2. The origins of the designing brain

In the previous chapter, I examined some of the broad principles of biological evolution, and laid the foundation of the case for considering the ability of humans to attribute significance and meaning to the material world as a suite of adaptations. In this chapter, the focus narrows: I will consider the relationship of our ancestors with the organic and inorganic environment; with each other; and, more critically for the purposes of this study, with the things they chose to pick up and use, or pick up, modify and use. Drawing on evidence from the disciplines of neurology, primatology and child psychology, as well as palaeontological and archaeological data, I will present some views as to the evolutionary origins and structure of the human brain. Initially I do this in order to suggest that - in broad terms - how we interact with our physical environment is, to no small degree, a function of the brain's evolved structure; and that, equally, that structure is, in part, a response to that environment's recurrent features. Then, pausing to acknowledge a little of the significance of the so-called 'Upper Palaeolithic Revolution' (or its equivalent in non-European parts of the world), and something of the richness which the brains of modern humans can support, I begin to explore the overwhelming importance of the social dimensions of our existence, and the extent to which many 'higher' brain functions are devoted to negotiating these.

These brain functions relating to the social dimensions of our existence are of fundamental importance. They form the basis of my analysis of the workings of aesthetics, insofar as they relate to artefacts in the chapter following this one, as well as, in chapter four, the workings of the symbolic and narrative significances and meanings which artefacts have bestowed on them. For the remainder of the present chapter, I piece together an account of the brain's workings as they may relate to our kinetic sense, and the cognitive, technical intelligence which developed from it.

2.1 The workings of the brain

Our relationship with the material environment is essentially a physical one: we experience it through our bodies, through the senses. Each body incorporates a delicately structured nervous system, at the centre of which is the brain. The brain (like every other aspect of our physical embodiment) is an evolved organ – that is, its structure and operation have arisen out of the processes of natural selection described in chapter one. There are disagreements about the extent to which its contemporary functions remain within this biological sphere, and these will eventually be considered, but it is with the evolved aspects of this complex organ that we begin.

As the cognitive scientist, Michael Tomasello, reminds us: 'Human beings are primates. They have the same basic sense organs, the same basic body plan, and the same basic brain plan as all other primates.'[1] The workings of the brain can be considered at three levels: that of reflexes, sensations and perceptions; that of cognition, that is, the psychological mechanisms which interpret information from this lower level (and which, to a degree found in no other species, includes those mental systems we call *consciousness*); and finally, the commissioning of behaviour that the workings of these other mechanisms prompt.

2.2 Reflexes, sensations, perceptions and cognition

In evolutionary terms, the reflex responses, sensations and perceptions which we all (barring accident or disability) experience today, are among the most ancient of our neural inheritances, stretching back to ancestor organisms very unlike ourselves. Contemporary primitive animals such as clams, for example, have their reflex 'snap shut' mechanisms which, as the philosopher Daniel Dennett suggests, in terms of their responses to the physical environment are capable only of '*proximal anticipation*'.[2] They are comparatively simple, and have evolved over time as economic devices which have enabled organisms to avoid dangers, or otherwise respond in manners which, on average, secure survival and reproduction. In humans, some reflexes do not even call on the brain to process them, but exist as discrete, neural wiring quite outside it.

As explained and illustrated in chapter one, the make-up of any organism reflects a history of 'trade-offs' where the particular combination of characters or traits represents the configuration which – given that which pre-exists and on which natural selection operates - most effectively enables the organism to survive and reproduce. This is no less true of the structures of the brains of organisms, where those mechanisms which survive and are replicated, are just those which have (in combination with others) proved their worth over evolutionary time. In negotiating the physical environment, the particular configuration of brain mechanisms can be seen as reflecting the recurrent characteristics of that environment. Thus, following Lewontin's observations about the nature of adaptations cited in chapter one, the brain can be thought of as the product of our constant interaction with our environment which, in many key aspects, has literally been shaped by it. In speculating on the origins of functions relating to sight, for example, Dennett reminds us that our 'visual systems…are exquisitely sensitive to patterns with a vertical axis of symmetry'[3] and that this was once a response to other (upright) organisms faced by our distant ancestors. Plainly this and, I suggest, comparable evolved, mental responses to shape, colour, symmetry, and pattern have consequences for our perceptions of objects, including artefacts. It is these which will be returned to in more detail in chapter three. For now, it is sufficient to note that these are evolved mechanisms, arising from the recurrent features of our physical environment, and which profoundly inform our mental representations of it.

2.3 The 'modular' brain

If a reflex is a comparatively simple mechanism, a sensation, perception or an act of cognition is each progressively more complex. In understanding how these relate to one another, it is useful to consider a view of the brain as 'modular' in structure. That is, that it can be thought of as a combination of neural mechanisms (modules), each dedicated to addressing something of recurrent, adaptive consequence in our environment. Because these features are recurrent, they have led to our brains consistently delivering particular sensations and perceptions, rather than others. These may correspond to that which is objectively there, yet sometimes they may not, and deliver to us what may be thought of as, variously, distorted or edited versions of objective reality.

Jerry Fodor points to the *Poverty of the Stimulus Argument*: a perceptual identification often seems to rest on implications fabricated by the brain, which go beyond anything the actual, raw data delivered to it might support. Consider, for example, the Phi effect. Two adjacent sources of light, each of a different colour, are turned alternately on and off at a particular frequency, yet the brain makes us believe we see a dot move and change colour, rather than registering what actually happens. The brain 'fills in' or creates the apparently missing data of the dot's movement and colour change. This 'information' must come from somewhere. Fodor argues:

> Poverty of the Stimulus Arguments do make it seem plausible that a lot of inference [as in the example above] typically intervenes between a proximal stimulus and a perceptual identification.[4]

To support his assertion that the brain consists (partly) of dedicated, evolved modules, geared to addressing particular recurrent environmental features, Fodor cites the famous Müller-Lyer Illusion (*fig. 8*). The first line seems longer than the second and, significantly, no amount of knowing they are identical in length will shift this perception. Cognition is, partly, built on perceptions, and as these two examples demonstrate, they have sometimes evolved to be at variance with objective reality.

> [What is] at issue is: How rigid is the boundary between the information available to cognitive processes and the information available to perceptual ones? How much of what you know/believe/desire actually does affect the way you see? The persistence of the illusion suggests that the answer must be: "at most, less than all of it."[5]

In that sense, it can be argued that perception is worked by 'encapsulated' modules, where a module is

> ...an informationally encapsulated computational system – an inference-making mechanism whose access to background information is constrained by general features of cognitive architecture, hence relatively rigidly and relatively permanently constrained... It is a main thesis of *Modularity* [his book] that perceptual integrations are typically performed by computational systems that are informationally encapsulated.[6]

In this way, Fodor seeks to suggest that perception resembles still simpler reflexes in being discrete; but, unlike reflexes, perception is inferential, and distinguished from cognition, in that the inferences are drawn from a tightly constrained ('encapsulated') information database. The adaptive advantage of this constraint on perception - it is claimed - is that, again, somewhat like reflexes, it is rapid, unreflective, and leaves little scope for the sorts of ambiguity which may creep in when invoking the more wide-ranging information store used in cognition. Such self-contained, perceptual reactions, argues Fodor, may once have been invaluable in avoiding predators, where a reflective organism could have become a dead one in the time it took to reflect. They persist in our make-up to this day.

In this way, our brains can be seen to embody *perceptual biases,* emphasising some features at the expense of others, and even distorting objective reality, where such distortions have delivered adaptive advantages in the past. These biases exist because of the constant pressure on the brain, within its limited neural capacity, effectively and usefully to process external stimuli. As Fodor implies, the brain has neither the capacity nor the time to absorb *every* piece of data about a physical environment, process and assess each of them, in all their conceivable combinations and then initiate appropriate behaviour. Dennett agrees:

> The brain's task is to guide the body it controls through a world of shifting conditions and sudden surprises, so it must gather information from that world and use it *swiftly* to "produce future" – to extract anticipations in order to stay one step ahead of disaster.[7]

It is useful to emphasise, at this stage, this distance between the reality of our physical environment and our sensory and perceptual mental representations of what it is that is out there. The latter is what we experience and react to, and out of which we build our cognitive understandings. It is, in that sense, a product of our evolved brains. Thus Lewontin's observation (cited in chapter one), regarding the extent to which organisms are in the constant construction of their own environments, can be seen to extend in a profound way - where humans are concerned - to the 'construction' of the physical environment in which we operate, insofar as we sense, perceive, recognise, inhabit and mentally represent it.

2.4 Domain-neutral modules and ontology

I suggested in the introduction that we engage with the physical environment at three principal levels: at the level of senses and perceptions (including our kinetic senses); at the level of cognition, by which an emotional spin is put on the information from these lower levels, thus building on some senses to create our *aesthetic* responses, and on our kinetic senses to deliver *technical* satisfaction; and, above that, at the level of attributing symbolic or narrative meaning to it. These can be seen to correspond to the three modes of brain activity described above, where the attribution of significance and meaning to the material environment, as well as the creating of artefacts to go into it, are thought of as initiated behaviour.

The modular description of the brain offers plausible insights into its operation at the levels of reflexes, sensations and perceptions and, to the extent that they arise out of these, some aspects of cognition; but the ability to attribute significance and meaning to a material environment is often built on both aesthetic and technical responses (i.e., cognition) and -

with a complexity arguably comparable with that of language - results in the ascribing of symbolic or narrative meaning. Just as one might ask if there is a suite of modules to support language, so it reasonable to ask if the ability to attribute significance and meaning to the material environment rests on a comparable cluster of inter-related modules. The wide variety of detailed practices in the areas of aesthetics and the ascribing of symbolic and narrative meaning suggests, at the very least, that the results of the brain functions may not be universal among humans, in the way that our sensory and perceptual inputs undoubtedly are. This has consequences for our understanding of the role of genetics in the workings of culture, consequences which will intermittently be pursued throughout the rest of this study.

2.5 Modularity: a qualification

Part of the problem of understanding the structures of the brain and how it operates is, as Annette Karmiloff-Smith[8] notes, that we do so largely by considering the behaviour which is their result. If we identify a behaviour, such as language, tool-making - or, indeed, by implication, the ability to attribute significance and meaning to the material world - it is tempting to infer a corresponding structure in the brain that enables or facilitates it. In accounts (such as Thornhill's[9]) which believe that the brain is a matrix of these dedicated, sometimes called *domain-specific,* brain structures, each is thought of as a 'module'. Most of the time, and in general terms, the past is like the future. For this type of stability, nature confers what Dennett calls 'hard-wired'[10] mechanisms (modules), 'which-way-up-am-I?- type things', as he puts it. For regular variations, responses are also usually hard-wired: growing thicker fur in winter, and so on.

> But sometimes the opportunities and vicissitudes in the environment are relatively unpredictable by Mother Nature or by anyone – they are, or are influenced by processes that are *chaotic*…In these cases, no one stereotyped design will accommodate itself to all eventualities, so better organisms [including ourselves] will be those

> that can *redesign themselves* to some degree to meet the conditions they encounter. Sometimes such redesign is called *learning* and sometimes it is just *development*.[11]

Dennett elects to call all these types of activity *post natal design fixing*. He maintains that this is a process 'analogous' (and later, 'strongly analogous'[12]) to that of evolution by natural selection, but *within the life of the organism*:

> This is the first new medium of evolution: post natal design fixing in individual brains. The candidates for selection are various brain structures that control or influence behaviors, and the selection process is accomplished by one or another mechanical weeding-out process that is itself genetically installed in the nervous system. Amazingly, this capability, itself a product of genetic evolution by natural selection, not only gives organisms who have it an edge over their hard-wired cousins who cannot redesign themselves, but also reflects back on the process of genetic evolution and speeds it up.[13]

This is often described as the Baldwin effect, and it is of importance in understanding the particular manner in which our own brains have responded to both physical *and* social environmental conditions.

Some organisms, including ourselves, have 'plastic' brains; that is, they can be wired and re-wired in the course of their lifetimes. Significantly, in Fodor's model of modularity, the higher cognitive activities are neither modular nor, in his terms, encapsulated.[14] Yet Karmiloff-Smith cites examples of 'modularists' who assert that they are.[15] She castigates these descriptions of the brain (espoused by Leda Cosmides and John Tooby, for example, and – with special reference to aesthetics – Thornhill) as the 'Swiss army knife' model,[16] where all or, as Fodor suggests, significant parts of the brain are thought of as an accumulation of inherited, genetically-controlled, dedicated modules - 'domain-specific', in the language of the psychologists - physiological, neural structures. Yet the environment (including the physical and social environment) can actually structure, that is, physically shape the brain, during an organism's (for which, for the purposes of the present argument, read 'human being's') lifetime. Karmiloff-Smith asserts:

> I agree that human evolution has led to increasingly complex behaviour. However, these behaviours are not simply triggered from genetically determined mechanisms. Rather they are the outcome of gradual formation of internal representations during the lengthy process of ontogenetic development [that is, as a child grows up]. It is in the part of the brain called the neocortex (evolutionarily the most recent part of the brain) that higher cognitive functions like language, number and faces are processed. Rather than genetically prespecified complex, domain-specific representations, evolution may have generated an ever-increasing range of different learning mechanisms in order to ensure adaptive outcomes. This would suggest that during postnatal development the brain has a capacity to learn and actively structure its own circuits while engaged in processing different types of environmental input.[17]

Significantly, for Karmiloff-Smith, this means that some domains or modules may develop in response to the demands of the environment in which the individual operates, rather than invariably being pre-programmed into the brain because of the demands of an environment found in the long vanished Pleistocene era (as Leda Cosmides and John Tooby have argued[18] - this is Dawkins' 'time lag' problem, alluded to in the previous chapter). Interestingly, Thornhill will have none of it:

> …environmental problems bringing about selection are specific and not general problems. Thus, it is expected that phenotypic solutions to environmental problems – that is, adaptations – will be special purpose in design, because a general purpose mechanism cannot solve a specific problem.[19]

Yet such an assertion flies in the face of both Dennett's and Karmiloff-Smith's emphasis on the importance of open-ended ontological learning modules and the flexibility they argue that these confer. With regard to ascribing significance and meaning to the material world, and the furnishing of that world with significant and meaningful created artefacts, it is apparent that the behaviour is a human universal, suggesting a genetic origin and implying that it incorporates a suite of interconnected, evolved modules; but the manifestations of the workings of this suite - if so it be - in different cultures over time and space are, indeed, diverse, suggesting they might well be the result of just these open-ended, non-domain-specific, learning modules, where the brain's wiring is configured during the individual's lifetime, in response to contingent, environmental stimuli (where environment, as noted, will include both the physical and the social). Such a view accounts more convincingly for both historical and contemporary practices in this field of artefacts, than the suggestion by Thornhill, that they can be explained by ever more convoluted combinations of dedicated, domain-specific modules.

2.6 *The Upper Palaeolithic 'Revolution': magnitude, timing, location and speed*

I am shifting the focus of this argument away from the brain, as such, and towards evidence from archaeology, towards artefacts, which can be thought of as the records of some of the behaviour which the brain initiates, with a view to understanding better how the brain came to assume its modern configuration. I begin this part of my argument by previewing an important turning point in human history: the Upper Palaeolithic 'Revolution' found in Europe, or its equivalents in other parts of the world. There is much debate surrounding where, when and how these events occurred, and some of that will be explored shortly. The key factor is that it is taken to represent the emergence of modern humans with brains like our own. I introduce this major phenomenon now, in order to give the reader an opportunity to infer from the descriptions of events from much earlier in our evolution, something of the eventual destination to which those events lead.

Some have argued that the big turning point in the pre-history of humans is the appearance of new tool types in Africa about 250,000 years ago, but, conventionally, most have cited the apparent 'explosion' of artistic, creative outputs, exemplified in the popular imagination by the astonishing cave paintings of the Upper Palaeolithic Period, especially those at Lascaux, Altamira and, discovered in 1994, the Grotte Chauvet near Avignon. At 30,000 years old Chauvet is *twice* the age of Lascaux and Altamira, and includes 300 images of

> rhinoceroses, lions, mammoths, hyenas, bears, reindeer, ibex, two yellow horses, a red panther and an engraved owl. There was also a centaur-like composite of human and bison, some stencils of human hands and an abundance of red dots, many arranged in geometric patterns or animal forms. [20]

In Marek Kohn's judgement, 'although its concentration of variety is exceptional, Chauvet is characteristic of its period, in which art and technology suddenly flourish as never before.'[21] Conventionally, the Upper Palaeolithic 'Revolution' is dated to about 30,000 to 50,000 years ago.

I have written 'apparent' explosion and put inverted commas around the word 'Revolution' to indicate that there is considerable disagreement - about the timing, location and speed of this development. Outside Europe, there is steadily accumulating evidence that something very similar was happening elsewhere in the world. As Kohn writes with justifiable excitement about Chauvet, so Pinker, citing evidence from Australia and the Middle East, as well as Europe, enthuses about

> …unprecedented arts and technologies, which used new materials like ivory, antler and bone, as well as stone, sometimes transported for hundreds of miles. The toolkit included fine blades, needles, awls, and many kinds of axes and scrapers, spear points, spear throwers,

> bows and arrows, fishhooks, engravers, flutes, maybe even calendars. They decorated everything in sight – tools, cave walls, their bodies – and carved knick-knacks in the shapes of animals and naked women, which archaeologists euphemistically call "fertility symbols." They were us.[22]

Given these apparent discrepancies about timing, location and speed, I will, refer to this change for the balance of this study as 'the emergence of modern humans', although some argue that the species responsible, *Homo sapiens,* may have lived several thousands of years before these dramatic changes occurred. Later in this chapter, I will return to this matter of timing, as it has prompted some interesting speculations as to the origins of the modern human mind.

Indeed, I introduce this evidence now, as it certainly seems to suggest something uncommonly close to our modern concept of design: that is, useful artefacts which have had extra consideration given to their forms, finishes and decoration quite over and above anything utility alone would require – a recognisably 'modern' human design practice, as evidence from the 'bore-hole' artefacts drawn from the past 3,500 years of human history explored in chapter three will show. It is not unreasonable, on the basis of the archaeological evidence, to impute modern brains, every whit as sophisticated as our own; and to suggest that, in an extraordinary, conscious way, quite unlike any other species on Earth, our brains can draw on technical, kinetic skills, exercise our aesthetic sensibilities, and - as the paintings and decoration of artefacts seem to suggest - deploy them for social purposes.

In order to establish quite how we acquired such patterns of thought and, more importantly, what consequences this history may have for our contemporary engagement with artefacts, evidence and arguments relating to much earlier phases in human and pre-human evolution now need to be picked up.

2.7 Human brain size

One of the most obvious differences between our distant hominid ancestors, modern Great Apes and ourselves is in the sheer size of our brains, relative to the size of our bodies. Australopithecines were only some four feet high, and their brains were about the same size as that of chimpanzees. About 2 to 2.3 million years ago, archaic *Homo* species appeared. Unlike the australopithecines, *Homo habilis* gradually developed larger and larger brains. Then, through a succession of *Homo* species, some half a million years ago the size of brains increased fairly rapidly for about 300,000 years.[23] Modern humans – *Homo sapiens*, our own species – first appear some 100,000 years ago, or earlier. Compared with modern chimpanzees, our own brains are four times as large, measured as a ratio to body size.

Large brains came at considerable 'expense' in evolutionary terms: they were expensive to run: they required 22 times as much food to sustain them as their equivalent in terms of muscle tissue at rest.[24] To make matters worse, these (literally) big-headed infants made childbirth difficult - as it remains to this day, compared with the comparative nonchalance of other primate and other mammalian births. Because of this, among human infants, brain growth has to continue rapidly in the period immediately following birth. This was a high-risk, high-cost, strategy: unlike the offspring of other species, which tend to be born fully-formed, human infants are relatively helpless, and remain more or less wholly dependent on their parents for nurture and the provision of food for the earliest part of their lives.[25] Furthermore, during this period of brain growth, offspring are especially demanding in terms of a high-quality diet. Such are the metabolic demands of brain tissue, it has been suggested that an increase in brain size meant that some other organ in the body had to be correspondingly reduced, if the metabolic rate of the organism as a whole were to remain the same, and that this organ was the gut. To process food sufficiently efficiently to support these high energy consuming brains with a reduced gut size may well have been one of the factors which led to the eating of highcalorie meat. Initially this may have begun as scavenging from the carcasses left by other carnivores, but eventually developed into hunting.

This diversity of diet may, itself have been a dividend – possibly, even, the chief one - with different strategies open to different populations, depending on the nature of the resources in their environment. As noted in chapter one, specialism is accompanied by vulnerability through inflexibility: should that environment change, such dietary 'generalists' would have the edge over narrower specialists, such as the plant-grinding successors to the australopithecines, *Paranthropus robustus* and *Paranthropus boisei*.

2.8 The neocortex and social relations

The co-operation between individuals needed to rear vulnerable offspring, the collective, organised responses needed to hunt without getting killed – all these point to the over-arching importance of brain growth as a means of sustaining the *social*. A detail of the structure of the brains of modern humans, compared with those of primates, tends to confirm the view that this was what this development was about. Dunbar notes:

> The neocortex is what you might call the 'thinking' part of the brain, the place where conscious thought takes place. It is a rather thin layer, being a mere five or six nerve-cells (about three millimetres) deep.[26]

Much that is distinctive about human mental activity is physically located in the neocortex, including the processing of language. As noted, Karmiloff-Smith proposes it as the physical location for her domain-neutral, 'learning' modules. Dunbar was the first to notice an apparently significant correlation in primates between the size of the neocortex (that is, as a proportion of total brain size) and social group size. Briefly, evidence from primates (as well as other species, including bats) suggests a close correlation – too close to be accidental, in the 'tests for an adaptation' sense - between the size of the neocortex, and the number and quality of the relationships an individual can sustain. Indeed, using Dunbar's model, a group size for *Homo sapiens* of approximately 150 relationships with other individuals can be predicted. He cites evidence from modern hunter-gatherers to support this view, as well as some examples taken from recent history. Further examples from life as we lead it in our highly technological, complex, urban environments, with conurbations accommodating millions, suggest that although this feature of the brain emerged in the Pleistocene period, there is evidence to suggest that, even in such dramatically different circumstances, in practice, something like this upper limit continues to pertain.[27]

2.9 Intentionality and artefacts

It is often argued that one of the key differences between non-human primate brains and human brains (or, indeed, between infant humans in their early development, and the child and adult thereafter) is the high number of levels of intentionality which human brains can accommodate. Most animals with brains *know* that they are hungry, or *believe* that they are in danger; that is the first level of intentionality. If an individual can imagine that others, like themselves, have minds, and speculate on what that other may be thinking, that is the second order (sometimes called having a 'theory of mind'). Speculating on what another may be thinking that a third thinks is the third order, and so on. Dunbar suggests an absolute upper limit for humans of six orders of intentionality, but maintains that in practice, we habitually use second and third orders, are capable of fourth and fifth, but find sixth fantastically difficult.[28]

As evidence from Franz de Waal's[29] classic study concerning the chimpanzees of the Burger's Zoo, Arnhem, testifies, non-human primates can lead complex, indeed dramatic social lives, with alliances, rivalries, deceptions, battles, and appeasement. Such social complexity among non-human primates is described by some as 'Machiavellian intelligence',[30] that is, behaviour whereby the individual seeks to extract every last personal advantage out of each social interaction. Maynard–Smith and Szathmáry go as far as to suggest:

> …selection for social intelligence was a major cause of the increase in brain size in monkeys, apes and humans, and…a theory of mind was already present in the common ancestor of chimpanzees and humans some 5 [or 6] million years ago.[31]

Nonetheless, it can be said with confidence that non-human primates are less adept at these orders of intentionality than we are, and that this has many consequences for them. Interestingly, evidence from Tomasello suggests that some of these consequences are to do with the uses to which objects are put. As he indicates, in their natural environment, non-human primates:

- do not point or gesture to outside objects for others;
- do not hold objects up to show them to others;
- do not try to bring others to locations so that they can observe things there;
- do not actively offer objects to other individuals by holding them out;
- do not intentionally teach other individuals new behaviours.[32]

Monkeys, it is thought, do not have a theory of mind; chimpanzees, however, do; while we humans, with our many levels of intention, outdo them both. Thus, while non-human primates may lead social lives of greater or lesser degrees of complexity, they do not, as we humans routinely do, use objects to articulate those relationships. From the perspective of the present study, the last point on Tomasello's list is also significant, to the extent that it relates, firstly, to the transmission of anything which, by human standards, we might describe as culture (insofar as it is *intentionally* transmitted), and secondly - and as a consequence of this – to the instruction in the making and using of artefacts.

2.10 Human brains are social brains

As noted, we shared a common ancestor with chimpanzees six million years ago; our genetic make-up places us closer to chimpanzees (98.5%[33]), than either of us is to the gorilla.[34] The greatest difference between us and chimpanzees in terms of behaviour is human culture and its many expressions, of which the creation of our own contributions to the physical environment (the subject of this study) is a major part. Such behaviour is made possible, mainly, because that 1.5% genetic difference has led to us having, by primate standards, much larger, and differently organised brains. Nicholas Humphry suggested in 1976 that 'the higher intellectual faculties of primates have evolved as an adaptation to the complexities of social life' and that our 'styles of thinking which are primarily suited to *social problem solving* colour the behaviour of man and other primates *even towards the inanimate world.*' [35] [emphases added]. Mithen, echoing Humphry's line of argument, suggests that even human consciousness itself (that is, reflexive consciousness) originally evolved 'as a cognitive trick to allow an individual to predict the social behaviour of other members of his or her group…In other words, consciousness evolved as part of social intelligence.'.[36]

I do not intend aligning my argument to any one particular account of how modern humans came to emerge. I will, however, suggest on the basis of the arguments cited above, that in principle, Humphry's assertions are correct, inescapable and critical: that we are but an extreme example of a cluster of socially organised species (primates); that our more complex thinking (and, by implication, behaviour) is geared towards furthering goals of social organisation; and that, inevitably, as a consequence, how we engage with the material environment - and again, by implication, how we engage with artefacts - are both products of this intensely social evolutionary history.

2.11 Kinetic sense and technical pleasure

Our brains eventually supported the dazzling products of the Upper Palaeolithic, and its equivalents (and possibly, antecedents) elsewhere. Before considering what circumstances - especially in relation to the changes in the structure of the brain - may have led to this immensely significant event in human history, I will sketch in something of the possible origins of designing – an activity (in its fullest sense) at the heart of that major change, and central to the pursuit of fully human life ever since.

Contemporary common experience confirms that there are pleasures attached to identifying a thing which can be used (especially if that use is novel); there can be pleasure in modifying a thing, such that it can efficiently be used; and there can be pleasure in using a thing that is effective. We might think of these as 'technical' pleasures arising from our 'kinetic sense', by which I mean our senses both of inhabiting and moving in our own bodies, and of our interactions through those bodies with physical things. (I will set to one side the other major cognitive pleasure derived from our engagement with the material environment – aesthetic pleasure - until the next chapter; aesthetics are of such importance that they warrant a much fuller exploration than the one offered here with regard to the kinetic, technical pleasures of designing.)

The account which follows does not locate particular evolutionary events at particular times, but merely extends the commonly acknowledged principle that, while their contingent triggers may be almost infinitely varied, in broad terms, our emotions – a vital dimension of cognition – are evolved in origin. As E. O. Wilson wrote:

> The biologist who is concerned with questions of physiology and evolutionary history, realizes that self-knowledge is constrained and shaped by the emotional control centres in the hypothalamus and the limbic system at the centre of the brain. These centres flood our consciousness with all the emotions – hate, love, guilt, fear, and others – that are consulted by ethical philosophers who wish to intuit the standards of good and evil. What, we are then compelled to ask, made the hypothalamus and the limbic system? They evolved by natural selection.[37]

Among those 'others' is pleasure, and the emotion of pleasure is often adaptive. So, for example, eating and sex feel good. They are pleasures evolved in order to encourage us to engage in both, and thus enhance our chances of survival, and of reproducing respectively (and of passing on our genes). Ehrlich reminds us of the 'purposes' of emotions, and their importance in securing our evolutionary survival:

> In human beings...emotions play many roles (for example, informing other people of our moods, motives and intentions),...but a particularly important role for them is to coordinate and assign priorities to...brain programs [modules]...Emotions can be thought of as subjectively experienced conscious states of awareness that are focussed primarily on the perceived goodness or badness of some thing...[38]

The cognitive scientist, Steven Pinker, remarks:

> …nothing in culture makes sense except in the light of psychology. Evolution created psychology, and that is how it explains culture. The most important relic of early humans is the modern mind.'[39]

Therefore, by inference, at least, the modern pleasures attached to – in its simplest forms – the kinetic, technical aspects of design are both evolutionary and adaptive in origin.

2.12 'Thing using' and cognition

The historian of engineering, F. T. Evans, has suggested[40] that the first step in the emergence of designing must have been - as with chimpanzees - the ability to recognise that a found object (a stick for extracting grubs, or a stone to crack nuts) had a special, utilitarian potential which marked it out from other naturally occurring objects. This refinement of an individual's ability deliberately to discriminate, if advantageous in the securing of resources, would, on average, deliver an adaptive edge - be it ever so marginal - and thus, over time, become part of a virtuous cycle in natural selection. Evans suggests such 'thing using' stretches back beyond the two million years or so for which there are archaeological records of stone tools, perhaps as far back as the point, some six million[41] years ago, when the hominid line split off from that of the ancestors of the chimpanzees.

> If there were stone tools two million years ago, then we can infer that there were other tools for a long time before that…we should leave our minds open to the important possibility that things were being used…[42]

Chimpanzees plainly display emotions when confronted with or denied food. The sociobiologist Andras Ludmany[43] maintains that we store our experiences as specific information patterns (which he calls IPs) in the brain. As each new experience presents itself, we try to match it with our store of IPs, rather than creating a new IP from scratch, every time the unfamiliar heaves into view. Recognition delivers satisfaction and satisfaction gives pleasure. Cumulatively, these can become complex, but individually, they need not be.[44] Ludmany mounts this argument as an evolutionary explanation for aesthetic sensibilities; I propose it extends - by implication - the 'I see/hear/feel/smell/taste food' satisfaction to include a similar, positive feeling when identifying those things – objects with 'tool potential' - which might help secure food.

Conventionally, we tend to think of designing as necessarily including the conceiving of and *making* of a thing. Yet I suggest the earliest stage in the evolution of designing may not have involved the fashioning of an artefact much, if at all, but instead, the exercise of a critical faculty, an adaptive, advantageous act of discrimination, reinforced by an emotional satisfaction.

In Evans' view the dividends of such foraging for 'found tools' for our hominid ancestors may have been considerable:

> Plain pebbles can crack nuts and seashells, or can be thrown as missiles. A dead animal offered, apart from its meat: shoulder blades to dig with; a bladder to carry water; hard, pointed horns; gut; a jawbone studded with teeth…and so on. Above all, it is necessary to imagine what power there was in a stick. It can scrape and dig, revealing new food sources like roots and bulbs; for primates have nails not claws, so they are poorly fitted for digging. The stick can extend the reach and knock down fruit and nuts. As a club it is an energy storing weapon – other animals can only store energy by charging at high speed…And lastly, it might have made walking easier for a learner biped just as it does for an ageing one.[45]

Thing *using* may itself have been satisfying. Mithen, the archaeologist, is persuaded of young children's possession of a dedicated 'intuitive physics' module;[46] while on the basis, partly, of his own direct observations of very young children, Pinker, the child psychologist, is wholly persuaded of the innate nature of our technical intelligence:

> Artifacts come with being human. We make tools, and as we evolved, our tools made us. One-year old babies are fascinated by what objects can do for them. They tinker obsessively with sticks for pushing, cloth and strings for pulling, and supports for holding things up…around eighteen months, children show an understanding that tools have to contact their material and that a tool's rigidity and shape are more important than its color and ornamentation.[47]

Mithen and Pinker's views would tend to confirm Evans' suggestion that technical, 'kinetic' intelligence is innate and the result of a long, evolutionary history. I suggest too, that the pleasures it delivers are evolved.

Pinker's remark about colour and ornamentation is suggestive. Could it be that however important aesthetic judgements have become to us, such an appreciation is only a characteristic of later development? Put simply, did aesthetic sensibilities evolve more recently than technical ones? In chapters three and five I will argue that – in terms of their workings among modern humans – there is evidence that this may, indeed, be so.

2.13 Tool-making and cognitive advances

Whatever their lost or unidentified (and probably unidentifiable) antecedents, the earliest archaeological evidence of tools is the modified stones and pebbles and flint flakes (so-called 'Oldowan' tools), the oldest dating from 2.5 million years ago in Ethiopia (*fig. 9*). Although these had no consistent form, Mithen suggests they mark an incremental advance in cognitive skills:

> First, although the function of the Oldowan tools remains unclear, there is little doubt that some were made to make other tools – such as the production of a stone flake to sharpen a stick…The making of one tool to make another tool is unknown among chimpanzees. It involves holding in one's mind the qualities of two contrasting types of raw material, such as stone and wood, and an understanding of how one can impinge on the other. [Secondly] To detach the type of flakes one finds at sites in the Oduvai Gorge, one needs to recognize acute angles on the nodules, to select so-called striking platforms and to employ good hand-eye co-ordination to strike the nodule in the correct place, in the right direction and with the appropriate amount of force. Members of *H. habilis* were working stone nodules in a fundamentally different manner from the way chimpanzees work raw materials.[48]

The successors to the Oldowan tools, Acheulian handaxes (*figs.10, 11 and 12*), which first appeared, according to Stephen Mithen, 1.4 million years ago,[49] marked further cognitive advances. Kohn suggests that unlike

> ...the hominids who chipped out the Oldowan tools, the makers of these artefacts seem to have had an idea in their heads of the shape

> they wanted to produce. They seem to have envisaged a form and imposed it on their material.[50]

…which is recognisably a key mental aspect of design in its modern configuration. Indeed, it should be noted that while artefacts which seem to testify to brains like our own have been made for – at most – some 70,000 or 100,000 years, our ancestors created these handaxes for more than a million years. It would seem unlikely that such practices sustained over such a vast time span should not leave traces of some sort in our contemporary relationships with the things we make.

2.14 Handaxes as tools

There has been much speculation as to the uses to which these handaxes were put.[51] There is evidence they were well-designed as tools. Some argue they were part of moves towards exploiting more effectively an environment in which plant-rich forest was gradually giving way to increasingly large savannah grasslands. Overall, food resources were becoming less plentiful, and (apart from the reasons already cited above) a diet supplemented by meat made sense. Glynn Isaac, an archaeologist and modern 'knapper' who conducted numerous practical experiments, concluded they could have been used in 'butchery, hacking sticks or clubs from branches, sharpening sticks, opening up beehives, digging into logs to get larvae, peeling off bark and shredding pith.'[52] Kohn tells of an Oxford research student who persuaded a butcher to dismantle a deer carcass with an Acheulian axe:

> This exercise, demonstrating that it is possible to cut up an animal of medium size without having to grip the axe tightly, raises the possibility that the continuous edge might be an attractive design from an economic point of view. The greater the length of the sharp edge on a handaxe, the longer the tool could be used before being discarded.[53]

Peter Jones concluded that the almond shape arose as a compromise between efficiency, weight and strength. Overall, he judged it 'a well-designed tool aimed at the problem of living and travelling through material scarce areas'.[54] Plainly, in terms of technical, kinetic intelligence, the makers of these handaxes were doing well.

2.15 Handaxes: aesthetic appraisal and social significance?

Isaac had noted that the simplest of handaxes could probably have achieved all of the tasks he proposed as efficiently as the more refined, elegant ones. 'Why' ask Kohn and Mithen,

> was time invested in making these artefacts when less extensively retouched artefacts, or even plain unretouched flakes, are suitable for tasks such as butchery, woodworking and other activities for which handaxes were used?[55]

The material – flint – was not easy to work in the first place. Evans, the engineering historian, whom one senses has had his own personal experience of it, calls flint 'the most bloody-minded and fractious of materials in creation'.[56] Further, Kohn, in his sustained meditation on Acheulian axes, *As We Know It*, observes, 'It is questionable whether the improvements in efficiency offered by [the more sophisticated, worked] handaxes were great enough to repay the extra effort required to make them.'[57]

Somehow, these extra 'costs' (in terms of time and effort) must have been justified. There are clues pointing to the strong possibility that these artefacts may have had significances to our hominid ancestors only tangentially linked to their usefulness: firstly, even to modern *Homo sapiens* many of them are beautiful, and it is a beauty which depends partly on their shape, their *symmetry* in several directions, and often on their *regularity*, which as noted, may often have been a superfluous detail, in terms of function. I am not suggesting that *Homo habilis* or *Homo heidelbergiensis* had an aesthetic sensibility in quite the same terms as modern humans; but it is not unreasonable to infer a preference, at least, for – and pleasure at - these 'non-useful' characteristics, which (as pursued in the chapter following) may eventually have formed the basis of some of our own predispositions, with regard to these matters.

Secondly - and puzzlingly - archaeological finds include sites where many of them seem to have been discarded *unused*, or after very little use. Thirdly, they often appear at individual sites in great numbers; and lastly, there are some examples of handaxes which could not easily be used at all, because of their great size, such as those found at Furze Platt and Shrub Hill in southern England (*fig. 11*). There are even examples where it appears as if a decision has been taken deliberately to allow a fossil embedded in the rock to remain there – something which to a modern eye, looks suspiciously like a decorative, 'artistic' decision.

Kohn and Mithen (and more recently in 2003, Mithen alone[58]) argue that these apparent anomalies can only be fully understood, once the handaxes are considered – in a manner directly akin to the tail of the peacock or the antlers of male deer – as tokens of *sexual fitness*, following what is known as the *Handicap Principle*. As Geoffrey Miller has proposed that the mechanism of which the Handicap Principle is an element - *sexual selection* – serves to explain the origins of *all* human culture, including aesthetics and much else besides which is the subject of this study; and as in chapter five I refute that stance, I will take a little time to explain it here.

2.16 The Handicap Principle

Miller writes:

> Darwin understood that in most sexually-reproducing species, there would be strong incentives for choosing one's sexual mate carefully, because one's offspring would inherit their traits, good or bad, along with one's own traits. Bad mate preferences would find themselves in poor-quality offspring, and would eventually die out.[59]

As explained in chapter one, in evolution, for any trait to be sustained by *natural selection* (that is, persistently to figure in succeeding generations' genetic make-up), it must deliver some advantage to the organism in terms of either survival or reproduction, or both. In other words, it must be efficient. Darwin had noticed that some traits – the fantastic tails of peacocks, the elaborate nests of bower birds - seemed to make little sense in terms of their contribution to survival. Famously, the peacock, by supporting so impractical an ornament, not only impairs its owner's ability to escape predators, but also, as with the bower bird, requires that time and energy be diverted towards the maintenance of its ornament (incur 'costs', in other words), which might otherwise be devoted more directly to the securing of resources. These, and other similar traits (on average, displayed more by the males of species, rather than by females) do make sense, however, if considered as adjuncts to courtship. The elaborate tail, the ornamented nest, and much else (including, among hominids, Mithen and Kohn argue, the Acheulian handaxe), are reliable indicators to potential mates of genetic fitness, that is of the strength, health, intelligence or other valuable characteristics of the bearer.

Survival itself only proves an ability to secure sufficient resources to survive. Bearers of these tokens of sexual fitness, by contrast, prove they are 'fit' enough to secure surpluses – an attractive prospect to a potential mate, who may bear the chief responsibility for rearing such offspring as may arise from any union. The costs expended on these otherwise seemingly inefficient adjuncts guarantee to the potential mate that the indication is authentic and reliable. After all, if it could easily be faked, its value as such a signal would disappear. As Miller puts it: 'Utility rules under "utilitarian selection", but waste can rule under "signal selection".[60] Design theoreticians should note how this, a biological theory of the past two decades or so, is vividly and uncannily accurately pre-figured in Thorstein Veblen's theory of 'conspicuous consumption' in his cultural classic, *The Theory of the Leisure Class*, originally published in 1899.[61]

2.17 The handaxe as genetic fitness indicator

The peacock has no choice but to sport its tail; the hominid, however, could choose whether or not to make a handaxe, and also what kind and quality of axe to make. Kohn and Mithen suggest this is a process known as 'strategic choice',[62] in which the male - and it is predominantly males, in this scenario[63] - elects to create more or less costly artefacts, depending on the circumstances in which he finds himself (time needed to secure resources for survival, present dangers, his own abilities, etc.). The handaxe would have to be created in the presence of the desired mate to guarantee that the courting individual had not just picked it up. In such circumstances, it could, according to Mithen, reliably demonstrate a number of potentially attractive qualities: an ability to identify sources of the high quality raw material needed to make the axe, and by implication a good knowledge of resources in the environment in general: 'The ability to comprehend and exploit the environment in this way would be attractive in a mate, as an indication of heritable perceptual and cognitive skills.'[64]; the ability to form and execute plans, to respond and rethink as each flake was detached, to display, in fact 'persistence and determination'[65]; 'health, strength, good eyesight and coordination, whereas poor knapping might indicate the opposite'[66]; social skills, to the extent that the knapper had to bear the handicap of producing the handaxe and still survive and prosper in social groups; and finally – in an argument which will be picked up in chapter three - it is suggested that, as Miller avers, the symmetry of the handaxes may have 'play[ed] on the perceptual biases of receivers to attract attention, provoke excitement, and increase willingness to mate'.[67]

Mithen proposes two possible origins for this bias towards symmetry: sensitivity to symmetry has been taken by Dennett, among others, to have arisen in the deep evolutionary past from a sensitivity to the symmetry of other animals. In recognising it, the organism would effectively detect a potential predator, prey or sexual partner. The other explanation is that symmetry is often a reliable signal of healthy genes in many organisms – an 'honest advertisement', in the jargon.

Once both the behaviour (or more properly, perhaps, the 'performance') and its tangible outcome had succeeded (or failed – archaeological sites include countless very roughly formed, apparently carelessly or badly formed examples) to attract the attention of the prospective mate in the desired way, the handaxe could be discarded. It could only be seen to be made from scratch once. As a fitness indicator, at least, it was now useless.

After more than a million years of more or less unchanging production, the makers of these tools are joined by new, archaic *Homo sapiens*. From about 200,000 years ago onwards (usually referred to as the Middle Palaeolithic Period), new types of stone tools appear, and specialist tools for particular tasks gradually supplant the generalist handaxe. The last handaxes of this pattern were being produced in a limited way only some 50,000 years ago;[68] the function of the handaxe in sexual selection, it seems, had gradually slipped from practice, to be replaced by other behaviours. With bigger brains, and more slowly maturing infants, Kohn and Mithen argue, foraging techniques may have changed. Females alone could perhaps no longer secure sufficient resources on their own, and may now have needed a more practical, useful mate. According to Mithen, although many of these new tools of the Middle Palaeolithic were often finely made, none of them were carved or decorated.[69]

2.18 The timing of the emergence of modern human brains

I am endeavouring to explain something of the relationship which we, *Homo sapiens*, have with artefacts. To that extent, I am interested in how our brains became recognisably 'modern'. As noted, conventionally, the dramatic evidence of the Upper Palaeolithic Period has often been taken to indicate not only the existence of the modern human brain, but also its emergence. The conventional dating of this deeply significant turning point has been given as between 30,000 and 50,000 years ago. Yet it is argued modern *Homo sapiens* first appeared about 100,000 years ago, or earlier with - after a few false starts - a gradual spread out of Africa to other parts of the world. If the conventional timing is accepted, and these *Homo* *sapiens* possessed brains substantially identical to our own, why this apparent 50,000 year delay?

I have suggested that there is a question mark over this timing: both Pinker[70] and Oppenheimer, among others, have recently tended towards the view that earlier dates for this development are viable. Pointing to the Euro-centricity of the conventional view (at the expense of data from other parts of the world), as well as the slender chances of tangible evidence surviving at all, they favour 70,000 or even 100,000 years as a more likely proposition for the emergence of *Homo sapiens* with 'modern' brains, and something akin to modern sensibilities, and in a fundamental, rather than a contingent sense, modern culture. As an un-named archaeologist complains on the Blombos Cave Project website (an excavation in the southern Cape in South Africa):

> Modern human behaviour developed in Africa at a much earlier stage [than evidence from Europe would suggest], and this development is linked to anatomical modernity - a gradual process that perhaps started more than 200,000 years ago but certainly long before the start of the European Upper Palaeolithic. Most 'late origin' models draw heavily on the European Middle/Upper Palaeolithic transition (about 40,000 years ago) for their construction, but applying eurocentric evidence for 'modern behaviour' to an African context has drawn considerable criticism. Until recently archaeological evidence for modern human behaviour in Africa has been limited and, consequently, the model for a late European linked development of 'modern behaviour' is widely accepted. Unfortunately only a small number of archaeological sites that date to this time range have been well excavated in Africa and evidence supporting an early African origin has been limited – in comparison there are many hundreds of well excavated European sites demonstrating a florescence of modern behaviour traits from about 40,000 years ago.[71]

Oppenheimer broadly concurs:

> It is absurd to suggest that they [in Australia] and the rest of the world had to learn their own speech and paintings from Europeans [where conventionally, the Upper Palaeolithic Revolution is said – exclusively – to have occurred]. There is every reason and much evidence…to suppose that their common African ancestor had already mastered the skills of speech, art and symbolic representation long before leaving Africa 80,000 years ago.[72]

To propose some fantastically rapid, cultural transmission, to explain the near contemporaneousness of some finds dotted about the world, whereby Australian and African peoples 'learned' culture from Europeans also strikes Oppenheimer as equally fallacious:

> The simplest answer, which does away with this paradox and similar ones, is that the African ancestors of all non-Africans came out of Africa painting, talking, singing, and dancing – and fully modern![73]

2.19 The origin of the modern mind?

An alternative proposition for the delay – if delay there was - is made by both Pinker, and in some detail, by Mithen. Pinker suggests that the administrative convenience of believing fossil remains to be those of *Homo sapiens* tends to underplay the extent to which the species may have evolved, or successive, minor subspecies been a part of the process. As the earliest specimens have low brows, and differ somewhat from anatomically modern *Homo sapiens,* then why not, asks Pinker, allow that brains may have developed too?[74]

In *The Prehistory of the Mind,*[75] Mithen takes this idea further. He argues that, in the hominid brain, it is reasonable to infer that three major modules or intelligences evolved (of which all other 'smaller' modules are subsets) in response to recurrent tasks hominids faced in their adaptive environment: *social intelligence* as noted, a commonplace among primates; *technical intelligence,* that is, skills and pleasures building on kinetic sense;

and *natural history intelligence* or the ability more effectively to discriminate among plants and animals which might be the more beneficial from the point of view of securing resources, or avoiding danger. According to Mithen, during this period of apparent stasis (which he describes as 'rather dull',[76]) these three modules may have increased in efficiency, but, critically, operated largely in isolation from one another.

We have been considering the possible uses and significances of stone tools in advance of the Upper Palaeolithic Revolution. If Mithen's proposition is true, then this has consequences for the argument mounted here: the ability to identify found objects in the *natural* environment as having *technical* 'tool potential' may – as with modern chimpanzees - have been severely limited for a long time; and the *social* consequences of *technical* tool-making, ownership or use, similarly undeveloped. Thus – as with children with autism today – technical abilities might be developed to quite high levels, without them necessarily impinging on the quality of social interaction.

The significance hominids may have attached to Acheulian axes – created while these modules remained isolated, by this account - only corresponds in part to how modern human minds engage with artefacts: the reflexive and sensory levels of engagement were almost certainly there, as well as most perceptual aspects; who can say whether technical pleasure was present or not but, also at the cognitive level, the consistent forms and finishes of the axes seem a reasonable body of evidence from which to infer the beginnings of some aesthetic preferences (the basis of which I will shortly explain in the following chapter). But, in terms of their *meaning,* nothing – in Kohn and Mithen's account, at least – suggests the handaxes were operating at anything other than the cognitive level of *signals*; that is, that as genetic fitness indicators, they referred narrowly to a present state, and not, as is habitually done in modern human material culture, as symbols, referring to things or states absent (or, by extension, as symbolic elements in narratives).

According to Mithen's hypothesis, the 'walls' in the hominid mind between the social, technical, and natural history modules only dissolve once symbolic thought - and with it the grammar (structures) of language - evolved, such that intelligence from one module might easily inform intelligence in another, in the manner we recognise in our modern selves. Mithen suggests that:

> …language switched from a social to a general-purpose function, consciousness as a means to predict other individuals' behaviour to managing a mental database of information relating to all domains of behaviour. A cognitive fluidity arose within the mind, reflecting new connections, rather than new processing power. And consequently, this transformation occurred with no increase in brain size. It was, in essence, the origins of the symbolic capacity that is unique to the human mind…[77]

Only with the appearance of this 'cognitive fluidity' can the technical possibilities of the natural environment's resources be fully recognised; only then can symbolic social significance be attached to that natural environment; and - as the evidence of the Upper Palaeolithic period, no less than that from Africa, Australia and elsewhere in the world - seems mutely to testify, only then can symbolic social significance be ascribed to the artefacts, created by applying technical intelligence to materials found in the natural environment. In short, only then can the modern mind both generate – and interact with - the full richness of human culture.

Conclusion

Mithen's is an attractive and persuasive account. But, for the purposes of the present argument, it is not essential that what Maynard-Smith and Szathmáry call his 'speculative'[78] proposition is precisely accurate or not. So, for example, the sequence he describes may be sound, but the timing awry. It could be, as noted, that further non-European, archaeological evidence predating that presently associated with the Upper Palaeolithic 'Revolution' has yet to come to light, supporting still further the idea that the modern human mind existed anything up to 50,000 years or more earlier than Mithen and others often suggest; and that the change was, indeed, more gradual, than the attractive, headline-grabbing 'Revolution' of hitherto conventional accounts implies. Or again, it might be that the modern human mind existed earlier, but left behind few, if any, tangible, non-compostable traces. Yet another view could be that through repeated exposure, the recurrent 'truths' about the character of the natural environment and the mechanical behaviour of materials would eventually be apprehended by a brain with a steadily improving general intelligence, rather than with domain-specific intelligences – although I suggest that on the basis of such consensus as there is about the workings of the brain cited above, this last is unlikely.

The critical points are these: there is a strong, persuasive body of expert opinion which points to the over-arching significance of the *social* in driving human evolution, as hominids competed with other species for resources in unstable, and sometimes difficult circumstances. If the absence of remains[79] and the example of the limited abilities of modern non-human primates is allowed as evidence,[80] then it seems likely that, after the split from the common ancestor six million years ago, our most distant antecedents had but the rudiments of technical intelligence. Thereafter, archaeological evidence suggests that simple stone tools and then handaxes with distinctive formal qualities became commonplace. A credible account of the possible significance of handaxes as genetic fitness indicators (that is, an explicitly *social* role) has been proposed. Handaxes can further be regarded as evidence of limited advances in technical and cognitive competences, as well as, perhaps, the beginnings of what (if they may be termed such) might be considered as their aesthetic preferences. It is these which will be pursued in the next chapter.

Things seem to remain eerily static for more than a million years, suggesting that during this period, hominids developed very little, if at all. In the Middle Palaeolithic Period, something happened – a change in climate, a neural breakthrough, a crisis in resources, something else yet to be identified, or any combination of these – which precipitated a somewhat more varied approach to the design of stone tools, and to tools made of other materials; this suggests further 'progress' in terms of cognitive 'designing' skills, especially in relation to technical intelligence; but at this stage, they were devoid of decoration. Indeed, there is no evidence of 'art' at all, suggesting that the modern human mind was not yet fully formed. I favour the view (as proposed by Mithen, above) that at some point consciousness, and - with a critical importance that no one disputes - symbolic thought and language, both arose in response to the demands of larger, and therefore, by definition, more complex social relationships.

However, once again, the argument mounted here stands if other reasons are found: it is chiefly important that they *have* evolved, and that they continue to play central roles in how we feel, think and behave, and that, whatever their origins, they play major roles in mediating our social relationships. Indeed, at some point (sooner or later) after the first appearance of *Homo sapiens* 100,000 years or more ago, there is evidence that the fully modern mind had, indeed, taken shape. Paintings, sculptures, decorated artefacts, personal decoration, technically ingenious and diverse types of tools all point unambiguously to the fact that people walked the Earth with senses, emotions and behaviours comparable to the ones found (albeit with a bewildering variety of contingent cultural content) in ourselves.

The key principle is this: we are evolved creatures. In evolution (apart from a regular peppering of non-purposive,[81] and usually minor 'accidents'), in all major respects, our physiological, neural and mental make-ups are profoundly informed by this history, and its guiding principle of adaptation: nothing is for nothing. Throughout this study, I have emphasised the three levels at which we engage with artefacts: at the level of the reflexes, senses and perceptions; at the level of cognition, by which I mean, principally, technical and aesthetic pleasures; and at the level of symbol and narrative. Following the principle just outlined, I will use the next chapter to develop some ideas about the origins of the first two of these. This will form the foundation for the first half of the model proposed in chapter five.

Yet no credible account of human evolution would fail to attach importance to the human capacity for symbolic thought, language and narrative (even if its significance were quite other than that suggested by Mithen). Accordingly, I will turn my attention to these in the whole of chapter four. These are the arguments which will underpin the second half of the model subsequently developed in chapter five.

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[11] Dennett, p. 183
[12] Dennett, p. 184
[13] Dennett, p. 184
[14] Fodor, p. 496
[15] Karmiloff-Smith, p. 144
[16] Steven Mithen recalls attending a lecture by Leda Cosmides in the mid 1990s, where she actually held up a Swiss army knife 'declaring it to be the mind'. Mithen, S., *The Prehistory of the Mind: The Cognitive Origins of Art and Science, Thames & Hudson,* London, 1999 (orig. 1996), p. 42
[17] Karmiloff-Smith, p. 144
[18] Tooby, J., Cosmides, L., 'The Psychological Foundations of Culture', in Barkow, J.H., Cosmides, L., Tooby, J., *The Adapted Mind: Evolutionary Psychology and the Generation of Culture,* Oxford University Press, Oxford, 1995 (orig. 1992), pp. 19-136
[19] Thornhill, p. 17
[20] Kohn, M., *As We Know It,* Granta Books, London, 1999 p. 173
[21] Kohn, p. 173
[22] Pinker, S., *How the Mind Works,* Allen Lane, The Penguin Press, (The Softback Preview), London, 1998, p. 202
[23] Dunbar, R., *The Human Story: A new history of mankind's evolution,* Faber & Faber, London, 2004, pp. 26-29. Ironically, the largest brains were

inside the skulls of the Neanderthals, who, it has been suggested, the slightly smaller-brained *Homo sapiens* may have brought to extinction.
[24] Mithen, *The Prehistory of the Mind*, p. 11
[25] I have not read this anywhere as a specific suggestion, but it occurs to me that this evolved capacity of human infants to learn if they are to survive might have been a turning point in the development of specifically human culture; that is, that this infant capacity rapidly to learn may have begun as a by-product of a species evolving to support a larger brain (or a larger neo-cortex, as explained later) which could service the management of larger, more complex social groups; but that this ability, even if less pronounced in adult life, did, nonetheless, eventually spill over into adulthood, thus enabling human evolution through culture, as well as through biology.
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[28] [28] Dunbar, R., *The Human Story: A new history of mankind's evolution,* pp. 45-52
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[38] Ehrlich, P. R., *Human Natures: Genes, Cultures, and the Human Prospect*, Island Press, Washington, 2000, p. 121
[39] Pinker, p. 210
[40] Evans, F. T., 'Two Legs, Thing Using and Talking: The Origins of the Creative Engineering Mind', *AI & Society*, vol.12, 1998 pp. 185 - 213
[41] Evans actually writes 'five to eight million' years ago, but authorities seem now to be settling on six million years as credible.
[42] Evans, p. 192
[43] At least, that is how he styled himself when he presented his paper at the annual conference of the European Sociobiological Society at the Free University of Amsterdam in 1993, on which the article cited here was based. I do not know how many still describe themselves as 'sociobiologists', now that the more neutral 'evolutionary psychology' tag has been developed. Ludmany, A., 'The Adaptive Role of the Aesthetic Experience: An

Epistemological Approach', in Bedaux, J. B. B. and Cooke, B., (eds.) *Sociobiology and the Arts,* Editions Rodopi, Amsterdam/Atlanta, GA, 1999, pp. 223-236

[44] Ludmany, pp. 223-236

[45] Evans, p. 194; Could the stick be the distant ancestor of the magician's all-powerful, magic wand, speculates Evans (p. 200)? Apart from the familiar black and white stick of modern times, magicians almost invariably have a staff of some kind, as Prospero does in Shakespeare's *The Tempest*. As will be explored in more detail in chapter four, myth – even at its most fantastical - is thought by many to embody practical wisdom. Evans' speculation is not unreasonable.

[46] Mithen, S., *The Prehistory of the Mind,* pp. 54-55

[47] Pinker, p. 327

[48] Mithen, S., *The Prehistory of the Mind* p. 96

[49] Kohn, M., and Mithen, S., 'Handaxes: Products of Sexual Selection?', *Antiquity* vol. 73, pp. 518-526; reproduced on http://www.antiquityofman.com/handaxes.html visited 28.07.04

[50] Kohn, p. 58

[51] Some have suggested these 'handaxes' might have been hafted onto handles of some sort, but there is little by way of conclusive proof to support this assertion. The discussion which follows does not address this possibility.

[52] Isaacs, G., 'Foundation Stone: early artefacts as indicators of activities and abilities' in Bailey, G. N., and Callow, P., (eds.), *Stone Age Prehistory: Studies in memory of Charles McBurney*, Cambridge University Press, Cambridge, 1986, quoted in Kohn, p. 59

[53] Kohn, p. 97

[54] Jones, P. R., 'Results of experimental work in relation to the stone industries of the Olduvai Gorge' in Leakey, M., and Roe, D., (eds.), *Olduvai Gorge* vol 5: *Excavations in Beds III-IV and the Mesele Beds 1968-71*, Cambridge University Press, Cambridge, 1995; cited by Kohn, pp. 97-98

[55] Kohn and Mithen

[56] Evans, p. 192

[57] Kohn, p. 59

[58] Kohn and Mithen; Mithen, 'Handaxes: The First Aesthetic Artefacts', pp. 261-275

[59] Miller, G. F. 'Sexual selection for cultural displays' in Dunbar, Knight C., and Power, C., (eds.), *The evolution of culture.* Edinburgh University Press, 1999, pp. 71-91; reproduced on the University of New Mexico's website: http://www.unm.edu/~psych/faculty/cultural_displays.htm visited 04.12.03

[60] Miller, G. F., 'Book review of *The handicap principle: A missing piece of Darwin's puzzle,* by Amotz and Avishag Zahavi, Oxford University Press, 1997' found at the University of New Mexico's website, http://www.unm.edu/-psych/faclty/zahavi_review.htm visited 27.07.04

[61] Veblen, T., *The Theory of the Leisure Class,* Great Minds Series, Prometheus Books, New York, 1998, (orig. 1899)

[62] Kohn and Mithen

[63] Although Kohn allows that females may well have also made handaxes. They were after all, practical tools as well. Knowledge of the skill in making would enable females better to appraise their suitors' efforts; they might also have made them as a means of instructing offspring in the art.
[64] Mithen, S., 'Handaxes: The First Aesthetic Artefacts', in Voland, E., and Grammer, K., (eds.) *Evolutionary Aesthetics,* Springer Verlag, Heidelberg, 2003, p. 267
[65] Mithen, S., 'Handaxes: The First Aesthetic Artefacts', in Voland, E., and Grammer, K., (eds.) *Evolutionary Aesthetics,* Springer Verlag, Heidelberg, 2003, p. 267
[66] Kohn and Mithen
[67] Quoted by Kohn and Mithen. The amendments in square brackets are theirs.
[68] Mithen, S., 'Handaxes: The First Aesthetic Artefacts', in Voland, E., and Grammer, K., (eds.) *Evolutionary Aesthetics,* Springer Verlag, Heidelberg, 2003, p. 261
[69] Mithen, S., *The Prehistory of the Mind* p. 23
[70] Pinker, pp. 201-204
[71] Taken from the Blombos Cave Project website http://naples.cc.sunysb.edu/CAS/cape.nsf/pages/blombos visited 17.04.04
[72] Oppenheimer, S., *Out of Eden: The peopling of the world*, Constable, London, 2003
p. 29; Pinker broadly agrees: Pinker, pp. 201-204
[73] Oppenheimer, S., *Out of Eden: The peopling of the world*, Constable, London, 2003, p. 113
[74] Pinker, pp. 202-204
[75] Mithen, S., *The Prehistory of the Mind: The Cognitive Origins of Art and Science, Thames & Hudson,* London, 1999
[76] Mithen, S., *The Prehistory of the Mind* p. 21
[77] Mithen, S., *The Prehistory of the Mind* p. 209
[78] Maynard Smith, J., and Szathmáry, E., *The Origins of Life: From the Birth of Life to the Origins of Language,* Oxford University Press, Oxford, 1999. p. 143
[79] 'Absence of evidence is not evidence of absence', as the aphorism goes. Caveats to the simple interpretation of this gap in remains have already been provided. However, in principle, it may nonetheless be that nothing has been found, because nothing (or nothing comparable) was made.
[80] Thornhill claims such comparisons are invalid. His 'Swiss army knife', domain-specific, modular model of the brain rests on the proposition that each module is the result of members of a particular species negotiating a particular recurrent environmental feature. 'Contrary to the belief of some, the selective forces that designed humans cannot be elucidated directly by the study of non-human primates…' In this stricture, he is very much in the minority. Thornhill, p. 13
[81] Obviously, what I mean here is characters that *seem* as if they are purposive, in the manner of the tests for an adaptation in chapter one.