Memetics: a Darwinian pseudo-science.

C. R. Hallpike

1. *The memetic World View.*

The conquest of culture is a long-standing ambition of some biologists, who regard claims for its uniqueness as a kind of Creationism. Sociobiologists (e.g. Alexander 1979) have asserted that kin selection and reciprocal altruism give us the key to understanding culture, but other biologists have been more sceptical. So Dawkins says of socio-biology: 'These ideas [kin selection and reciprocal altruism]...do not begin to square up to the formidable challenge of explaining culture, cultural evolution, and the immense differences between human cultures around the world...' (Dawkins 1978:205) He is one of a number to propose that the gene itself is just one example of the more general category of a *replicator*, a unit of information or instruction that can make copies of itself and which can be passed on in some way, and that another example of a replicator is the meme. This is anything in human culture that can be imitated – an idea, a tune, a dress fashion, and so on – and like the gene has the sole 'purpose' of replication, of making copies of itself:

> Both biological and cultural evolution involve *nothing but* [my emphasis] the differential propagation of instructions: soma and society are merely an instruction's way to make more instructions. They [soma and society] are epiphenomena. Evolution is not about the survival of the individual carrier of an instruction; it is about instructions competing with each other to increase their (respective) frequencies. (Barkow 1978:11)

It is worth reflecting for a moment on the very different origins of the gene and the meme. The idea of the gene was developed as a response to a specific research problem, Gregor Mendel's attempt to discover how the traits of plants are passed on from generation to generation. As is well known, from experiments with the hybridization of garden peas, he showed that traits such as tall or short stems, yellow or green pods, and round or wrinkled peas did not blend into intermediate forms over successive generations, but remained constant, and that their relative frequencies in each generation conformed to predictable mathematical ratios. He concluded, very reasonably, that these traits each had to be based on some kind of hereditary 'element' (gene); that each plant received one variant (or allele, in modern terms) of the gene from each parent; that the genes were inherited separately, and were not linked; and whether a gene was expressed depended on whether it was dominant or recessive.

This allowed him to explain the ratios of the trait frequencies in successive generations. The origins of the meme, however, could hardly have been more different.

Whereas Mendel's idea of the gene derived from specific problems in the heredity of plants, the idea of the meme was not stimulated by any specific research problems in the social sciences. On the contrary, it was proposed by biological theorists and philosophers with no background in the social sciences, but who, in the pursuit of an ideological agenda, wished to apply neo-Darwinian theory to human society. The history of the meme (and similar concepts) shows that it is the expression of a World View, a whole philosophy of life which believes that natural selection is the algorithm that explains not just biological evolution, but emergent order of every kind, Universal Darwinism.

> If I were to give an award for the single best idea anyone ever had, I'd give it to Darwin, ahead of Newton, Einstein and everyone else. In a single stroke, the idea of evolution by natural selection unifies the realm of life, meaning, and purpose with the realm of space and time, cause and effect, mechanism and physical law. (Dennett 1995:21)

Blackmore's admiration is equally extravagant:

> Darwin's theory of evolution by natural selection is, to my mind, the most beautiful in all of science. It is beautiful because it is so simple and yet its results are so complex. It is counter-intuitive and hard to understand but once you have seen it the world is transformed before your eyes. There is no longer any need for a grand designer to explain all the complexity of the living world. There is just a stark and mindless procedure by which we have all come about – beautiful but scary. (Blackmore1999:10)

Darwinism is therefore 'a scheme for creating Design out of Chaos without the aid of Mind' (Dennett 1995:50), and that, as we shall see, includes human minds as well as the Divine Mind. Indeed, this Universal Darwinism extends not only to biology and the evolution of human sociocultural systems, but to the universe as well, and Dennett argues that the physical laws of our universe could also have evolved by natural selection acting on an infinity of different laws of physics over sufficient time (ibid., 177-80).

Creationism is obviously quite irrelevant to social evolution: no one suggests that agriculture, the early state, or writing were the results of Divine intervention, but *human* design might seem to have played a fairly obvious part in their evolution. One of the basic aims of memeticists, however, is to deny this, on the grounds that, like God, we are also an illusion, created by the memes themselves.

> To start to think memetically we have to make a giant flip in our minds just as biologists had to do when taking on the idea of the selfish gene. Instead of thinking of our ideas as our own

> creations, and as working for us, we have to think of them as autonomous selfish memes, working only to get themselves copied. We humans, because of our powers of imitation, have become just the physical 'hosts' needed for memes to get around. This is how the world looks from a 'meme's eye view'. (Blackmore 1999:8)

So if we are told that we do not really take an aspirin to cure our headache, but that the 'aspirin for headache' meme has actually been using us to replicate itself, there is no point in criticizing this as bizarre, since the memeticist would take it as a compliment, that only goes to show what a revolutionary insight is provided by the meme's eye view. Revolutionary it may be, but is it true? To make good its claim, it must pass some precise and stringent tests, which will occupy the rest of this paper.

It should be emphasised, however, that it is possible to base a Darwinian theory of culture simply on the notion of variation, and the relative frequency of those variants, without the need to postulate that they take the form of *replicating particles* like memes. Mesoudi *et al*. (2004:2-4), for example, propose exactly this, and I also use it as the most plausible form of a Darwinian theory of culture in *How We Got Here* (2008:4). Our specific concern here, though, is the meme, and assessing the claims of its proponents that it is an essential concept for a scientific explanation of human society and culture.

2. *What evidence is there that memes exist at all?*

One of the main reasons for the popularity of the meme idea is precisely that it seems so clear and simple: memes are the cultural analogue of genes, and just as geneticists can identify particular genes and give them names, such as FOXP2, it should also be possible to identify memes and say what they are like. They are supposed to replicate and be selected, and these properties alone would logically require them to be bounded or particulate entities of some kind. The Darwinian properties of fidelity, fecundity, and longevity, normally ascribed to memes, also assume the continued existence of some kind of entity, as does the metaphor of 'the meme's eye view'. 'Such a unit must be able to be transmitted and be open to variation (mutation). Therefore, in the final analysis, it must be particulate.' (Stuart-Fox 1986:67). And again,

> To use Dawkins' famous title, it is necessary for genes to have a 'self' to be 'selfish'. For the same reason, if, following Dennett and others, we are to believe that the same evolutionary algorithm governs meme and gene selection, memes have to be something with a defined existence in the world; they cannot remain an arbitrary unit of analysis, created merely to talk conveniently about the world, but with no clear ontology. (Bloch 2000:193)

But the well-known examples of memes that are often produced – tunes, catch-phrases, ways of making pots, God, ten-second-slow-downs by drivers causing traffic jams, and Darwinian theory – suggest that we are indeed in the presence of 'an arbitrary unit of analysis', and defining the meme still remains a basic problem for memetics. After examining some attempts to say what memes are, Aunger concludes: 'even this brief foray into attempts at defining memes suggests there is disarray at a fundamental level in the subject'. (2000:7)

Of course, anthropologists constantly refer to cultural traits, and it is also possible to use the idea of cultural variations, but neither traits nor variants are replicating particles of culture, which is the distinctive and significant nature of memes.

> If one takes the notion of a meme in the strong sense intended by Richard Dawkins…this is indeed an interesting and challenging claim. On the other hand, if one were to define 'meme', as does the Oxford English Dictionary, as 'an element of culture that may be considered to be passed on by non-genetic means', then the claim that culture is made of memes would be a mere rewording of a most common idea: anthropologists have always considered culture as that which is transmitted in a human group by non-genetic means. (Sperber 2000:163)

So if memetics is not simply to be a restatement of the obvious in an intellectually pretentious way, it seems clear that a meme must at least be some generic type of bounded entity, and its proponents must be able to tell us how to recognize one. But, when pressed, memeticists sometimes deny that it is actually necessary to be clear about what memes are, and fall back on vague and evasive generalisations:

> Fortunately, culture need not be closely analogous to genes. Ideas must be gene-like to the extent that they somehow capable of carrying the cultural information necessary to give rise to the cumulative evolution of complex cultural patterns that differentiate human groups. They exhibit the essential Darwinian properties of fidelity, fecundity, and longevity, but, as the example of phonemes shows, this can be accomplished by a most ungene-like, replicatorless process of error-prone phenotypic imitation. All that is really required is that culture constitutes a system maintaining heritable variation. (Boyd and Richerson 2000:158)

But, as we shall see, the whole problem with ideas is precisely that they do *not* display 'the essential Darwinian properties of fidelity, fecundity, and longevity', and the requirement that memes should merely 'maintain heritable variation' is so vague that it no longer seems worth bothering with them at all. Even so, might there still be indirect evidence that memes exist? 'Good indirect evidence for memes would consist of establishing that there is an *independent dynamic* to cultural change which cannot be assigned to the goal-directed activity of people.' (Aunger 2000:208) Many social tendencies, indeed, are not specifically intended by any one, but we do not need

memes to explain them. The much more obvious explanation is that they are the result of the working of complex systems, such as the economy. A good example of 'an independent dynamic' is the long-term historical tendency for currencies to lose their value through inflation, but this has not been a consequence of the competition between the memes of pounds, shillings, and pence to become more abundant, but of the interaction of such factors as changes in the supply of money and precious metals, population levels, trade, and communications.

The meme hypothesis first became widely debated in the mid-1970s, and after all this time we are entitled to conclude that there is really no plausible, let alone compelling evidence that memes, in the sense of self-replicating particles of culture, exist at all. Some enthusiasts, however, prefer to dismiss the whole issue: as Laland and Brown say, for example, 'We suggest that memeticists should just get on with it' (2002:226), so let us see how far this takes us.

3. *Spreading in the meme pool.*

The key idea of Universal Darwinism is that of the replicator, whether gene or meme, and because replicators attain success by producing more copies of themselves than their competitors, this inevitably means thinking in terms of populations of independent entities rather than structures such as societies or organisms. The images of the gene pool and the meme pool are therefore of central importance in this populational thinking, and persuading us of the plausibility of the meme:

> Just as genes propagate themselves in the gene pool by leaping from body to body via sperm or eggs, so memes propagate themselves in the meme pool by leaping from brain to brain by a process which, in the broad sense, can be called imitation. (Dawkins 1978:206)

We can begin by dismissing the whole image of memes as autonomous and active agents, 'propagating themselves in the meme pool by leaping from brain to brain' like viruses (a favourite analogy of memeticists) or fleas. Ideas, catch-phrases, and ways of making artefacts are obviously nothing like viruses at all, which really are autonomous agents, and invade us without our knowledge and certainly without our conscious participation. The words, ideas, artefacts, and so on that constitute Dawkins's 'cultural soup' don't do any leaping on their own account: *we* have to produce them and communicate them, and we do so in the course of highly structured and complex activities, in which the 'memes' are chosen by us in collective processes for their appropriateness to particular circumstances, topics of discussion, and so on.

While Dawkins knows, of course, that genes do not really live in gene pools, which are statistical abstractions, but inside complex organisms, he would like us to believe that memes really do live in meme pools, or 'cultural soup', to use his own expression. So 'in general memes resemble the early replicating molecules, floating chaotically free in the primeval soup, rather than modern genes in their neatly paired chromosomal regiments' (ibid., 211). But while human society, technology, and culture are much less rigid in their organization than are physical organisms, with a great deal of variability and dysfunction, they still have no resemblance to soup. They are very complex systems, with intricate chains of causality, but memeticists, like Darwinians generally, are utterly indifferent to how systems work.

It is, or should be, obvious to any scientist that it is totally inappropriate to represent organized systems – societies, knowledge structures, languages, machines, bodies, and so on – simply as *populations* of bits and pieces, meme-soup, because this ignores all the *causal relationships* between the bits and pieces that make the system what it is. It would plainly be absurd to conclude, for example, that because retinal cells are much rarer than fat cells, they are less successful, because this ignores their functional importance in the working of the body. In the same way, counting the relative frequencies of the 'memes' can tell us nothing about their different functions within sociocultural systems, and their structural relations to one another. Structural relations would include hierarchical subordination, specialisation of function, recursion and embeddedness, homeostatic regulation and feedback loops, exchange, and causal priority, just to name a few.

So, according to the Oxford English Dictionary, the first five commonest words in English are *the*, *be*, *to*, *of*, *and*; and the first five commonest nouns are *time*, *person*, *year*, *way*, *day*. And the commonest letter in the English alphabet is *e*, followed by *t*, *a*, *o*, *i*, *n*, and *s*. But so what? This tells us nothing of the slightest interest about how the English language works, and the rules governing the formation and transformation of its syntactic structures. Nor can counting the numbers of things capture their relative importance in a system, and in social hierarchies the importance of roles is actually *negatively* correlated with their frequency. There are obviously far more private soldiers than generals in an infantry division, but this does not mean that the 'general' meme has failed to replicate itself as successfully as the 'private' meme, and that therefore the role of general is much less important than that of private. In the same way, the fact that there are far fewer oil refineries and power stations than

garages and shops selling electrical goods does not mean that they are less important in the meme soup and therefore more likely to die out.

The whole variation and selection model, on which memetics is based, also ignores the basic causal processes by which innovations appear and spread. The idea of the meme is inherently mutational, that is, conceives of innovation as analogous to a change in a particular gene, whereas social and cultural innovation is typically *combinatorial* and processual. If Darwinian theory can be regarded as a meme, then so too can chaos theory which, like Darwinian theory, had a number of complex roots:

> The discovery of chaos was made by many people, too numerous to list here. It came about because of the conjunction of three separate developments. One was a change of scientific focus, away from simple patterns such as repetitive cycles, towards more complex kinds of behaviour. The second was the computer, which made it possible to find approximate solutions to dynamical equations easily and rapidly. The third was a new mathematical viewpoint on dynamics – a geometric rather than a numerical viewpoint. The first provided motivation, the second provided technique, and the third provided understanding. (Stewart 1996:130-31)

This combinatorial account of the origin of chaos theory, which has no resemblance to a mutation, is typical of many other analyses of how some important idea or inventions originated by *the bringing together* of disparate factors. It also demonstrates a further essential point, which is that in socio-cultural systems, there is no clear division between variation and selection. A very good example of this is the invention and spread of the shipping-container, and its consequences for world trade.

The shipping-container was first envisaged by the American owner of a haulage company, Mr McLean, while sitting in his truck waiting for his load of cotton bales to be transferred one by one on to a ship. It struck him how much time and money could be saved if the whole trailer could be lifted on to the ship, and after many years of research and development the shipping-container became a practical reality. Variation and selection were here combined, since he was in the transport industry and could see the enormous advantages of the container, and so anticipate why manufacturers, shippers, and customers would all want to use them.

To give a genuine explanation of how the ‘shipping-container’ meme actually spread, it is not enough merely to invoke ‘selection’: it also requires a close causal analysis of the transport process. The container allows ships to be loaded and unloaded by one man with a crane, instead of by hundreds of dock-workers; the contents are secure from pilfering and breakage, so further reducing costs; each ship need only spend a few hours in port, instead of several days, so that many more ships

can use the port; and very large ships can be built to carry many thousands of containers stacked on their decks as well as in the holds, with only a few crewmen. Costs of transport are reduced from more than 30% of the total costs of goods to less than 1%, with the effect that it now costs less to ship a TV set from China to Britain than for the customer to drive it home from the store. The low costs of transport also mean that countries with cheap labour can now compete directly with Western nations, driving many of their manufacturers out of business, but also increasing the volume of world trade dramatically. Even this elementary analysis shows that to say that a meme spreads by selection is empty and trivial. What we want to know is first how something like the container was invented, and secondly, what its effects were, and why, and here memetics has nothing to contribute.

Memetics not only fails entirely to address the general problem of process in sociocultural systems, but the more specific problem of how memes actually combine to produce highly complex social organizations, belief systems, and knowledge structures. This basic gap in the explanatory framework of memetics results from the extreme vagueness of the meme concept itself, which can be anything at all from tunes and hair-styles to monarchy and the theory of evolution. The discoveries of the atom and the gene were so productive because they revealed, beneath the surface appearance of things, not just the basic building blocks of material objects and organisms, but explained precisely how they *combined* to produce all the different types of objects and the species of living things. But we can only understand this process of combination because we can identify different *types* of atoms and genes, each with their own properties. In the case of the meme, however, it is not possible to say what a meme is, other than that it is a unit of replication. As a result, while we can think of memes combining, this is only at the trivial level of ordinary observation: the 'blade' meme combines with the 'handle' meme to form the 'knife meme' – not exactly on the same scientific level as knowing that table salt is produced by the molecular combination of sodium and chlorine atoms. Unlike the atom and the gene, therefore, the meme is of absolutely no analytical value because it is impossible to establish any systematic differences between types of meme that would allow us to develop laws about how the different types of memes combine in complex structures.

The closest we get in memetics to any attempt to deal with structures of memes is the memeplex, 'a co-adapted stable set of mutually assisting memes', which 'may evolve in the same kind of way as co-adapted gene complexes' (Dawkins 1978:212,

213). So, for example, 'Mutually suitable teeth, claws, guts, and sense organs evolve in carnivorous gene pools, while a different set of stable characteristics emerged from herbivorous gene pools' (ibid., 212). The example he uses to illustrate a memeplex is the Christian Church, but all he does is take isolated memes, such as belief in hell-fire, faith, and clerical celibacy, and try to show how each of these perpetuates itself. There is no attempt to analyse their relations with one another within the Church as a whole. Blackmore's analysis of the memeplex, again focused on religion, is no improvement, while Dennett in his long section on memes (1995:335-69) does not even discuss the mutual interaction of memes within larger structures of belief systems or social organizations.

To sum up so far, then, the populational model of memetics is of inherently the wrong type to understand the operation and evolution of causal and conceptual systems, to understand *process*, and this is exacerbated by the extreme vagueness of the meme concept, and its consequent inability to explain memetic combinations of higher levels of complexity, in the manner of atoms and genes.

4. *Malthus and the meme*

Many discussions of memetics also tend to leave out a crucial part of what Dennett calls 'Darwin's dangerous idea'. They seem to assume that variation plus selection will do the trick, but forget that selection will not operate automatically and needs to be driven by a high degree of *competition*. According to the Malthusian principle which, Darwin repeatedly emphasised, is at the heart of his theory, competition is driven by the inexorable pressure of population on the necessary resources of life. 'So the normal state of affairs for *any sort of reproducers* [my emphasis] is one in which more offspring are produced in any one generation than will in turn reproduce in the next. In other words, it is almost always crunch time.' (Dennett 1995:41) But why should it ever be crunch time for memes? How, in other words, is the Malthusian principle to be translated into cultural terms at all? Unlike biological offspring, there is no inherent tendency for memes to multiply at a geometric rate, or at any particular rate at all, nor do they need food, nor, if they are simply ideas, do they impose any other burden on the physical resources available to any human population. To be sure, if we could each only remember a few hundred words, there would be intense competitive pressure on the vocabulary of any language spoken by a specific community, but in reality the human capacity for remembering

words is enormous, and in any case, it is not necessary that all the members of a community should each remember exactly the *same* words. Similarly, just how many myths, for example, would start to strain the cultural resources of a tribe, or how many riddles, and how many novels, or how many paintings, would strain our cultural resources? Yet without some way of answering this kind of question, how is the memeticist to calculate the selective pressure that is operating on any particular meme pool?

Unlike Dennett, Blackmore, Dawkins, and other memeticists, Mesoudi *et al.* (2004:4-5), however, do attempt to give an answer to this question, and it is important to see what they say. They quote Darwin himself on linguistic competition: 'A struggle for life is constantly going on amongst the words and grammatical forms in each language. The better, the shorter, the easier forms are constantly gaining the upper hand, and they owe their success to their own inherent virtue.' (From *The Descent of Man*, p.91.) They continue:

> Clearly, the 'struggle' Darwin was alluding to here cannot be directly compared to the competition over finite physical resources alluded to by the reference to Malthus. Rather, we have to think in more general terms, of a competition for limited 'slots' or functionally equivalent 'solutions' to specific 'problems'…We suggest that an appropriate way to conceptualise what any set of cultural variations are in general competing over is in terms of functional categories. Thus, synonyms will be in competition for describing the same semantic category; different hammers will be in competition for effective hammering; and different gestures may be in competition to fulfil the same social function. (ibid., 4)

The notion of 'functionally equivalent solutions to specific problems' is certainly worth considering, and is essentially saying that 'There is only one best, or preferred, way of doing something, and this produces an analogous situation to Malthusian competition because only one variant will ultimately succeed.' One among many possible examples would be the increased use of ball-point instead of fountain pens, which could be said to have competed 'to fulfil the same social function'. In the Malthusian situation, however, competition arises from the fact that the population is too large for all of them survive, given the food available to them. There is, however, nothing Malthusian about this competition between types of pen, which did not arise from the *number* of the competing variants, but simply from human beings *choosing between two alternatives*, which could equally well be two ideas.

Human choices, therefore, are what drives competition between cultural variants, but whereas the Malthusian situation must be a relentless driver of biological competition, 'functionally equivalent solutions to specific problems' is a far weaker

explanation of competition between sociocultural variants, because most of what count as 'specific problems', outside narrow aspects of technology and medicine, are not matters of survival, but of fashion and personal preference and psychology, and in many cases, such as literature and the arts, there are no apparent 'problems' at all. For example, as examples of the 'struggle' Darwin was alluding to, Mesoudi *et al*. refer to semantic categories, and 'the successive replacement over recent years in youth culture of the adjectival synonyms "neat", "fab", and "cool".' (ibid., 4) But in what way are any of these 'better, shorter, or easier' variants than the others, and what particular semantic problem are they supposed to be solving? (Some semantic categories, such as those involving praise and blame, money, sex, and drunkenness, are actually notable for the *proliferation* of their synonyms.)

Many memes, then, are not solutions for anything. As Allen Orr has pertinently remarked: 'the fitness of memes is strangely tautological: while we can often point to phenotypic or ecological reasons why certain genotypes are fitter than others, a meme is deemed "fit" only because it is common (e.g. "Elvis is alive" is certainly a fit meme, but it is neither true nor helpful – it is merely popular).'(1996:472) Here we should remember that Darwin himself – whom Mesoudi *et al* claim to be following - would not have approved at all of the merely statistical conception of fitness embodied in memetics, because he was a 'perfectionist': '[A]s natural selection works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection' (The *Origin*, p.440), and this means perfection of adaptation to an independent environment.

A vast amount of 'memes', particularly in modern culture, are not functionally equivalent solutions competing with one another to solve specific problems, but are simple novelties that if anything create new problems, and may become fashionable for a time simply *because* they are newer, and unfashionable simply because they are older. Indeed, far from increasing competition and the power of selection, as it should do in the Malthusian model, it can also be said that too many memes actually inhibit competition, because as the level of cultural 'noise' increases - as it has, for example, on the Internet - it becomes steadily more difficult to bring competing memes into contact with each other. We might call this 'The Tower of Babel Syndrome', and what it produces is something like primitive warfare – an endless succession of skirmishes, but no decisive outcomes. Without effective competition, however, the whole Darwinian model of natural selection collapses when applied to memes.

5. *Imitation and replication*

According to the theory, besides having lots of copies, replicators like memes and genes need longevity and fidelity. Longevity is the ability of the replicating unit to survive unchanged - the longer the better, of course. This in turn requires fidelity, the accurate copying of a unit at each replication, which is quite crucial, since inaccurate copying would very soon lead to the collapse of the whole process[1].

Imitation and its relation to mental activity are therefore of central importance in memetic theory – indeed, the genuinely unique human capacity for imitation in the animal world is much stressed by Blackmore as the foundation of the whole memetic process and the fidelity of replication. 'My reason for restricting meme acquisition to imitation (i.e. excluding other kinds of learning) is my suspicion that only imitation is capable of sustaining a true evolutionary process' (Blackmore 2000:27). But while we imitate tunes, designs, gestures, words and catch-phrases all the time, it is possible to imitate without understanding anything beyond the meme itself – the company logo, the name, the tune, and so on. This, however, is wholly inadequate to describe the transmission of ideas, which have to be *understood* – the word 'meme' itself being a good example. While we learn words by hearing and reading, by imitation, we only learn their meaning by questioning and repeated use of them in different contexts, and even in a dictionary there will be many shades of meaning that need to be understood. Indeed, when it comes to learning the grammar of our language, the imitation model breaks down entirely, because children do not acquire knowledge of grammatical rules in the bit-by-bit process that imitation would involve:

> One of the most striking facts about language is its 'creativity' – the fact that by the age of five or six children are able to produce and understand an indefinitely large number of utterances that they have not previously encountered – and the behaviourist's 'learning theory', however successful it might be in accounting for the way in which certain networks of 'habits' and 'associations' are built up in the 'behaviour patterns' of animals and human beings, is totally incapable of explaining 'creativity' – an aspect of human 'behaviour' manifest most clearly (though perhaps not exclusively) in language. (Lyons 1970:84)

Indeed, quite apart from the case of language, 'no psychologist believes that cultural learning is essentially a matter of imitation' (Sperber 2000:172), and 'No satisfactory model of imitation has been worked out so far, although developmental psychologists and ethologists have long been trying to define and operationalize it.' (Conte 2000:96). Memeticists, therefore, have to face the fact that imitation is quite inadequate to serve as the main basis of memetic replication, since ideas are also *interpreted* and *assimilated* by the receiver in accordance with his existing cognitive

structures, and the way in which he understands his social and natural environment (on this see in particular Atran 2001). But if memes have to be replicated through the much vaguer processes of 'social learning', or 'cultural transmission', how, then, can fidelity of replication be maintained? Indeed, is it justifiable to go on talking of memes 'replicating' at all?

On this point, Dawkins concedes:

> Here I must admit I am on shaky ground. At first sight it looks as if memes are not high-fidelity replicators at all. Every time a scientist hears an idea and passes it on to somebody else, he is likely to change it somewhat. . .This looks quite unlike the particulate, all-or-none quality of gene transmission. It looks as though meme transmission is subject to continuous mutation, and also to blending. (Dawkins 1978:209)

He attempts to find a way round this by using the example of Darwinian theory:

> …when we say that all biologists nowadays believe in Darwin's theory, we do not mean that every biologist has, graven in his brain, an identical copy of the exact words of Charles Darwin. Each individual has his own way of interpreting Darwin's ideas…Yet, in spite of this, there is something, some essence of Darwinism, which is present in the head of every individual who understands the theory. (Dawkins 1978:210)

All theories, ideologies, and belief systems have certain key ideas; those of Darwinism include variation, selection, adaptation, and competition, and if this is all that Dawkins means by 'essence' who could disagree? But he actually thinks that the essence of the Darwinism meme is much more than this, and involves *the agreement by all who hold the theory* about what it implies. Disagreements about what the theory implies must therefore produce a *different,* heretical meme:

> The *differences* in the ways that people represent the theory are then, by definition, not part of the meme. If Darwin's theory can be subdivided into components, such that some people believe component *A* but not component *B*, while others believe *B* but not *A*, then *A* and *B* should be regarded as separate memes. (ibid., 210)

He is forced into this position because he is trying to salvage the claim that meme transmission does have strong fidelity of copying, so that memes can preserve their identity over many replications. But his claim has the obvious and fundamental flaw that the key ideas, especially adaptation and selection, are not simple and transparent notions at all, but have very complex implications and unpredictable ramifications about which there will inevitably be disagreements. Gould's and Vrba's 1982 concept of exaptation, for example, denies that all adapted features of an organism were historically the result of natural selection, and Kauffman 1993 maintains that there are spontaneous sources of order in organisms that do not need selection to explain them. Some biologists think that these ideas are compatible with standard Darwinian theory,

others do not. The memeticists assert that the meme is a valid analogy of the gene, and a truly Darwinian concept, while other biologists dismiss it as a meaningless metaphor. What the key ideas imply is therefore not fixed at all, but grows and changes in the course of further discoveries and arguments – as, for instance when Darwinism had to assimilate the new science of genetics in the twentieth century. The fact that a theory has some key ideas does not therefore mean that they constitute an immutable essence, or that those who believe the theory will necessarily agree about their application to real problems. The theorists are simply working within the framework of a common tradition, in which some ideas are more important and last longer than others because people understand their strategic importance in the theory, and because of their generality.

Again, Dennett, having reminded us that Darwinian evolution 'depends on *very* high fidelity copying' of the DNA, then goes on to say:

> Minds (or brains) on the other hand, aren't much like photocopying machines at all. On the contrary, instead of just dutifully passing on their messages, correcting most of the typos as they go, brains seem to be designed to do just the opposite: to transform, invent, interpolate, censor, and generally mix up the 'input' before yielding any 'output'. Isn't one of the hallmarks of cultural evolution and transmission the extraordinarily high rate of mutation and recombination? (Dennett 1995:355)

What, then, is his answer to the fidelity problem? Essentially, it is to substitute the cultural trait, the 'distinctly memorable unit', for the meme: 'One of the most striking features of cultural evolution is the ease, reliability, and confidence with which we can identify commonalities in spite of vast differences in underlying media' (ibid., 356). He mentions the common theme in the plots of *Romeo and Juliet* and *West Side Story*, pottery styles, monarchy, and tattooing, and on p.344 gives the examples of the *Odyssey*, calculus, chess, perspective drawing, and evolution by natural selection. The anthropologist would accept these as cultural traits, in the sense of asking which of them are to be found in societies X, Y, and Z. But they are transmitted by an often arduous process of learning that can take years, not by anything resembling imitation and, like Dawkins's 'essence' of Darwinism, they also have no resemblance to the meme defined as an instruction trying to replicate itself. Blackmore has nothing more significant to contribute, and we can conclude that memetics has no answer at all to the basic problem of fidelity of copying. And without this, of course, selection cannot work.

6. *Invention and design.*

To understand the process of cultural transmission, then, we must take the inner workings of people's minds into consideration, but just as memeticists are embarrassed by the structural properties of societies and belief systems, and avoid mentioning them as far as possible, they are remarkably silent about what goes on inside the mind. Clearly they do not deny that inner mental processes take place, but they cannot allow them to be directed by conscious human goal-seeking, because that would allow the demon of the designer to reappear on the scene, which would be almost as bad as the return of God. But inner mental processes are obviously of special importance when we try to explain how *new memes are invented.*

Blackmore uses the case of the Cherokee Indian Sequoyah, who designed a syllabary for his own language in about 1820, as a test case for memetics.

> I have suggested that human consciousness is not the driving force behind the creation of language (or anything else for that matter) and Sequoyah looks like the ideal case to prove me wrong. In fact, I choose him as a perfect opportunity to explain what I mean. Sequoyah was presumably as conscious as any human being. In discussions about creativity people often assume that consciousness is somehow responsible for creativity, but their view meets with serious problems as soon as you try to imagine what it means. You are almost forced into adopting a dualist position, with consciousness as something separate from the brain, that magically leaps in and invents things. A more common view in science is to ignore consciousness and treat creativity as a product of the intelligence and ability of the individual concerned – ultimately taking the process back to brain mechanisms. This escapes from the dualist trap but leaves out the importance of all the ideas already available in the creative environment. The memetic view includes all this. What I am proposing is this.
>
> Human brains and minds are a combined product of genes and memes. As Dennett (1991:107) puts it 'a human mind is itself an artifact created when memes restructure a human brain in order to make it a better habitat for memes'. In Sequoyah's case he must have had an exceptional brain, with exceptional determination and motivation, and he happened to come across a writing system that was already available at a time when his own people were in a position to take up his ideas and use them. Sequoyah's thinking was an exceptional part of the process, but was itself created out of the interplay between memes and genes. All this is a wonderful example of replication creating design out of nowhere. As ever, there is no designer other than the evolutionary process. (Blackmore 1999:206-7)

It may be conceded that this is a very unimpressive account of our mental processes, even at an every-day level of analysis. All this talk of 'the interplay between memes and genes' is not much of an improvement on Dawkins's notion of cultural soup, and our previous discussions of the invention of chaos theory, and the shipping-container, illustrates how extremely bizarre is the memeticist assumption that conscious thought is not involved in invention, and that 'replication can create design out of nowhere'. The creative flash of inspiration itself may often not be produced by conscious calculation, but is well known to arise unexpectedly, and there

would be nothing very surprising if the initial idea for the shipping-container had occurred to Mr McLean in this way.

The real issue here, however, is not actually creativity at all, but *problem solving*, and this *is* necessarily conscious, because it involves having a conversation with oneself with questions and answers, and one cannot have such a conversation without being aware of it. The question 'What dimensions should my containers be?' must have occurred to Mr McLean, and 'How can I put my language as marks onto paper?' is a question that Sequoyah must have asked himself, as a preliminary, and while he began by trying to represent whole words by pictures he clearly became dissatisfied with the enormous numbers of these that were needed, and then asked himself what alternative there could be. He is said to have been inspired to use sounds instead of pictures while listening to a bird singing, and recognising some similarities in its notes to the Cherokee language. It was nevertheless a conscious recognition, as were his subsequent choices of symbols from picture books to represent particular sounds, and his organization of his syllabary around the six vowels of the Cherokee language. This elaborate syllabic structure could only have been produced by a series of questions and choices that were consciously made, and no 'magical leaping in and inventing things' occurred at all. (Note the obsessive tendency to treat any idea of human creativity as superstitious.)

In the first place, then, it is wholly implausible to suggest that this process consisted only of the 'interplay between genes and memes', in which consciousness was at best some sort of spectator. The new memes created for this syllabary, and the 'memeplex' of the whole structure were obviously *not* examples of 'replication creating design out of nowhere', but of centralised decision-making by a design*er*. We can also conclude that here the existing memes of Cherokee and American culture were subordinated to conscious human purpose, and that without such purpose the new memes of the syllabary could not have been created.

Secondly, the invention of the Cherokee syllabary can by no stretch of the imagination be described as a mutation, in the sense of a random combination of memes. Such a situation of a non-literate people wanting to acquire writing occurred on a number of other occasions, and in modern times occurred for example on Easter Island, among the Vai of Liberia, and the native peoples of Canada, and the response in each case was similar because it was a conscious response to a situation perceived in a similar way.

A better example of memes being coordinated and developed in new ways by conscious human purpose in a situation perceived as similar is that of the meme itself. While Dawkins invented the actual word 'meme' he was not, of course, the first to think of the idea it represents. If one believes, for whatever reason, that the neo-Darwinian paradigm can be validly extended to human culture, then there will obviously be a problem of finding some basic unit of replication upon which selection can work, analogous to the gene. Many other others who have reflected on this problem have come up with essentially the same solution: the *mneme* (Semon 1921), the *memory image* (Blum 1963), the *idea* (Boulding 1970), the *instruction* (Cloak 1975) the *concept* (Hill 1978), the *culturgen* (Lumsden and Wilson 1981), the *menteme* (Stuart-Fox 1986), and of course the *meme* itself (Dawkins 1976). While it is true that there has been competition between the various alternatives to the meme, and Dawkins congratulates himself on the victory of the *meme* over the *culturgen* (Dawkins 1999:xiv), the invention of these different terms did not constitute a mutation, a blind innovation in the meme soup. Each of these thinkers was consciously looking for something which would perform essentially the same conceptual task in a wider context of Darwinian theory - units of information competing for survival and replication.

7. *Can memetics actually solve any problems?*

Whereas the notion of the gene, from its beginnings with Mendel, proved a very powerful solution to specific problems, a growing criticism of memetics is that it has not been able to solve any real problems in a convincing way.

> In my opinion, memetics has reached a crunch point. If, in the near future, it does not demonstrate that it can be more than merely a conceptual framework, it will be selected out…A framework for thinking about phenomena can be useful if it delivers new insights but, ultimately, if there are no usable results academics will look elsewhere. (Edmonds 2009:198)

A useful test case of the explanatory power of the meme has been provided by W.G.Runciman, one of the vanishingly small number of sociologists who is a keen supporter of memes, and who has attempted to use them to explain the survival and eventual extinction of citizen-hoplite warfare in the Greek city states. Runciman, like other memeticists, is hard-pressed to give any clear definition of the meme, and the best he can manage is that they are 'bundles of information or instructions transmitted exosomatically as units of cultural selection' (1998:735). He asks how the military institution of citizen-hoplite warfare managed to survive from the middle of the

seventh century BC to the middle of the fourth, when it was replaced by mercenary warfare, and says that 'it is difficult to see how the persistence of hoplite warfare can be accounted for without reference to the distinctive set of norms, values and beliefs which both encouraged and legitimated it.' (ibid., 733). He maintains that four crucial memes, or 'bundles of instructions', were crucially important in this respect: 'be ready to go to war', 'commemorate the fallen', 'dedicate spoils to the gods', and 'avoid shame and guilt' (meaning 'better dead than defeated'). (ibid., 738-40). But with the emergence in the fourth century of mercenaries who were more professional and innovative than the traditional citizen-hoplites, these faded away as an institution.

> It was not that heavy-armed infantry became redundant or that warfare came to be regarded as any less normal a feature of inter-state relations. The change was that willingness to risk death in battle on behalf of the *polis* of which he was a citizen could no longer be seen by the young Greek male as the supreme manifestation of virtue. (ibid., 744)

The traditional warfare memes

> …were increasingly unlikely to be replicated in an environment where military prowess was no longer a matter of courage and endurance so much as of the acquisition of the maximum of booty with the minimum of risk. The literary sources clearly attest the rapid decline of the hitherto unquestioned warrior culture as soon as the traditional 'memes' had ceased to confer the prestige and self-esteem on their carriers which they formerly had. (ibid., 744)

But the whole Darwinian model of a changing environment 'selecting' new memes, presumably such as 'acquire the most booty with the least risk', and deselecting old ones like 'dedicate spoils to the gods', seems highly unrealistic. In the first place, Runciman's particular choice of memes appears arbitrary and disputable, as must always be the case with such notional entities - why, for example, is there not simply a 'citizen-hoplite' meme that gets replaced by a 'mercenary' meme?

> Furthermore, if everything in a sociocultural system is composed of memes, what does the selecting? Runciman refers to the environment and says, for example, 'This changed environment [the features of mercenary warfare] deprived of their cultural function all four of the "memes" which had sustained traditional hoplite warfare' (1998:744). But 'environment' here means nothing more than yet another collection of memes (those associated with mercenary warfare), and so the memes turn out not only to be the units of selection but also, wearing different hats, to be the environment as well. In the social selectionist theory advocated by Runciman, variation and selection therefore seem indistinguishable, and so quite different from their counterparts in Darwinian theory. (Hallpike 1999:628)

Rather than introducing notions of memes and selection here, it is surely far more straightforward to treat citizen-hoplites, mercenaries, and their associated moral codes as simply parts of a broader social process involving the general collapse of the traditional *polis*:

> What was 'new' in the fourth century was not the mercenary, but the large numbers of destitute and desperate men increasingly available for such service. For who were these recruits to a rapidly expanding, yet socially stigmatised military professionalism? Overwhelmingly, they were economically displaced and politically disfranchised ex-citizens, whose former integration within polis society had been shattered by decades of ruinous inter-polis warfare and an attending factionalism between rich and poor. The mercenary is not a random mutant catalyst whose arrival alters an environment in equilibrium – he is himself a product of social disorder and communal breakdown! Driven from his ancestral land by mounting debts and the repeated loss of his crops and farming implements to ravaging armies, or exiled from his city during one of the many armed seizures of power and property that marked the collapse of civic communalism, the mercenary is essentially a 'displaced person' whose recourse to the profession of arms represents a survival strategy in a world where law, tradition, and patriotic loyalty were giving way under the violent impress of rampant aggression, both between and within the city-states. Civic demilitarisation does not arise in the aftermath of the mercenary's ascendancy; it actively prepares the ground for the shift to the new forms of warfare…(Bryant 2004:473-4)

Bryant justifiably dismisses Runciman's whole memetic model, with its entirely notional and redundant concepts of 'environment', 'indirect bias', and 'selection' of memes, and replaces it with a clear and convincing explanation based simply on the analysis of social process.

So far, then, memetics has failed every basic test of its viability, but there is worse.

8. *Memetics as self-refuting.*

While, as we have seen in the case of Sequoyah, memetics denies human intellectual control of the meme production process, it does allow some role for human psychology in the selection of memes:

> Actions that are easy to imitate will make for successful memes and ones that are difficult to imitate will not. Apart from that, the effective transmission of memes depends critically on human preferences, attention, emotions and desires – in other words the stuff of evolutionary psychology. For genetic reasons we are driven by the desires for sex, for sex of different kinds, for food, for better food, for avoiding danger and for excitement and power. (Blackmore 1999:58)

One can therefore understand why memes relating to sex, power, money, and excitement should find it easier to replicate than those linked to repression, weakness, poverty, and boredom. But does truth have any selective advantage over falsity? 'Natural selection', says Blackmore,

> has generally equipped us to choose ideas that are true over those that are false. Our perceptual systems are designed to provide as accurate a model of the external world as possible. Our capacity to think and solve problems is designed to give true rather than false answers, so in general, true memes should thrive better than false ones. (ibid., 180)

In the first place, our perceptual systems have nothing whatsoever to do with memes because they operate entirely on the level of individual physiology, with no social input from other people. Secondly, the claim that 'Our capacity to think and solve problems is designed to give true rather than false answers' is obviously wrong. In particular, 'scientific method', unlike vision and hearing, was not designed by genetic selection at all, but is the result of a recent historical process of what Blackmore would call memetic selection, and in general a vast amount of human thought is mistaken, at least to some degree. And since Blackmore is particularly keen to combat 'false' memes, notably those of religion, and the illusion of personality, she is obliged to admit that 'Memes do not need to be true to be successful' (ibid., 180). She concedes that it is to the memes' advantage to be able to mimic truth, just as it is to their advantage to be able to mimic altruism, and other desirable memes like 'successful', 'scientific', 'supported by overwhelming evidence', 'a triumphant paradigm', and so on. Since the only 'aim' of memes is to replicate as much as possible, there is no reason why they should have any innate bias towards truth or anything else of concern to human beings. Remember that 'The first rule of memes, as for genes, is that replication is not necessarily for the good of anything; replicators flourish that are good at...replication – for whatever reason!'. (Dennett 1995:362)

So how can we tell when memes are only mimicking the truth? Since Blackmore has ruled out the operation of conscious reasoning as a means to attain truth, there can only be the mindless competition of the memes inside the 'meme habitat' of our brains, and since we cannot expect the memes themselves to be honest with us there seems no way left by which any objective notion of truth could be established. However popular and successful a scientific theory may be, this can therefore only show that its memes have been particularly successful in replicating themselves, but it is quite possible that this is due to their skilful mimicry of truth. Until the nineteenth century, Euclidean geometry was wrongly thought to be necessarily true of the physical world; Ptolemaic astronomy was a highly sophisticated astronomical model that survived for around 1500 years until Copernicus; Newton's physics was unchallenged until Einstein in the twentieth century, and in other areas of knowledge, too, many theories that were passionately believed to be true, like Marxism, Freudianism, and Behaviourism, are now as the snows of yesteryear, but they were highly successful memes in their time. In all this we see nothing more than the ceaseless ebb and flow of competing memes, a process in which the science of

memetics itself can claim no privileged status. The so-called progress of science is a mirage that has simply been produced by the ever-increasing ability of memes to mimic truth, an ability honed, of course, by natural selection. If memetics is true, the belief that we can somehow stand outside the process and make conscious, independent, and objective judgements about truth and falsity is an illusion. Indeed, the very notion of truth itself is simply a highly successful meme.

At this point memeticists therefore have a choice. On the one hand they can agree that objective scientific research is possible, that people can consciously create new hypotheses, test them by measurement and experiment, and build up bodies of knowledge that have high claims to be true, or at least good approximations to the truth. This also concedes that the same kind of mental activities are possible in other areas of life besides science, and that generally it is we who create the memes in the first place, for our own purposes, and that their spread is not simply blind imitation, but can be mediated by conscious thought: in other words, that memetics is false. On the other hand, they can cling to their faith in memetics, in which case, for reasons we have seen, the whole idea of objective truth becomes an illusion, another trick, like altruism, pulled off by the memes to improve their own replication. Memes can only be more or less *successful*, not more or less *true*, from which it follows that memetics itself is only one memeplex among hosts of others, and like science as a whole can have no claim to objective truth. Memetics, like extreme cultural relativism, or Derrida's deconstructionism, is then swallowed up by its own scepticism. But the one thing the memeticists cannot possibly do is build themselves some kind of latter-day Noah's Ark of objective scientific truth, which can keep their ideas safe, while everything else is swept away in the Great Flood of memes.

There is an underlying truism at the heart of memetics, which is that social systems and systems of ideas are not under the control of anyone, and develop in unpredictable ways. But it is remarkably perverse to conclude from this that we are therefore nothing more than the passive vehicles of our ideas and artefacts, and that our choices, purposes, and creativity do not play an essential part in social life and its evolution over time even though we cannot control or predict its outcome. While science is often counter-intuitive, we should not assume that whatever is counter-intuitive must therefore be science. The whole strange phenomenon of memetics calls to mind Sir Peter Medawar's obituary of Freudian psychiatry as 'a terminal

product...something akin to a dinosaur or a zeppelin in the history of ideas: a vast structure of radically unsound design and with no posterity.' (Medawar 1982:140)

Note

1. 'For evolution and selection to take place, genetic information has to be stored in a relatively stable molecule such as DNA in what Schrödinger referred to as a "code-script". Without this structure, a mutation, which is nothing else but a change of code, could not take place and in the absence of a precise copying mechanism mutations cannot be selected. Information in genes is encoded in digital form with four letters, but in memes messages are encoded in continuously varying analogue symbols that might rapidly decay into noise as they are transmitted from individual to individual…' (Benitez-Bribiesca 2001:30)

References

Alexander, R.D. 1979 *Darwinism and Human Affairs*. Seattle & London: University of Washington Press.

Atran, S. 2001. 'The trouble with memes: inference versus imitation in cultural creation', *Human Nature* 12(4), 351-81.

Aunger, R. (ed.) 2000. *Darwinizing Culture: the status of memetics as a science*. Oxford University Press.

Barkow, J.H. 1978. 'Culture and sociobiology', *American Anthropologist,* 80, 5-20.

Benitez-Bribiesca, L. 2001. 'Memetics: a dangerous idea', *Interciencia* 26(1), 29-31.

Blackmore, S. 1999. *The Meme Machine*. Oxford University Press.

Blackmore, S. 2000. 'The memes' eye view', in *Darwinizing Culture*, ed. R.Aunger, pp. 25-42. Oxford University Press.

Bloch, M. 2000. 'A well-disposed social anthropologist's problems with memes', in *Darwinizing Culture*, ed. R.Aunger, pp. 189-203. Oxford University Press.

Blum, H.F. 1963'On the origin and evolution of human culture', *American Scientist* 51, 32-47.

Boulding, K.E. 1970. *A Primer on Social Dynamics. History as Dialectic and Development.* New York: Free Press.

Boyd, R. & Richerson, P.J. 2000. 'Memes: universal acid or better moustrap?', in *Darwinizing Culture*, ed. R.Aunger, pp.143-62. Oxford University Press.

Bryant, J.M. 2004. 'An evolutionary social science? A skeptic's brief, theoretical and substantive.' *Philosophy of the Social Sciences* 34 (4), 451-92.

Cloak, F.T. 1975 'Is a cultural ethology possible?', *Human Ecology* 3, 161-8.

Conte, R. 2000. 'Memes through (social) minds', in *Darwinizing Culture*, ed. R.Aunger, pp. 83-119. Oxford University Press.

Dawkins, R. 1978. *The Selfish Gene*. London: Granada Paladin. [First published 1976, Oxford University Press.]

Dawkins, R. 1999. Foreword to S. Blackmore *The Meme Machine*, vii-xvii.

Dennett, D. 1991. *Consciousness Explained*. Boston: Little, Brown.

Dennett, D. 1995. *Darwin's Dangerous Idea*. London: Penguin.

Edmonds, B. 2009. 'Three challenges for the survival of memetics', in *Philosophy After Darwin*, ed. M.Ruse. pp. 198-202. Princeton University Press

Gould, S. & Vrba, E. 1982. 'Exaptation – a missing term in the science of form', *Palaeobiology* 8(1), 4-15.

Hallpike, C.R. 1999. Comment on W.G.Runciman's 'Greek hoplites…' *JRAI,* 5(4), 627-9
Hill, J. 1978. 'The origin of sociocultural evolution', *J.Social Biol. Struct*. 1, 377-86.
Kauffman, S.A. 1993. *The Origins of Order. Self-Organization and Selection in Evolution.* New York and London: Oxford University Press.
Laland, K.N. & Brown, G.R. 2002. *Sense and Nonsense. Evolutionary perspectives on human behaviour*. Oxford University Press.
Lumsden, C.J. & Wilson, E.O. 1981. *Genes, Mind, and Culture*. Harvard University Press.
Lyons, J. 1970. *Chomsky*. Fontana Modern Masters. London:Fontana/Collins
Medawar, P. 1982. *Pluto's Republic*. Oxford University Press.
Mesoudi, A., Whiten, A., and Laland, K.N. 2004. 'Perspective: is human cultural Evolution Darwinian? Evidence reviewed from the perspective of The Origin of Species.' *Evolution*, 58, 1-11.
Orr, H.Allen. 1996 'Review of D.Dennett's Darwin's Dangerous Idea', *Evolution*, 50, 467-73.
Runciman, W.G. 1998. 'Greek hoplites, warrior culture, and indirect bias', *JRAI* , 4, 731-51.
Semon, R. 1921. *The Mneme*. London: Allen and Unwin.
Sperber, D. 2000. 'An objection to the memetic approach to culture', in *Darwinizing Culture*, ed. R.Aunger. pp. 163-73. Oxford University Press.
Stuart-Fox, M. 1986. 'The unit of replication in socio-cultural evolution', *Journal of Soc. and Biol. Structures*, 9, 67-89.

This paper is also pp.104-127 in C.R.Hallpike's latest book *On Primitive Society, and Other Forbidden Topics,* published by AuthorHouse, which can easily be ordered on line. Please click on the link below:

http://www.authorhouse.co.uk/Bookstore/BookDetail.aspx?BookId=SKU-000476952

.