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SELFISH GENES – A MISTAKEN THREAT

SYNOPSIS

The aim of this essay is to examine the scientific validity of selfish gene theory, and then its supposed threat to human dignity. In the first section, Darwin's theory of natural selection is presented and the importance of individual reproductive success explained. The problem of explaining altruistic behaviour is then considered, with the errors of 'good of the species' and 'group selection' arguments exposed. Hamilton's theory of kin-altruism proves acceptable, with his concept of inclusive fitness as that which natural selection maximizes. Dawkins prefers emphasis on genes, regarding inclusive fitness as contrived from gene selection. The question of whether the two positions are equally correct is considered, with evidence favouring Dawkins' view point. The supposed threat of selfish genes is seen to be that of determinism. Traditional arguments for human free-will, such as a separate soul or unpredictable brain, are examined and rejected. It is Mackay's argument for logical indeterminacy that provides the solution. Although gene selfishness is not conscious, selfish genes may be regarded as one factor contributing to the fallen nature of man and creation.

INTRODUCTION

"We are survival machines - robot vehicles blindly programmed to preserve the selfish molecules known as genes" - so says Richard Dawkins in the preface to his book *The Selfish Gene*.¹ At first sight, it is not surprising that Dawkins' views are found disturbing by Christians and Humanists alike, both groups seeing them as a threat to human dignity. Many eminent biologists are similarly non-plussed by the selfish gene concept, finding it difficult to equate with the co-operation and integration of genes within the bodies of organisms they have studied.

What then do we make of Dawkins' 'selfish genes'? Are they simply a piece of science fiction, suitable for the paper-back book stall, but definitely not the academic library? Are they perhaps just an alternative way of understanding evolution? Even Dawkins suggests this as one possibility, with the 'necker cubes' analogy on the cover of his second book *The Extended Phenotype*.²

In this essay, I will first look at the historical background and scientific validity of selfish genes. I then hope to establish their status, not simply as one option when thinking about natural selection, but as the *only* accurate description of the mechanism of evolution. Finally, some of the implications for Christians will be examined, in particular the biblical view of the nature of man. My aim is to show that the supposed threat to human dignity is a mistaken one.

NATURAL SELECTION

The idea that living animal and plant species arose by an evolutionary process was proposed at various times in the eighteenth and nineteenth centuries. The reason that 'evolution' is now so closely associated with the name of Charles Darwin, is that he was the first to put forward a convincing mechanism - natural selection. This is seen to be the logical conclusion of three general observations from the biological world:-

- 1) Over-population - animals and plants produce more than two offspring per mated pair per lifetime, but population levels do not continually increase.
- 2) Variation - members of the same species show variation in many of their traits.
- 3) Heredity - individuals tend to possess traits similar to those of their parents.

The over-production by parents, e.g. female salmon may produce five million eggs, does not swamp the world with their fully grown offspring, because the majority succumb to predation, starvation and the like, before reaching adulthood. The trait variation between individuals means that some are more likely to survive and reproduce than others. It is those traits which confer the best ability to survive and reproduce, that are most likely to be passed on to the next generation. Thus, gradual evolution of species towards improved survival ability and reproduction potential is envisaged.

It was in 1858 that Darwin first published an article on his theory, jointly with another English naturalist, Alfred Russel Wallace; Darwin's revolutionary book *On the Origin of Species by means of Natural Selection* came out a year later. It was on the urging of Wallace that in 1866 Darwin adopted Herbert Spencer's phrase 'survival of the fittest', in order to emphasize the lack of thought and direction in the operation of natural selection. Unfortunately, the phrase has proved rather confusing, considered by some to be a tautology, as indeed it is if fitness is defined as a measure of survival ability. However, it is clear that the ability to survive is only indirectly advantageous in evolutionary terms, in that it may increase reproductive potential. A trait which enables an individual to give rise to more surviving offspring than other members of the species, will tend to spread within the population even if it reduces an individual's expected lifetime. This is an important point in the explanation of characters such as bird song, deer antlers and bright plumage which often benefit reproductive ability at the expense of survival ability. 'Fitness' is generally defined as that quality which natural selection tends to maximize, and has been commonly regarded as the product of survival time and fecundity, in other words, reproductive success.

One problem which Darwin faced in the decades towards the end of his life, was the total lack of knowledge concerning the mechanism of heredity. Ironically, the experiments which provided the first insights into this process were being carried out by the Austrian monk Gregor

Mendel at the same time as the "Origin of Species" was being written. His work only became widely known when rediscovered in 1900, sixteen years after his own death and eighteen after that of Darwin. Mendel's breeding experiments using pea plants revealed that inherited traits are governed by pairs of factors that separate during the formation of gametes and recombine on fertilization. Factors governing different traits usually assort themselves independently between gametes. These fundamental laws of heredity form the basis of modern genetics, with Mendel's factors controlling trait expression now known as 'genes'. The combination of Mendelian genetics and natural selection has developed into a comprehensive theory of evolution, often called neo-Darwinism or the Modern Synthesis.

THE PROBLEM OF ALTRUISM

By the 1950s most biologists accepted that Darwinian theory provided a very convincing explanation of the adaptation of a species to its environment, due to the maximizing effect of natural selection on survival and reproductive abilities. This applied not only to morphological traits, but also to animal behaviour - a realization for which Konrad Lorenz was largely responsible. He suggested that innate behaviour patterns could be thought of in the same way as morphological traits, both determined by the inherited genetic code and shaped by natural selection on an evolutionary time-scale.³ Although Lorenz perhaps underestimated the importance of learning in behaviour, the fact that the instinctive elements of an animal's behaviour are as much evolutionary adaptations as inherited morphological features is now clearly established.

The recognition of this evolutionary aspect to animal behaviour led some ethologists to attempt an explanation of apparently altruistic social behaviour in terms of natural selection. Most argued along the lines that an altruistic trait would be favoured by natural selection, because it would benefit the species. A good example is Lorenz's ideas concerning the ritualization and inhibition of aggression between members of the same species.⁴ However, there is a basic flaw in the 'good of the species' argument: suppose

that a selfish individual happens to arise by mutation in an altruistic species. This individual would gain benefit from the altruism of his contemporaries, but without the cost of giving altruism himself; he is likely to have considerable reproductive success and thus the gene for selfishness would become increasingly common in succeeding generations. In the long term the elimination of altruism would in one sense be detrimental to the species, but to the blind process of natural selection this is irrelevant. The same flaw is found in explanations of altruistic behaviour based on the benefit accruing to a small group within a species - 'group selection'. This is not to say that groups containing altruistic members do not have higher reproductive success than selfish groups; but rather that the selective turnover of individuals is so much faster than the turnover of groups, that the effects of natural selection favouring altruism are simply out-paced by those favouring selfishness.

Was Lorenz incorrect in his observations of ritualized aggression? Certainly not, he simply gave the wrong explanation for those observations. A preferred interpretation of ritualization is that it is beneficial to all combatants from a selfish point of view not to settle disputes by physical fighting, since each avoids the risk of serious injury. It is important to realize that this selfishness is not necessarily conscious, but the result of natural selection operating on a species' instincts.

Is individual selfishness the basic rule which underlies all social interactions other than between parents and their offspring? One interesting and important reason why this is not the case, was first recognised by W.D. Hamilton.^{5,6} He noted that natural selection maximises reproductive success rather than individual survival, because reproductive success is a measure of success in passing on genes to the next generation. The significance of this point is that traits which cause an individual's genes to be passed on will be favoured, even if the individual is not a direct ancestor of the future individuals possessing the genes. Hamilton realized that the close relatives of an individual will possess some of his genes by common descent; therefore a gene for kin altruism could be favoured by natural selection if

the benefit to the reproductive success of kin possessing that gene exceeded the cost to the altruist in terms of his own reproductive success. The probable proportion of an individual's genes which kin possess is predicted by their degree of relatedness, e.g. full siblings - one half, uncles - one quarter, first cousins - one eighth; net benefit to an individual's genes is therefore less likely as the degree of relatedness to the recipient of altruism decreases. Hamilton recognized that parental care was only a special case of kin altruism, favoured by natural selection because of the close genetic relationship between parent and offspring.

Hamilton's theory necessitated a new definition of fitness, since individual reproductive success was seen to be too narrow. He therefore broadened the term to 'inclusive fitness', which many people have thought to be the sum of an individual's reproductive success, plus half the reproductive success of each sibling, plus an eighth of the reproductive success of each cousin and so on. The fallacy of this view is illustrated by the fact that if a female gives birth, then the inclusive fitness of her siblings and those of her mate will increase, whether or not they assist the infant, or even if they are thousands of miles away. The true definition of inclusive fitness is, 'an individual's own reproductive success, plus his *effects* on the reproductive success of his kin multiplied by their relatedness, minus the effects of kin on his own reproductive success'.

Maynard-Smith called the process of natural selection favouring altruism towards kin - 'kin selection'. Unfortunately, Hamilton's theory is still prone to misunderstanding twenty years after its inception⁷. For example, kin selection does not imply that animals consciously calculate their degree of relatedness to those around them before behaving altruistically, it is again a case of natural selection blindly shaping the instinctive behaviour of a particular species. Often the identity of relatives will not be entirely clear - however, a 'rule of thumb' might be employed, e.g. behave altruistically to individuals in your troop since they are likely to be closely related to you. This is definitely not the same as group selection.

SELFISH GENES

Richard Dawkins first published *The Selfish Gene* in 1976; this was followed in 1981 by a book aimed more specifically at academics, *The Extended Phenotype*. Dawkins' basic proposal is that the unit of natural selection, that to which we refer when we say an adaptation is 'for the good of' something, is the 'gene'. He argues that the blind process of natural selection involves the differential survival of genes from generation to generation - it is those genes whose effects happen to increase their own chances of survival which will tend to spread through the population. Natural selection thus results in gene 'selfishness', which may manifest itself at the level of the individual organism, either as individual selfishness or as altruism towards kin. Hamilton explicitly acknowledged gene selection as the basis for his theory of kin altruism; but rather than maintaining this emphasis on genes, he translated gene selection to the level of the individual by creating the concept of 'inclusive fitness'. Dawkins regards inclusive fitness as somewhat contrived and in his own words, "the instrument of a brilliant last-ditch rescue attempt, an attempt to save the individual organism as the level at which we think about natural selection."

What exactly are the genes to which Dawkins refers? Since Mendel's day there have been rapid advances in the study of genetics. These include the elucidation of the genetic code as the sequence of nucleotides making up deoxyribose nucleic acid (DNA) molecules in an organism's chromosomes. The nucleotide sequence specifies the sequence of amino acid residues in the proteins synthesized by animal and plant cells - it is proteins which regulate the physiological activity within an organism, linking the inherited genetic code (genotype) with its physical manifestation (phenotype). Many people assume that the term 'gene' refers to the nucleotide code for a protein. However, alternative definitions are also used, e.g. the minimum unit of mutational change, or the minimum unit of recombination.⁸ Dawkins uses the term in yet another way - as any stretch of DNA long enough to have a consistent phenotypic effect, but short enough to have a degree of

longevity before dissection at a cross-over event. It is the 'gene' defined in this non-discrete way which is the unit of natural selection, since it functions as an 'active germ-line replicator'; a 'replicator' in the sense that it is accurately copied, 'active' in the sense that it influences its probability of being copied and 'germ-line' in the sense that it is potentially the ancestor to an indefinitely long line of descendent replicators.

Is Dawkins wrong to suggest that genes are selfish? He is no more inaccurate than those who suggest that natural selection produces selfish individuals. Genes do not consciously decide how to pass on as many of their replicas as possible to the next generation, nor do individuals consciously attempt to maximize their inclusive fitness; both however, behave as if they did, hence the usefulness of the 'selfish' description. Does the finely-adjusted integration of genes within individual organisms, conflict with selfish gene theory? The genes within an individual are certainly well-integrated, but this is because it is selfishly advantageous for each gene concerned. There is usually nothing to be gained in terms of replication success by non-integration, and any deviant mutant genes which arise will be rapidly eliminated by natural selection. In a sense, a gene is in competition with its alleles (alternative genes which can occupy its position in the chromosome and fulfill its role in a slightly different way); it competes for its particular locus in the chromosomes of the next generation. However, there is no such competition with other genes, and selfish gene theory actually predicts the integration of genes at different loci.

GENE SELECTION - JUST AN ALTERNATIVE?

Gene selection seems a reasonable enough alternative to individual selection, but is it any more than this? One approach to this problem is to look for situations where natural selection cannot be explained by, or conflict with, maximization of inclusive fitness. Good examples include transposable elements and segregation distorters:-

Unlike most pieces of DNA, transposable elements have the ability to replicate independently of normal chromosome replication, their copies can then integrate into various other positions in the genome. This enables them to spread very rapidly through a population, often carrying other genes with them as well as altering the phenotypic effects of genes in the vicinity of an integration point. Their spread cannot be explained in terms of inclusive fitness, but is totally acceptable from a gene selectionist view-point. Since they were first discovered by McClintock (1950) in maize plants, transposable elements have been found to be common in a wide variety of organisms.⁹

During gamete formation, the two homologous sets of chromosomes in normal cells (diploid) separate to produce haploid cells with one set of chromosomes. If a segregation distorter is present in only one set of chromosomes in the diploid cells, then those gametes which do not contain the distorter gene self-destruct, apparently due to a sabotage mechanism. This is of selfish benefit to the distorter because it is then present in all gametes produced by the individual, not just fifty per cent. When an individual possesses segregation distorters in both sets of chromosomes, then all gametes are sabotaged and the individual is sterile. These intriguing genetic elements have been best studied in drosophila and evidence suggests that they exist at levels higher than those expected by spontaneous mutation alone.¹⁰ Their success reduces an individual's inclusive fitness due to the wastage of gametes, but is to be expected under selfish gene theory.

Dawkins' own approach to establishing the importance of gene selection, as opposed to individual selection based on inclusive fitness, is as follows: he argues that animal communication should be regarded not as mutual co-operation for the transfer of information, but as the manipulation of the receiver by the sender. We are already used to the idea that an animal's phenotype can include features not strictly part of its body, e.g. different caddis fly species, when larvae, each construct a distinctive protective home out of small stones and twigs. We are also used to the idea that an animal's behaviour is very much part of its phenotype.

Dawkins proposes therefore that the manipulative aspect of animal communication implies that genes in one animal can exert phenotypic effects on the body of another animal. If the phenotype of genes is no longer restricted to the body in which they sit, but extends to other bodies, then the commonly assumed exact correlation of natural selection based on individual inclusive fitness with that based on gene selfishness, will break down. Dawkins' argument is fully and lucidly expressed in *The Extended Phenotype*.

DETERMINISM AND FREE-WILL

Why is it that most people find the idea of Dawkins' selfish genes so disturbing? The reason is that they immediately associate them with 'genetic determinism' - the idea that human behaviour is under the control of those dreaded genes. This is seen as a affront to human free-will, the blind mechanisms of DNA making our future frighteningly inevitable. Dawkins points out the error in this view that genes are somehow super-deterministic; in a world where all matter behaves in a methodically predictable way, behaviour which is shaped by the environment rather than being primarily innate, will be no less deterministic. The problem is mechanistic determinism, full-stop; whether the inevitability of behaviour carries a 'genetic' or 'environmental' label is irrelevant.

For Christians, the problem of future inevitability is compounded by the biblical teaching that God is Sovereign over all events in the physical universe,¹¹ including the affairs of mankind.¹² In the New Testament, Paul refers to a divine plan and God "working out everything in conformity with the purpose of His will".¹³ The traditional answer to the free-will dilemma is to propose that man possesses in addition to a body, a separate spiritual part - the soul - which is outside the physical universe and therefore free from the clutches of determinism and God's sovereignty. In recent years many theologians have become unhappy with this bipartite view of the nature of man, suggesting that its origins lie in Greek philosophy rather than the biblical text. The idea that it provides a solution to the source of human free-will also carries a serious logical flaw; if God

is sovereign over everything that happens within the physical universe, including the activity of our bodies, then how can a separate soul have any effect counter to the sovereignty? As well as this, proponents of a separate soul have difficulties providing a mechanism for the interaction between body and soul. Descartes suggested the pineal gland as the contact point between our bodies and our immaterial minds, but there is no evidence to suggest that any human tissues behave at all differently from other pieces of physical matter.

A preferred interpretation of the words 'soul' and 'body' is given by Professor R.S. Wallace in the *New Bible Dictionary*; he proposes that they are used in the Bible "according to the different aspects of man's activity or being which it is intended to emphasise ... The use of the word 'soul' may emphasize his individuality and vitality with emphasis on his inner life and feeling and personal consciousness. The use of the word 'body' may emphasize the historical and outward associations that affect his life. But the soul is, and must be, the soul of his body, and vice versa".¹⁴ Convincing proof of the identification of our conscious thought processes with the activity of our brain cells, comes from work on the psychological effects of brain damage. Professor Gareth Jones in his book *Our Fragile Brains* gives several tragic examples of disruption to personality, memory and information integration as a result of lesions to specific parts of the brain.¹⁵

Is then our mind, our personal consciousness, simply an epiphenomenon of our brain cell activity? The answer is No, for although our conscious experience does have an explanation in terms of atoms and molecules, brain cells and impulses, there is no reason why these levels of explanation should be more significant than an explanation in terms of beliefs and emotions etc. A useful analogy is that of a wooden sign-post: at one level it can be described in terms of atoms and molecules, at another level as a particular arrangement of wood and paint, and at another level as a sign-post indicating that London is five miles to the West. The molecular level provides a complete description of the sign-post, but definitely does not give all the most useful information.

Another route to an explanation of human free-will is to suggest that there is a degree of unpredictability within man's brain. However, a moment's thought will reveal that the exact opposite should be expected - only if the components of a man's brain behave in a regular way, will he be able to make consistent, rational and sensible choices. The predictable behaviour of matter, which forms the basis of mechanistic determinism, rather than being in conflict with human choice, is in fact highly desirable in man's environment and within his brain in particular. I am not advocating that matter is necessarily deterministic to the extent of being totally predicatable, but we should certainly not expect our brains to be any less deterministic than other matter in the universe.

LOGICAL INDETERMINACY

Must we accept Dawkins' suggestion that our apparent free-will is simply an artefact of our complex central nervous system? Does the subjection of our future to God's sovereignty and the mechanistic operation of our brains imply that our future is inevitable? The answer, somewhat surprisingly, is No.

What do we mean by 'inevitable'? An inevitable event, e.g. the rotation of the earth at twenty-four-hour intervals, is one that will take place whether we like it or not, or whether we believe it or not, i.e. we are correct to believe it will happen and incorrect to believe that it won't. There is a fundamental difference between events such as the rotation of the earth, and our future actions, in that the latter are not independent of what we believe. Our beliefs, or if you prefer the configuration of impulses in the cognitive regions of our brains, will have considerable bearing on the actions we do. This relationship between our beliefs and actions affects the inevitability of those actions in the following way:

Suppose that you are shown a plan of your future. Remember that for the plan to be inevitable for you, you must be correct to believe it and incorrect not to believe it. If the plan has not taken into account the effects of your

future actions that your believing it will have, then you will be incorrect to believe it, i.e. the plan will turn out to be inaccurate if you believe it. If however the plan has taken into account the effects of you believing it, then you will certainly be correct to believe it, but you will also be correct if you don't believe it because the plan has been adjusted to take into account your belief. We therefore come to the conclusion that there is no unconditional plan of your future which you would be correct to believe and incorrect not to believe.

This property of man's future is known as 'logical indeterminacy' and was first recognised by Donald MacKay, Professor of Communication at Keele University.¹⁶ It shows that despite the existence of an unconditional divine plan of our future, there is no such plan that is inevitable for us. Many people find it hard to believe that something which is true for one person (in this case, God) is not necessarily true for another (in this case, man). In this respect, logical indeterminacy is similar to Einstein's theory of relativity. It is important to realise that it is not simply a case of a man 'feeling' that his future is not inevitable, it is a question of what he is correct to believe. A man presented with a plan of his future actions, might well be perfectly correct to believe it, but if so, he would also be perfectly correct not to believe it. The inevitability of our future, although relative, is objective not subjective.

MANKIND AND SELFISHNESS

We have seen that man's lack of a soul and the mechanistic operation of his brain does not conflict with his free-will, in the sense that his future is not inevitable from his own point of view. Does this mean that animals and machines can also be regarded as having free-will? The fundamental difference between man and animals or machines is his ability to think in abstract terms. The significance of this is seen in the dependence of the logical indeterminacy argument on the ability to entertain beliefs - it is only mankind for whom the question of future inevitability is a comprehensible issue. It is also man's cognitive faculties which confer on him moral responsibility, not only in the

non-inevitability of his future from his point of view, but in his ability to comprehend moral good and evil. Biblical evidence for this comes in Genesis 3 (taken literally or otherwise) where the Fall of Man was the result of eating from the tree of the knowledge of Good and Evil.

What then of the moral implications of selfish genes? I have stressed throughout this essay that gene selfishness does not imply that genes possess conscious thought, but only that they behave as if they do. Man, as a product of natural selection, necessarily possesses selfish genes, but these are only one factor influencing his behaviour and do not detract from his moral responsibility which (as we have seen) results from his cognitive faculties. Having said this however, the tendency towards individual selfishness which selfish genes are likely to induce, surely conforms well with the Bible's view of man's inherent sinfulness.¹⁷ We have already noted that evolution by natural selection does not involve a striving towards a pre-conceived goal, it is a blind process which will continue as long as matter behaves in a predictable way. This accords with the biblical view that the world is condemned to futility,¹⁸ and man's selfish genes can thus be seen as an intimate link between his own fallen nature and that of the world around him.

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