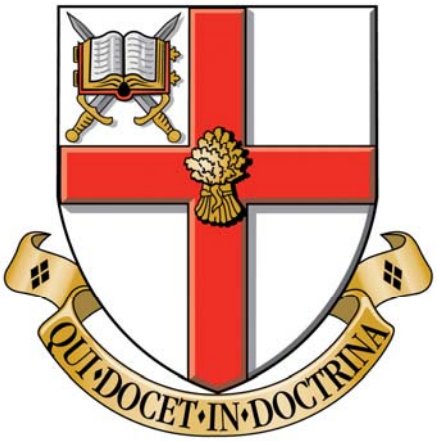

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Not Just Making Babies

A Darwinian Perspective

A transcript of a presentation from the conference

The New Genetics: Critical Perspectives

As a first year undergraduate, I found myself, with some of my fellow students, outside one of the labs puzzling over that term's timetable. "What does one do in a genetics practical?" somebody asked. "Well, I understand getting the results takes about nine months," came the reply, "but setting up the equipment is quite a lot of fun."

In retrospect, virtually nothing we went on to do over the next two years of genetics courses had anything to do with pregnancy or babies per se. Just how a species produces its offspring is of secondary importance to the fact that it does so successfully. That's not to say, as far as humans are concerned, that pregnancy or babies are unimportant but what importance there is is chiefly to the individuals concerned. When a whole species is at stake, the individual is but one of many contributing to the numerical and statistical effects of reproductive strategy. In the wider scheme of biological things, the human way of going about reproduction is only one of a range of strategies and is not necessarily the one that's been done the most or for the longest nor even the best.

Recently, I heard a Professor of Physics from Durham University comment that mathematics and physics were easy sciences. They had clear axioms and rules underpinning all the work that could be done. Biology, he said, was the hardest science - he was glad not to be a biologist, nothing in biology was entirely predictable. But that's

not to say that we can't make some sense of what's going on. Although some prefer to look out into the universe on dark nights and wonder what it's all about, there are much more important questions a lot closer to hand.

I've been asked to speak because of my interest in the emerging science of Darwinian medicine and, I hope, not just because my travelling expenses are the cheapest.

The name of Charles Darwin still elicits a variety of responses more than a century after his death and going on a century and a half after the publication of his book 'On The Origin of Species'. Darwin is responsible for, what I once heard deliberately referred to as, EVIL-lution. Even to those of a less Tertullian frame of mind, Darwinian explanations of a range of biological phenomena seem sometimes to be nothing more than 'just so' stories - like those of Rudyard Kipling; devised, albeit by serious thinkers, to explain away an otherwise incomprehensible world.

So I shall use this time to, in the immortal words of Max Bygraves, "Tell you a story" or rather provide a series of illustrations, without too rigorous argument, which I hope will show how humankind might be viewed from a different perspective. I have come neither to praise Darwin nor to bury him but rather to look from the vantage point he began to erect.

To some, the term 'Darwinism' sounds like a religion and one that seeks to supplant true religion. It is indeed an unfortunate term. But in bringing up religion - as I shall again - I should like to make this somewhat metaphysical point to start with. If God created all life, plant, animal and humanity, then quite correctly God has a relevance to all aspects of His creation. Alternatively, if some natural biological process is responsible for the same, then it is not

inappropriate to argue that that biological process is equally relevant to all aspects of the aforesaid 'creation'. It's not misplaced to make that point here, for it is true that in Darwinism there is probably a bit more 'belief' required than in some of the other more directly hands-on, experimental sciences. Indeed, some have argued that Darwinism isn't, in fact, science at all, while others have argued vehemently that it is. In his intellectual autobiography 'Unended Quest', Sir Karl Popper, who has done more than anyone else to provide a clear basis of demarcation between what is and is not science, describes Darwinism as a 'metaphysical research program'. And so it may prove to be a useful vehicle by which we too might wonder what it's all about.

Darwinism is perhaps better thought of as a banner under which thinkers of a range of opinions rally rather than a specific set of trenchantly held views. From the outset, Darwin and Huxley held quite different opinions about what was responsible for biological change - as did Wallace and as have sympathetic thinkers ever since. The philosopher Michael Ruse, when trying to define what characterized a Darwinian, couldn't and stated:

"In the end, I had to be satisfied with some mushy sociological notion. A 'Darwinian' was someone who thought of himself as a Darwinian, or some such thing."

That's not to say that Darwinians have nothing in common. That commonality is the notion that life, as we now know it, is the product of eons of EVO-lutionary progress.

The fundamental Darwinian or evolutionary stance is put quite concisely by the anthropologist, Wanda Trevathan, when she states that:

"All characteristics and behaviours of a species ultimately can be evaluated in terms of their reproductive consequences. Natural

selection has favoured and will continue to favour genetically based characters and behaviours that enhance reproductive success."

Trevathan's added slant towards behaviour is deliberate because the main thrust of her book - from which these are the opening sentences - concerns not so much the mechanics (or plumbing) of reproduction but the behaviour of parents and children, studied from an evolutionary perspective. That is, studied not in terms of what's going on now only, nor in a wider cross-cultural sense but principally in terms of how certain strategies contribute to the benefit of the human species as a whole by helping it to perpetuate itself successfully.

The story of the peacock and the peahen may illustrate this point. All animals wish to reproduce. The male strategy tends to be to broadcast his seed far and wide in the hope that some will find a place to grow; whereas the female must live with the consequences. Because of the nature of her reproductive physiology, the female has to invest more in the reproductive process than the male. So how does a peahen choose a mate that is worthy of her expenditure on the shared offspring she alone raises? The answer is, by choosing a mate who will provide her with viable offspring in which to carry on her posterity (that is, her genes). That being the case, she must adopt a strategy that, albeit unwittingly and most probably under genetic influence, ensures that she chooses well. We find, naturally enough, that the state of a peacock's tail reflects his physiological ability to grow such a thing. His physiology, in turn, depends on the state of his biochemistry and this, in turn, is a product of his genetic constitution. One might put it another way: the better the peacock's tail, the better the peacock's genes. Thus, it is no surprise to find that peahens respond more favourably to males with tails which are more finely developed and symmetrical than to others. While human partner

choice is very much more convoluted than this, it is within reason to suggest that some element of this basic biological process is nevertheless at work. Give an adolescent male the choice of Sporty, Scary, Baby, Posh, Ginger or Dame Vera, the chances are that he won't bother checking medical records, war records or any sort of records before making his choice.

Previously, Darwinians have focused on biological forms which, by implication, have been 'normal'. The adoption of a Darwinian approach to matters of health and disease is relatively new, having arisen only in the last decade. Importantly, during this time there has been the realisation that taking this slightly different perspective opens up an entirely new category of medically orientated questions.

The type of questions commonly asked by clinicians might be characterized through the story of scurvy. 'Why are so many sailors suffering from scurvy?' it was asked. The first reaction was to assume that scurvy was a venereal disease. But, as we now know, it wasn't the excesses of a sailor's sexual diet that was it's cause but the limitations of his daily diet. The answer to the physician's question was simple (although not originally expressed in these terms) – Vitamin C deficiency. This led to lime juice being carried on board ship as a source of that vitamin. These sorts of questions are still asked but are they really Why-type questions? Clinical questions are often described as 'proximate' as they are seeking nearby answers to problems that, to a Darwinian, have been eons in the making. It is better to describe them as How-type questions. It's more a case of 'How do you turn a previously healthy sailor into a scurvy sea-dog?' The real Why-type questions should be "If this vitamin is so important, WHY do we have to rely on external sources to keep our bodies working properly; WHY don't we have an

internal production of our own?" We do produce some vitamins for ourselves, but not all; just as we make some amino acids for ourselves, but not all. Thus, dietitians talk of essential and non-essential vitamins and amino acids - with essential meaning that it is essential to have these in our diet since that's our only source.

To be able to ask such questions, we must first come to the realization that humans are not only limited by the confines of their bodies in the obvious ways - that they can't fly (unaided) and that they can't swim down to great depths or stay submerged for great periods of time etc. - but also that humans are innately imperfect at doing what they do.

The words of the Psalmist typify a quite contrary attitude endemic to all humankind:

"[4] What is man that thou art mindful of him? and the son of man, that thou visited him? [5] For thou hast made him a little lower than angels, and hast crowned him with glory and honour. [6] Thou madest him to have dominion over the works of thy hands; thou hast put all things under his feet ..." (Psalm 8:4-6)

An example of this type of thinking may be seen in the nineteenth century when the first diagrams were published to illustrate a new tree of life depicting the hierarchy of animal forms. At the very top of the diagram was Man. Perhaps more accurately, nineteenth century, white, middle class English man. And when the Piltdown hoax - the fraudulent discovery of the ancestor of all humankind (Eoanthropus or Dawn Man) - was perpetrated in the early years of this century, it was quite natural that he be found in England and not least, down south.

In the pre-Copernican universe, in which the Earth was the very centre around which all celestial bodies revolved, such a view was not surprising; humans were special, they were in fact made by the Creator's very own hands and since by definition, no divine Creator

can do a botched job, Man was perfect except where he had ruined things for himself. Now, it is evident that, as I said at the beginning "the individual is but one of many contributing to the numerical and statistical effects of reproductive strategy" and may even be at the mercy of some form of biological caprice.

Having found it difficult to characterize a Darwinian, how might one characterize a human being? I appreciate that it's not difficult to recognise one in the street (because they drive cars) but they do come in such different shapes, sizes, colours etc. (that is, the humans not just the cars). More than that, what we see of their variation on the surface is only a small proportion of the differences that are evident internally in both structure and function; at all levels from macroscopic to biochemical.

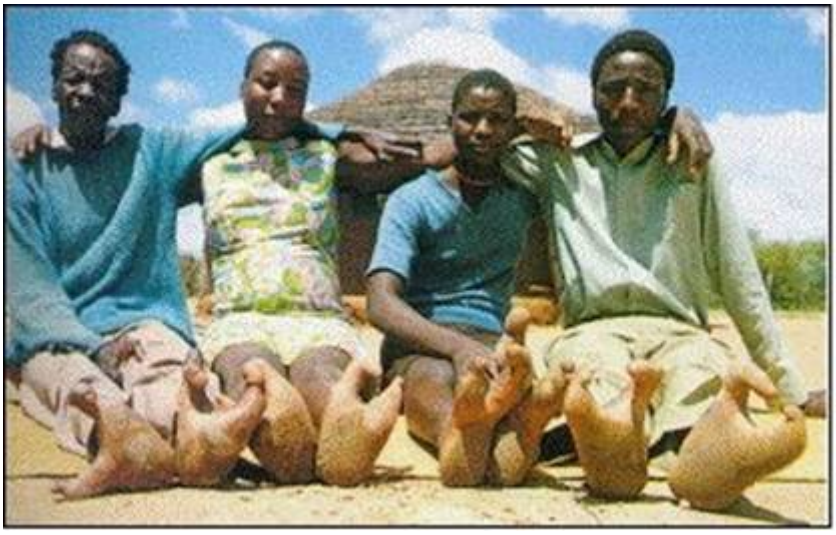
Perhaps three features, in particular, mark out humans from other animals. For want of a catchy aide memoire we could say: head, hands and feet. By feet, I mean, our ability to walk upright habitually; by head, I mean our enlarged, complex brains; and by hands, I mean the ten unassuming and somewhat unspecialized digits we call fingers.

One of the stages through which the hominids evolved prior to becoming modern humans was that of homo habilis or what might be called Handy Man because there is clear evidence for tool use.

I should now like to show myself to be handy by making this hankie disappear. [*I then performed a disappearing hankie trick.*]

You may be asking the How-type question 'How did he do that?' and I won't answer it. On your behalf, I shall ask the more intriguing Why-type question 'Why can he do that trick?'

To quote some more immortal words of Max Bygraves "You need hands." A bit obvious but there are people born with hands of a form that precludes them from ever being able to do this trick. Such people have a condition called ectrodactyly.



This is inherited as an autosomal dominant condition with variable penetrance. The gene which produces it is on the long arm of chromosome number seven. While affecting the hands, it can also affect the feet. Thus, in Africa there is what are called 'Ostrich footed' people. In particular, there are two tribes, the Wadomo of the Zambezi valley in Zimbabwe and the Kalanga of the eastern Kalahari desert in Botswana. The condition is not confined to Africa, though. Until recently, there was a well-documented family with affected hands and feet that formed part of a famous American travelling freak show and probably the best slide guitarist I've ever heard - playing in a street band I happened upon in San Francisco seventeen years ago - clearly had ectrodactyly displayed in both his hands. So it is not necessarily a condition that militates against useful life.

There is a story relating how the gene became established in Africa. I can't vouch for its total accuracy but I did hear it in academic circles. It states that there was a tribe in which a child with

ectrodactyly was born and that this was greeted with great concern that evil spirits had been at work and that the child could not be allowed to remain with the tribe. In such cultures, abnormal births are sometimes viewed as being essentially non-human. Some have it that it is not a deformed human child that has been born but really a hippopotamus and, that being the case, it should be placed with its own kind - in the river. And so it left the tribe. The story goes that a second child with ectrodactyly was born (presumably to the same family) and that it went the way of the first. Then a third child with this condition was born. This time it was decided that it was the gods who were really at work and that they wanted this child to be left with its family. And so, over time the gene for ectrodactyly, having been allowed to remain, became established as a characteristic of that tribe.

It is now generally accepted that the human race did not begin in Southern England but in Africa from whence it migrated out to populate the globe. If those migrants had come from a stock where the ectrodactyly gene had established itself before migrations had begun, then we would all be sitting here with hands and feet that looked like pincers.

Although it illustrates a point, this is not simply a hypothetical story. When Richard Owen, the great nineteenth century vertebrate anatomist wrote the book 'On the Nature of Limbs', he envisaged an archetypal ancestor to all the vertebrates now living. This archetype had five digits on each limb. Even though five is the standard form for our own species and that of a vast number of others, the assumption that our common ancestor also had five digits, although 'obvious', was completely without foundation. Since the mid-1980s, Owen's assumption has been questioned and now paleontological findings have shown that these common ancestors had, in fact, six,

seven, even eight digits - and not five. There has been a change in digit number reflecting, in turn, a change in the genes influencing limb formation.

We are but products of our past and what we call 'normal' is often nothing more than that most frequently experienced.

Most people here will be aware that humans are mammals - they have milk-producing glands with which to feed their young. The reason they can digest that milk is because they produce an enzyme which breaks down the difficult-to-absorb milk sugar into more easily absorbed sub-units. Once a child is weaned naturally, it's mother no longer produces milk - it would be energetically wasteful for her to do so. But since there are usually no milk sources available to the average newly weaned mammal, it would be wasteful for milk-digesting enzymes to continue to be produced. Thus, we find that mammals can drink milk as infants but not necessarily as adults. However, as we all know, adult humans can - or rather some of them can. Most Europeans and a number of African groups can drink milk but the Chinese, Japanese and some other Africans can't. To be able to drink milk as an adult resulted from a genetic change or mutation that allows sufficient enzyme to be produced even after weaning.

If milk drinking is deemed normal, it is only normal to those mutants who practise it. It is not a characteristic of the whole of humankind. One of the important effects of this gene has been the way in which it has influenced agriculture. There's no point having dairy herds if you can't sell the milk. It's also interesting to note that the man who devised the macrobiotic diet - in which all dairy products are avoided - was of Japanese extraction.

I used the term 'mutant' just then quite deliberately. It is a word overlaid with fearful connotations mainly resulting from the post-nuclear, sci-fi horror movies of the 1950s in which giant ants over-ran Los Angeles and the Amazing Colossal Man grew to huge proportions after being blasted by a plutonium bomb.

Alteration of existing genetic material is the only way to produce new genes. This process of alteration is, in fact, mutation. All the genes that we possess have arrived by this process at sometime in the past - be it more recently or millions of years ago.

There is an argument that proposes that, since birds are the last surviving descendants of the dinosaurs (who have been gone for tens of millions of years), if anybody really wanted to make 'Jurassic Park' come true, then they shouldn't mess about with insects in amber but take a fertilized bird egg and find a way to turn on the ancient dinosaur genes that are still in there but which are now no longer expressed.

People often worry that we might create a society of genetically altered people. Consider a society actually setting out to do this. In it there is a 'problematic' gene, a copy of which is present in 20 out of every 1000 people. It is a gene which only manifests itself in those individuals who inherit two copies of it - that is, those who are homozygous for that gene. That society decides to prevent the conception or birth of all such homozygous individuals. If we could be totally confident that in every subsequent generation we did eradicate all such individuals, and there isn't what might be called the Moses effect - the occasional avoidance of irradiation by the targeted - then it would take 25 generations to reduce that gene's frequency from 20 to 16 per 1000 people; that's 80% of what it was. At 20 years per generation (which is rather short by current standards), that's at least 500 years. No cost/benefit analysis is

necessary to see what small returns accrue from such necessarily vast efforts.

We should note, however, that nature has a way of doing this that is more persistent and thorough, more blind and ruthless than any political programme could ever be. This is natural selection. When the action of natural selection on a problematic gene prevents an individual from producing any offspring, then those individuals are simply dead-ends.

From natural selection, there is no hiding place in the bulrushes.

But WHY is it that if natural selection is so efficient, we can still observe such high frequencies for genes like cystic fibrosis which are not entirely conducive to reproduction? Surely, natural selection has had enough time to minimise such a gene's frequency?

There are a number of hypotheses about why the cystic fibrosis gene, in particular, is still so common. These vary in detail although not in principle. The cystic fibrosis gene conveys, it is suggested, a biological benefit. Clearly, this is not a benefit to those who inherit two copies but rather to those who inherit just one. It is important that these benefits are seen in the context of the environment from which we have come and over which we exerted relatively little modifying influence until recently. In such settings, there will have been many opportunities for our forebears to be assailed by a variety of ailments. Those whose genetic constitution enabled them to survive such ailments were those likely to leave not just more offspring but more offspring like them genetically. These would, in turn, leave more offspring of their own - and so on.

It is possible to demonstrate using theoretical models and to observe, in a variety of human populations, the stabilization of

certain gene frequencies resulting from the interaction between genes and environment.

Opinions vary as to the precise benefit of having a single cystic fibrosis gene. The suggestion that it protects against diarrhoeal disease now seems to have been largely excluded, as does the suggestion that it might convey greater fertility in some way. This leaves two current ideas: that it guards against asthma or that it conveys resistance to endemic infections, such as influenza, typhus, bubonic plague, syphilis or tuberculosis.

It has also been suggested that there is a 'dyslexia gene'. But if one pauses to think what this really implies, the suggestion should be a nonsense. I stressed just now that one has to see genes in the context of the environment from which we have come - indeed, the environment in which these genes first established themselves. By and large, that environment was non-literate. Dyslexia, however, can only show itself as such in literate societies. In fact, it is only now, in having a literate society, that such a gene can manifest itself as a problem. It is only now, in having a literate society, that we can call a gene a 'dyslexia gene' at all. Previously, it would have had to have been a gene for something else.

What this story really tells us is that, even if there is a genetic basis for dyslexia, it is, in fact, quite wrong to argue that it has a genetic cause. Societies that require its members to be literate are only a very recent phenomenon. By changing the parameters in which people must live, society, it might be argued, is the cause of dyslexia; not the gene.

Although described only as recently as the last century, Down's Syndrome may have a history much older than that of the human race. A condition equivalent to Down's Syndrome has been reported

in our biological cousins, the chimpanzees. The possibility exists that both humans and chimpanzees have inherited the capacity for this condition from a common ancestor. But just as dyslexia was no problem in an environment that was yet to insist upon certain intellectual skills, so too it has been suggested that the problems of Down's Syndrome have now become exacerbated where once they could be more readily accommodated. If the biology of Down's Syndrome hasn't changed in thousands, if not millions, of years, is there a benefit for the species here too? I simply don't know and I'm unaware that anybody has even posed the question in this way and I must leave this one unanswered.

Genes are also suggested as a cause for other brain-based phenomena; schizophrenia is one. I choose to use this as an illustration knowing virtually nothing about the condition, except that, as a student, the lecturer who spoke on this topic went to great lengths to discredit everything Freud had said about it. (Indeed, she went to great lengths to discredit everything Freud ever said.) She also went on to propose the hypothesis that most, if not all, religious experience was simply a manifestation of schizophrenia. The implication here was that a diagnosis, or more accurately the mere suspicion, of schizophrenia disqualifies everything one has to say about anything.

The theologian, Karen Armstrong, takes a different line. She suggests that Saint Paul may have been an epileptic and that this may be the explanation for his mysterious 'thorn in the flesh' and could also account for his experience on the road to Damascus. She goes on to suggest that rather than this being a basis for disqualifying the genuineness of Paul's religious experiences, it should be seen rather as the very vehicle through which God chose to reveal Himself.

Latterly, I have slipped into talking in terms of 'genes for ...' dyslexia, schizophrenia (and perhaps by implication) epilepsy, where there may be, in fact, no firm basis, as yet, for these suppositions. But I do so with less concern about biological accuracy than with getting to the story on which I wish to close. In these last few illustrations, one's attention may seem to have been focused on biologically-based phenomena but it was not, in fact, biology that was primarily at issue but rather our approach to those conditions. Are we so ready to accept that a gene causes a condition that we overlook the logical consequences of such assumptions? Are we too ready to use conditions and perhaps the genes that influence them as disqualifiers? This is for people to decide. Some of those people may be those who do biology but I do not think biology of itself will decide.

The so-called 'gay gene' has been in the news again - at least it was on 'The News Quiz' last week. At Berkeley in California, Marc Breedlove took two groups of male rats. In short, one group copulated with females at will, the other group didn't. Upon post mortem study of nerve cells in the spinal cord, distinct differences were noticeable, corresponding to what the rats were or were not doing. The hypothesis that has been forwarded from this work is that, since sexual activity seems to have a morphological effect on the spinal cord, does it not also have an effect on the brain which is an even more plastic organ? In turn, this asks whether features said to be associated with the brains of homosexuals really are, as originally suggested, innate, genetically-based features; they might after all be simply the product of sexual life-style. Much argument is sure to follow from this work. I would have to say, having read the journal article in which these findings were reported, that I would expect to see the same neuronal changes in the aforementioned adolescent Spice Girl fan for quite different reasons.

But I seem to have been asked about the possible gay gene more often than about any other of known action. I have to answer that people have a tendency to attribute to genes values of good or bad; acceptability or unacceptability; qualifying or disqualifying.

Some want there to be a genetic basis for homosexuality so that they can argue that it's simply a natural biological phenomenon.

Some want there to be a genetic basis for homosexuality so that they can argue that it's simply an aberrant biological phenomenon.

To a Darwinian, there are no good or bad genes in the human sense and certainly no way of using biology to act as some sort of arbiter that can make decisions for us. Instead, if a gene aids reproductive success, Darwinians deem it to be beneficial, irrespective of what else it might do. As we have already seen, a gene can kill individuals while contributing to the survival of a species. The system of values we see operating in biology is not the same as that used by people - indeed, it is not uncommon for people to find the mere description of these 'values' deeply offensive.

I doubt if I've 'succeeded' in doing that but I do hope that I've shown a glimpse of a quite different perspective.