and development of living things. Darwin sought to turn this view on its head. For page after page he developed his argument that all living things can be explained by a process of evolution, small successive changes to an organism over long periods of time, preserved in each successive generation by the process known as natural selection.

On any reading of his book it is apparent that Darwin was well aware of the many challenges that his theory faced and would continue to face. Employing commendable rhetorical skill, Darwin sought to address these perceived weaknesses in his theory, not only by putting forward his arguments in response but also, significantly, as quoted above, by setting a challenge to his opponents to disprove his theory.

And in one fell swoop of rhetorical genius he managed to overthrow a fundamental tenet of debate and a principle enshrined in the English and many other legal systems around the world, namely '*semper necessitas probandi incumbit ei qui agit*' or 'He who asserts must prove.'

Darwin was asserting a new theory in opposition to the prevailing view. The onus was on him to prove his assertion. To be fair to him he tried to do just that, but when those attempts were insufficient, in and of themselves, to prove his case he played his get out of jail card by throwing down a challenge to his opponents – you prove it couldn't have happened in the way I say it did.

Such an approach is clearly at odds with the evidence-based approach. Put another way, it is the exact opposite of the often-quoted principle that a man is innocent until proven guilty. It is not for a defendant to prove that he did not commit a particular crime; it is for the prosecution to prove that he did. Likewise, it is not for us to prove that Darwin's theory is wrong; it is for the proponents of that theory to prove that it is correct, that it is supported by the facts and is the best explanation of those facts.

Accordingly, having set out the facts we must now turn to perhaps the most important, and in some ways the most difficult, aspect of the evidence-based approach; defining the theory. Important, because without a clear definition it is impossible to assess properly whether the theory can be established from the facts. Difficult, because the modern theory of Darwinian Evolution has moved on from that set out by Darwin in 'The

Origin of Species' and because the word 'evolution' can mean different things to different people and in different contexts.

At the very outset I want to settle on a name. On one level it does not really matter what you call the theory as long as you know what the theory is. I have sometimes seen the theory referred to as merely 'evolution', other times as 'Darwinian Evolution' and still other times as 'Neo-Darwinian Evolution.' The difficulty is that without going on to explain exactly what is meant by each of these terms it is impossible to know for certain whether they are, or are intended to be, referring to the same thing.

The word 'evolution' can clearly carry more than one meaning. I could talk about the evolution of life and the evolution of the motor car and on one level the word has the same meaning, referring to change or development over time. However, when referring to the evolution of life, the meaning can be more than just change or development over time as, unlike with the evolution of the motor car, the evolution of life can be referring to the process of Darwinian Evolution.

Unfortunately the term 'Darwinian Evolution' can also carry more than one meaning. On the one hand it can be referring to the theory of evolution as set out by Darwin in 'The Origin of Species', whilst on the other it can be referring to the theory of evolution as that theory is understood by scientists today. When Darwin wrote 'The Origin of Species' he had no idea about things such as DNA, proteins, and genes and not surprisingly therefore his theory did not deal with them. Over the last approximately 150 years scientists have adapted and developed Darwin's theory in the light of continuing scientific discovery, resulting in a modern theory which differs from that set out in 'The Origin of Species.' To reflect these changes many scientists refer to the modern theory as 'Neo-Darwinian Evolution' or 'Neo-Darwinism.'

Up to this point in the book I have stuck with the term 'Darwinian Evolution' and for ease of reference that is the term I am going to continue to adopt. For the avoidance of doubt, I am using that term to refer to the modern theory of Darwinian Evolution as defined below.

If you cast your mind back to chapter two and the Theft Act you will recall the importance of setting out exactly what has to be proved in order to establish that someone is guilty of theft. A fundamental principle of the

evidence-based approach is that all the elements of the theory have to be proved in order for the theory itself to be proved. Proving four out of five elements will not suffice. Furthermore, elements of the theory are not the same as the theory itself. Thus, proving the first four elements of the offence of theft was not enough to convict the defendant of the theft of my Fiat Uno (turbo). Likewise, proving that the defendant acted dishonestly was not the same as proving he had stolen my car. Put another way, if a defendant is found guilty of theft it follows that he must have acted dishonestly as without dishonesty someone cannot be guilty of theft. But if a defendant has acted dishonestly it does not automatically follow that he is guilty of theft.

The question therefore arises as to what are the elements that make up the theory of Darwinian Evolution?

Unfortunately, unlike with the definition of theft we cannot turn to an Act of Parliament to determine the precise definition of Darwinian Evolution. 'The Origin of Species' is an obvious place to start, but we must also take into account the writings of modern-day proponents of the theory. We must also accept that there is no universally accepted definition. The present scientific consensus holds that Darwinian Evolution is true or proven, but certain aspects of the theory may be more controversial than others.

In very simple terms Darwinian Evolution asserts that once upon a time, billions of years ago, the first life form appeared on earth. That life form reproduced and so did its offspring. Over time, some of its offspring developed adaptations or changes that gave them an advantage in their particular environment. Nature selected those offspring with the advantageous adaptations by a process called natural selection, ensuring that in time those adaptations became the norm and the adaptations, or new features, spread throughout the population. This process of change and natural selection continued for billions of years resulting in the huge variety of life forms we see before us today (not to mention the extinct ones), all of whom can trace their existence back to that very first life form, otherwise known as the universal common ancestor.

Clearly this is a very simplistic explanation of the theory, but even on this basic level it is possible to identify what must be the essential elements of

Darwinian Evolution. And by a stroke of luck there happens to be five of them, just like the definition of theft in the Theft Act!

1. Billions of Years

For reasons that will become more apparent when we look at the other elements, Darwinian Evolution requires billions of years. As Darwin himself said on page 146 of 'The Origin of Species', his theory requires '*numerous, successive, slight modifications*.' One only has to consider for a moment the number of different life forms on earth today and their particular characteristics to realise that we are talking about a vast number of '*successive slight modifications*' to get from the very first life form to all of modern life. Add to that the life span of the life forms involved, particularly mammals like us humans, and the life spans multiplied by the number of '*slight successive modifications*' needed comes to billions of years. Remembering of course that when Darwinian Evolution refers to *'successive changes*' it is referring to generations and offspring, in that any change has to be selected by natural selection and preserved by being passed on to offspring.

Accordingly Darwinian Evolution cannot be true unless the time between the appearance of the very first life form on earth and the present day is counted in billions of years. A few million or even a few hundred million years will not do. Without billions of years the theory fails and thus the requirement for billions of years can properly be described as an essential element of the theory.

2. Common Descent

As defined above, common descent is an essential element of Darwinian Evolution. The theory asserts that all life forms known to man can trace their lineage back to that very first life form. However it must be noted that it would only require a small change in the theory or definition to reduce the need for this element. For example, some scientists argue that there is no universal common ancestor but rather that there were several or many life forms which originally appeared on earth, and thus whilst all life forms can trace their lineage back to one of those first life forms they do not necessarily go back to the same one.

Notwithstanding interesting debates in scientific literature about the existence of a universal common ancestor, I think it is fair to say that the majority view of the modern day proponents of Darwinian Evolution is in

support of a universal common ancestor and thus common descent is an essential element of that majority view.

3. Natural Selection

Perhaps the most well known element of Darwinian Evolution is what Darwin described as natural selection. Although Darwin is normally credited with 'discovering' the concept of natural selection, some historians question whether he in fact, to put it charitably, 'borrowed' the idea from some of his contemporaries, in particular from a man called Alfred Russel Wallace. For the purposes of establishing it as an essential element of Darwin's theory it matters not whether it was his idea or not, but if only out of a sense of geographical loyalty to Wallace who is buried only a couple of miles from my house, I'm in the camp of those who say Darwin 'borrowed' the idea.

The concept of natural selection is brilliant both in its simplicity and in the fact that it is self-evidently true. Indeed, over the years there has been much debate as to whether the concept is in fact tautologous, particularly with reference to the phrase 'survival of the fittest.' In simple terms natural selection is the process by which nature will select traits that are advantageous to a particular life form's survival and thus reproductive capacity.

By way of example imagine a population of birds, say finches, which inhabits a group of islands in some exotic far-flung place, say the Galapagos Islands. The birds all eat various seeds that are normally found in plentiful supply on the islands. However, in one particular year there, the weather is such that seeds are in short supply, in particular the smaller seeds, leaving a limited supply of larger seeds, thus making it a lot harder for the finches to find food.

At first glance the finches are identical, but on closer inspection it turns out that some of them have slightly bigger beaks than others. When seeds were plentiful this variation in beak size was irrelevant to all but the most dedicated ornithologist, but now it becomes very important. Those finches with the bigger beaks are more able to secure food as their beaks are better suited to breaking open the bigger seeds. The finches with smaller beaks find food much harder to come by and are thus far more likely to grow weak or die from starvation. It follows that the finches with bigger beaks are more likely to survive and thus leave healthy offspring and,

crucially, those offspring are likely to have the same bigger beaks. Fast forward a number of generations and before you know it most, if not all, of the finches on the Islands now have bigger beaks, except they're not bigger now because they're all the same size (just bigger than they were a few generations ago)!

And that is natural selection. Or as Wikipedia puts it:

> *'Natural selection is the gradual process by which heritable biological traits become either more or less common in a population as a function of the effect of inherited traits on the differential reproductive success of organisms interacting with their environment. It is a key mechanism of evolution. The term 'natural selection' was popularised by Charles Darwin, who intended it to be compared with artificial selection, now more commonly referred to as selective breeding*.'

It is important to note the reference to '*heritable traits*.' The process only works if the trait (adaptation/change) is passed on to the next generation. Mr Finch might have the biggest beak in the world, but if his son or daughter is born with a small beak there is nothing natural selection can do. This requirement of heritability emphasises once again the need for billions of years, given the lifespan of certain life forms. It is also a key point to bear in mind when we come to look at the fourth essential element of Darwinian Evolution.

4. Mutations

Although Darwin is normally given credit for coming up with the concept of natural selection, he knew absolutely nothing about the fourth element, mutations, and yet mutations go hand in hand with natural selection. To be more specific, mutations refers to genetic mutations which occur in an organism's DNA at the biochemical level, which explains why Darwin's theory made no mention of them owing to the fact that DNA and biochemistry were unknown to scientists in Darwin's day. Indeed, it is the addition of genetic mutations to Darwin's theory that is the main distinguishing feature between Darwin's original theory and the modern day variety, what I am calling Darwinian Evolution.

The significance of mutations can be seen by returning to the subject of natural selection. In Darwin's day he was able to describe the process of

natural selection as it occurred among the population of finches in the Galapagos Islands. Darwin spends a great deal of time in 'The Origin of Species' discussing animal breeding and pigeon breeding in particular, emphasising how breeders can select for certain traits (adaptations/changes). Thus, if a pigeon breeder wanted to breed a fast pigeon he would select his fastest male and female pigeons and try to get them to breed to produce an offspring that would hopefully inherit its parents' ability to fly fast.

However, whilst natural selection is fundamentally different from animal breeding (see the fifth element below), both require an essential element, namely a particular trait to select. In the case of the finches it was a bigger beak. Once the trait is present natural selection provides the explanation for how that trait spreads in any given population, how it is selected, but natural selection provides no explanation for how the trait arose in the first place.

Natural selection could be described as the process behind or driving Darwinian Evolution, whereas genetic mutations are the mechanism. The process can only deal with what already exists and therefore, in and of itself, it has little capacity to bring about change. It might alter the proportion or distribution of a particular trait in a given population, but it cannot create a new trait. After many years and many generations all the finches may have big or bigger beaks, but the bigger beaks were not created by natural selection, they were simply selected from the existing population. Thus natural selection on its own cannot explain Darwinian Evolution. It is an essential element but it is not enough. If all life forms have descended from a universal common ancestor there must be a mechanism that is capable of generating the new genetic information that is required to produce the traits for natural selection to select. And Darwinian Evolution tells us that that mechanism is genetic mutations.

Scientists today know that genetic mutations occur in our DNA. Unfortunately many of those mutations are harmful to us and result to differing degrees in pain, suffering, or death. Cystic Fibrosis, Haemophilia, and colour blindness are all caused by mutations in particular genes, whereas other conditions such as Duchenne Muscular Dystrophy are caused by mutations that result in a whole gene or genes being deleted.

It is a fairly well known fact that all of the conditions I have just mentioned can be passed on within a family, from one generation to the next. They are therefore the '*heritable biological traits (Wikipedia)*' that can be selected by natural selection. Accordingly it is absolutely essential to Darwinian Evolution that any trait created by mutations is inheritable, otherwise the trait will simply die out when the particular organism in which it arose dies.

In practical terms this means that a mutation has to occur prior to the organism reproducing. After all, it's all very well Mr Finch having a genetic mutation that gives him an enormous beak, but if the mutation only occurs when Mr Finch is a happily retired grandfather who spends his time looking after all his grandchildren, the mutation will be of no use from the point of view of Darwinian Evolution. It will simply die out with poor old Mr Finch and will not be passed on to his offspring.

As to what precisely is a genetic mutation, I turn reluctantly once again to Wikipedia:

> *'A **gene mutation** is a permanent alteration in the DNA sequence that makes up a **gene**, such that the sequence differs from what is found in most people. **Mutations** range in size; they can affect anywhere from a single DNA building block (base pair) to a large segment of a chromosome that includes multiple **genes**.'*

So far we have only considered the requirement for mutations and what they are, but we must also bear in mind the question as to how mutations occur. A significant amount of our knowledge about mutations comes from experiments done in laboratories where scientists have deliberately engineered mutations. A fairly well known example is the experiments conducted by various scientists on fruit flies, and in particular at least one experiment where scientists managed to produce a fruit fly which had four wings instead of the usual two by causing a deliberate mutation in the relevant part of the fruit fly's DNA. Another way in which mutations occur is by exposure to high levels of radiation, as seen for example with the Chernobyl nuclear reactor disaster. There are many sad stories of children from that area suffering from cancers that had been caused by mutations that were brought about by exposure to the high levels of radiation.

Although there are many possible causes for genetic mutations, for reasons that will become clear when we look at the fifth element, not all of them are available to Darwinian Evolution. In addition, as explained above, it turns out that the vast majority of mutations are not beneficial to the organism in which they occur. Thus not only are all the possible causes of mutations not available to Darwinian Evolution but the vast majority of the mutations themselves are not available also. After all, a mutation that kills the organism in which it occurs is not, for the most part, the type of mutation that will lead to the changes in life forms required by Darwinian Evolution. As a result the number of possible mutations available to Darwinian Evolution is restricted only to those which are beneficial to the organism in which they occur and that are caused in ways compatible with the fifth element.

5. Unguided

The fifth element of Darwinian Evolution was perhaps the most controversial element when Darwin first presented his theory in 'The Origin of Species.' Contrary to the widely held view of most other people at the time, Darwin left no room for any supernatural being to play a part in the development of life on Earth. His theory removed the need for any supernatural involvement in getting from the universal common ancestor to all the forms of life we see around the world, including us. This came as something of a shock to many people in the religiously minded society that was nineteenth century England.

In short, Darwinian Evolution asserts that nature itself is capable and nature alone is responsible for the development of life. Nature provides the creative mechanism in mutations and the clever animal breeder in the form of natural selection. Combine the two, add in a universal common ancestor and billions of years, and you have all the necessary ingredients to make all of life on Earth.

Although Darwin drew heavily on his knowledge of animal breeding, and although there are great similarities between the principles of animal breeding and his theory, Darwin knew that his theory was fundamentally different in one very important area. Unlike animal breeding, Darwinian Evolution is an unguided, purposeless process with no end goal in sight.

A closer look at animal breeding will reveal the similarities with Darwinian Evolution. To breed different or better animals the breeder

needs access to a population that contains different traits or characteristics. There also needs to be a mechanism for creating new traits if the breeder is to achieve significant change beyond that which is already present in the population. Thus, if the breeder wants to obtain a fast pigeon he will select a fast male and female so as to produce fast offspring. This is natural selection in action, or rather breeder selection in action. But common sense tells us that there is a limit to how fast a pigeon the breeder can produce if he relies solely on selection. Breeding fast pigeons with fast pigeons will not produce even faster pigeons ad infinitum. To get even faster the breeder requires a pigeon with a new trait which gives it an advantage when it comes to speed, like for instance a bigger or more aerodynamic wing. For this the breeder needs a creative mechanism, such as mutations.

The fundamental difference, however, is that if the breeder wants to proceed on the same basis as Darwinian Evolution he has to do away with himself! For Darwinian Evolution the presence of a breeder would be akin to the presence of a supernatural agent, some external force who had a hand in decision making, who played some part in deciding which traits to select and who had some end goal in sight as to what he wanted to achieve and thus what traits had to be selected to achieve that goal. The majority of people in Darwin's day were familiar with the concept of a breeder when it came to life on earth. They called him God.

As far as I am aware Darwin never expressly ruled out a role for God or a supernatural being in 'The Origin of Species', leaving it instead to the reader to draw that fact as being an inevitable consequence of his theory. Modern day proponents of Darwinian Evolution are far less bashful when it comes to explicitly ruling out any kind of supernatural involvement, or more particularly when it comes to emphasising the unguided, purposeless nature of Darwinian Evolution. This can be seen most clearly by returning to the subject of Richard Dawkins and his book, 'The Blind Watchmaker.'

To be honest, it is surprising how many people fail to spot or understand this point, particularly when there is such a big clue in the title of the book! Dawkins begins chapter two by stating the following:

> *'Natural selection is the blind watchmaker, blind because it does not see ahead, does not plan consequences, has no purpose in view.'*

This purposelessness, or blindness is not limited merely to natural selection. It applies equally to mutations. As stated above, not all possible mutations are available to Darwinian Evolution and this is because not all possible mutations are purposeless or blind. Many of the mutations brought about in laboratories are deliberately produced by scientists with a specific purpose or goal in mind. But if Darwinian Evolution has to rely on deliberate purposeful mutations then it has to rely on a breeder, some intelligent agent which causes particular mutations with a specific purpose or goal in view. One might even go so far as to describe what that breeder does as being 'intelligent design' or to give the breeder a name, maybe something original like 'God.'

It follows that if a mutation is to be available to Darwinian Evolution it must have come about in a random, purposeless way. In other words, by chance. Hence Dawkins finishes chapter 2 by stating (in the final paragraph) 'Mutation is random', something he repeats more than once throughout the book.

Dawkins devotes chapter three of his book to explaining how although mutations are random this does not mean Darwinian Evolution is random. As he states:

> *'This belief, that Darwinian evolution is 'random', is not merely false. It is the exact opposite of the truth. Chance is a minor ingredient in the Darwinian recipe, but the most important ingredient is cumulative selection which is quintessentially nonrandom [sic].'*

I do not necessarily take issue with Dawkins' contention that natural selection is non-random. The point I am seeking to emphasise is that natural selection is unguided. It is a blind, purposeless process with no end goal in sight. This has to be the case for mutations because they are random, and by definition something cannot be random if it is not unguided and purposeless. However, whilst non-random may be the opposite of chance, it is not the opposite of unguided or purposeless. A non-random event is capable of being either guided or unguided, but only the latter is allowed for Darwinian Evolution. Thus, in mutations and natural selection Darwinian Evolution may comprise of random and non-

random elements respectively, but both are unguided and purposeless, leading Dawkins to state:

> *'Evolution has no long term goal. There is no long-distance target, no final perfection to serve as a criterion for selection, although human vanity cherishes the absurd notion that our species is the final goal of evolution. In real life, the criterion for selection is always short-term, either simple survival or, more generally, reproductive success. If, after the eons, what looks like progress towards some distant goal seems, with hindsight, to have been achieved, this is always an incidental consequence of many generations of short-term selection. The 'watchmaker' that is cumulative natural selection is blind to the future and has no long-term goal.'*

Conclusion

So there we have the five required elements of Darwinian Evolution. Each and every one has to be proved to be true in order for the theory itself to be true. As we have seen, in order for the theory to be true it must be capable of explaining the bat's echolocation system, the malarial parasite, and the bacterial flagellum. But when I say 'explain' I mean both in theory and in practice, and as I know only too well from recent personal experience, working in theory and working in practice is not always the same thing.