A good account of debates and controversies surrounding the Knight-Power-Watts theory:

As We Know It

Coming to Terms With an Evolved Mind

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Part Three

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Ochre comes in shades of yellow, orange, red and brown; the core of it is the iron red of ferric oxide. Together with manganese dioxide, which is densely black, it offered Palaeolithic hominids a palette covering the spectrum of fire, from flame to charcoal.

Up to about 110,000 years ago, they only dabbled occasionally. Then, in southern Africa, ochre seems to have coloured their whole lives. It is present in 'copious' quantities at every cave and rock shelter that contains relics of occupation from this period. This was a monochrome explosion, based almost entirely on red ochre, and particularly upon strong reds, rather than orange or brown shades. The collectors of pigment made little or no use of the deposits of manganese ore and magnetite, a black iron oxide, which were available in some areas. According to Ian Watts of University College, London, who has made the study of prehistoric ochre his own, 99.5 per cent of all known African Middle Stone Age pigment is iron oxide, and 94 per cent contains a red streak.[18]

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The sudden red dawn, in a late stage of the Middle Stone Age, was an isolated one. In Europe, the pigment least infrequently used between 70,000 and 35,000 years ago was manganese dioxide. Just one Mousterian object in the published literature seems to share the character of the African ochre phenomenon. Described as a 'plaque' and estimated to be 100,000 years old, it is made from part of a mammoth molar tooth, and coated in red ochre. Like that other flash of Mousterian genius, the nummulite fossil with a line inscribed at right angles to a natural fracture, the plaque was found at Tata in Hungary.[19] Otherwise, ochre features hardly at all before the Châtelperronian, at which point Neanderthals suddenly adopted it. Nearly 20kg of the stuff have been recovered from one Châtelperronian level at Arcy-sur-Cure, the major Neanderthal ochre site.

Several of the southern African ochre specimens have been modified in ways that do not appear to have any practical purpose. They have notches cut out of them, holes drilled into them, and lines scored upon them; some of the latter form patterns, such as parallel lines or triangles. These were not just tools for making decoration, but objects of decoration themselves. They add to the unmistakable scent of symbolism that hangs over Palaeolithic ochre.

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Suppose that a party of Boxgrove hominids has made its way down the gully that cuts through the cliff, and is moving towards a waterhole. Glancing back, a juvenile notices that a wolf is standing by the stream, on the path they have just taken. To warn his companions, he cries out and points. The wolf is gone. The young hominid now launches into an energetic performance, gesticulating, posturing, executing steps like a modern human dancer, repeating a distinctively shaped sound over and over. He uses his whole body and a wide circle of space around it, as well as his voice.

His companions seem impatient at first, some turning away as if to resume the trek. This rouses him to still greater efforts, and eventually he commands their attention. Now they are all facing the cliff. The juvenile falls silent and squats down, as do some of the others. They gaze at where the wolf had been, as the sun passes by overhead.

Lower Palaeolithic jokes probably didn't have punchlines either. Aesop's fable of the boy who cried 'wolf' is leaden

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in Acheulean translation because of the effort needed to communicate without a symbolic culture. If the wolf had stayed where it was, the warning would have been simple. The juvenile would have only to signal alarm and the rough location of the cause for it. He might be able to use a specific sound to signify 'predator', or even 'wolf'. His companions would look in the direction he indicated, and verify for themselves that there was an object corresponding to his signal at the spot.

Unfortunately, the chances that they would be able to obtain this confirmation are reduced by the noise and commotion of the alarm signal itself. Without a symbolic order, everybody has to shout. Every signal has to carry its own conviction, and conviction is indicated by cost. Cheap signals are easy to fake, and so cannot be trusted.

If the wolf hears the alarm and makes itself scarce, the juvenile is immediately faced with a far more complex problem of communication. He has to convey the message that an important object was in a certain place, and justify the call on his companions' attention. The more information he can convey, the greater his chances of convincing the others will be. He is now under pressure to fill in the picture with more detailed information about the location and nature of the object, in order to demonstrate its significance. A wolf on the trail back to where they spend the night is more important than a wolf in the same general direction, but on the clifftop above. A group of horses would also be worth noting, and so would a thundercloud; but each would require a different response.

In a situation like this, the temptation is to exaggerate, or to lie. The audience has to decide whether to believe the performer. Like the Greeks to whom the shepherd boy cried wolf, the Acheuleans can draw on past experience to assess his trustworthiness. In the main, though, they have to gauge a message about an invisible object by the effort the signaller puts into it, and by whether they can verify it themselves. Both these measures

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are likely to require considerable effort on the audience's part. They cannot simply listen to the signaller's words while they carry on with what they were doing before. They have to stop, look and listen, in order to assess both the cost and the meaning of the signal. Once they are convinced that the juvenile is likely to be telling the truth, even if they are not quite sure what that is, they then have to see it for themselves. That requires staying put and staring, until the wolf reappears or they have had enough.

If we could see them now, they would probably look pretty stupid, with their slapstick antics and their solemn stares into the distance. It's true that they might well have found communication easier if their mental capacities had been greater, but that was not their fundamental problem.

Nor would it have been all right if they could have talked properly. The question of becoming human raises questions of self-consciousness, culture and language. Many scientists put language first, as the most impressively exclusive human trait, and many are inclined to treat it as a problem of machinery. This approach has been strikingly productive, leading to disputes as heated as any in the field of human origins.

Even the earliest hominids have been called in evidence. Most of what little information can be gleaned about hominid brain structure comes from the impressions that brains have left on the inside of fossil skulls. Dean Falk and Phillip Tobias believe that they can discern the mark of a region called Broca's area in the brain of very early *Homo,* but not in australopithecines. Broca's area has been associated with speech since 1861, when the anatomist and anthropologist Paul Broca identified it as the site of damage to the brain of a man known to hospital staff as 'Tan' - the only sound the patient could utter. It is hard to pin down, though, and monkeys have similar structures. Even if the convolution was one of the features that distinguished hominines from australopithecines, it

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may have arisen to perform some other function, long before it was recruited to serve language. Stephen Jay Gould and Elizabeth Vrba coined the term 'exaptation' to describe instances in which selection appropriates a

structure for a new purpose. Exaptation is considered to be standard procedure in evolution, but its suggested effects can be radical. One explanation for the evolution of insect wings, for example, is that they originated as fins for dispersing heat.

At the other end of the hominid timeline, the most heated controversies are located not in the brain, but just underneath it. The question at issue is whether any hominids other than anatomically modern ones had structures for sound production sophisticated enough for efficient speech. The vocal tracts of modern adult humans are distinguished from those of infants and other mammals by the low position of the larynx. This increases the volume of air available for modification during speech, and directs the outward impulses of air towards the mouth rather than the nose. These alterations make for clearer and more varied sounds, at the price of an increased risk of choking. In the words of Jeffrey Laitman, a pioneer of hominid vocal tract reconstruction, the effect of lowering the larynx is like turning a bugle into a trumpet.[20]

The position of the larynx in ancient hominids can be inferred from the shape of the base of the skull. Those of some Neanderthals are fairly flat, suggesting a high larynx, but those of some of their likely ancestors are curved, indicating a larynx in a characteristically modern low position. According to Laitman's colleague, Philip Lieberman, *Homo erectus* did not have a larynx low enough to support speech. The necessary vocal apparatus would therefore have emerged somewhere in the grey area between *erectus* and *sapiens,* during the past half million years.

At least one element of the system does appear to have been in place by this time, judging by another feature of the base of the skull. The hypoglossal canal is the duct through which run the nerves from the brain to

the muscles of the tongue. Three researchers from Duke University, in North Carolina, have compared the width of the canals in contemporary apes and extinct hominids. Chimpanzees, australopithecines, and a specimen assigned to *Homo habilis,* had canals of similar bore. Those of modern humans are twice as wide; most of the difference between apes and humans remains after corrections have been made for the different sizes of the primates' mouths. The team reasoned that the canals might be wider in order to accommodate more nerve fibres, necessary for controlling complex tongue movements (though their first study did not exclude the possibility that blood vessels took up the extra space). Since eating and drinking make basically similar demands on the tongues of apes and humans, speech is the obvious candidate to explain the increase in bandwidth.

If the difference relates to language, it is not surprising that very early hominids resemble apes rather than humans. This is a rare example of a finding that ruffles few feathers in the fractious domain of language origins, in which one camp thinks that language developed quietly and gradually throughout the course of hominine evolution, while the other maintains that language appeared late and all at once, immediately becoming the wellspring of the cultural deluge which marks the Upper Palaeolithic. The Duke researchers measured the hypoglossal canals of two skulls from the grey area of archaic *sapiens,* or *heidelbergensis,* or *rhodesiensis.* In these specimens, 200,000 or 300,000 years old, the widths of the canals were within the modern human range. So were those of two Neanderthals and an early modern human. Matt Cartmill, one of the researchers, suggested that Neanderthals 'had tongues as nimble as yours'.[21]

They also had a bone in the throat like ours, called the hyoid. When a fossil Neanderthal hyoid bone was discovered at a site on Mount Carmel, in Israel, it was hailed as a token of Neanderthal speech. Critics objected

that its position in the throat was unknown.[22] Since much of the vocal apparatus is made of soft tissue, the course of its development will always be uncertain.

Chris Stringer and Clive Gamble point out that once the shift towards language had taken place in the Neanderthals' ancestors, its reversal would be unlikely. The anatomical evidence may remain equivocal, but if the hypoglossal canals were indeed filled with a fat bundle of nerves leading from the undoubtedly large Neanderthal brain, it seems reasonable to suppose that Neanderthals had some sort of capacity for speech. If their larynxes remained short, they might have spoken a language with a limited range of vowel sounds. That would not have been such a terrible handicap, though. After all, the English upper classes managed without the vowel 'a' for half the twentieth century.

There may be a threshold of performance below which language as we know it cannot be sustained. People can process information about three times faster when it comes as speech than when it takes any other form. More than twenty units of information, each roughly corresponding to a letter, can be uttered and comprehended in a second. In any other modality, fewer than ten units of information can be processed in a second. If speech was as slow as that, a typical sentence might exceed the capacity of short-term memory. With a slow communication system, hominids would be limited to simple utterances. Their conversation might not have been sophisticated enough to stimulate the development of a comprehensive language faculty. The level of such a threshold is a matter of guesswork, but it seems reasonable to assume that the Neanderthals were well above it. They are simply too close to us.

Although the Neanderthals are the co-stars of human evolution, with their hulking charms and noble savagery, older varieties also raise interesting questions about speech. If they had nimble tongues as well, what were they doing with them? One possibility is that hominids, such as those of Boxgrove, could articulate a large

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range of sounds, but had not developed the capacity to organize them with syntax. They might have had words, but no language.

A lack of grammar was not the reason they were dancing and gesticulating in the imagined scene at the beginning of this section. Mime and gesture were not needed as a makeshift scaffold to give communication a structure. They were needed to overcome a lack of trust. Their powers of persuasion came partly from the sheer effort involved, and partly from the distribution of signals across modalities. As all but the most perfunctory messages were likely to require the use of facial expression, gesture and bodily movement, as well as sounds, there simply were no short cuts by which they could be delivered cheaply.

The idea of mime derives from the psychologist Merlin Donald, who has proposed that hominids passed through a stage in which they based their communication upon it. This was the first great human leap forward, establishing a mode of thought more fundamental than language, and independent of it. 'Mimetic action,' Donald writes, 'is basically a talent for using the whole body as a communication device.'[23] What made it possible, he argues, was a revolution in which hominids took control over their bodies.

Thanks to the work of Dorothy Cheney and Robert Seyfarth, the alarm calls of Kenyan vervet monkeys are among the most celebrated sounds in primatology.[24] Vervet alarm calls sort the monkeys' many predators into four classes. There is one call for large cats, either leopards or cheetahs; one for eagles; one for snakes, either mambas or pythons; and one for primates, baboon or human. On hearing an 'eagle' alarm, vervets look up at the sky; on hearing a 'cat' warning, they scramble up trees.

Marc Hauser, a theorist of animal communication, has observed a degree of flexibility in the system. Driving through the Amboseli National Park, where Cheney and Seyfarth have conducted their studies, Hauser heard

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vervets giving 'cat' alarms. These calls sounded wrong, though. They were slower than usual, as if 'the batteries of a tape recorder were run down during playback'. The cause of the alarm turned out to be a lion, a cat so large that hunting vervets would not be worth its while. 'Slowing the tape' was an appropriate response, but there is not much more that can be done with a tape or a vervet call. The monkeys' alarms are reliable because their only legitimate meaning is that a vervet has just seen a predator. Either the calls will be verified immediately, or not, in which case they will be disregarded. The monkeys who send the messages cannot elaborate them - unlike the Acheulean juvenile who cried 'wolf - so it only takes a glance for the other monkeys to check their veracity. While a system like this deals efficiently with a present and visible threat, it cannot cope at all with even the recent past.

Though apes have much more complex cognitive faculties than monkeys, they remain generally unable to exert deliberate control over their signals. Sometimes chimpanzees manage to stifle their cries, but only with difficulty. If they see something exciting, such as food, they generally cannot help but let the cat out of the bag. They do not cry 'food', though. Despite their much greater cognitive capacities, chimpanzees do not attach particular meanings to particular calls.

The reason may be that they are too clever for their own good. A boy in the playground is being threatened by a larger boy. He points over the larger one's shoulder and cries 'Behind you!'. 'That's the oldest trick in the book,' retorts the aggressor. Judging by an incident recorded by Richard Byrne and Andrew Whiten, the trick may be very, very old indeed. A sub-adult baboon was harassing a younger animal, which brought a party of adults to its aid by screaming. When the harasser saw the adults coming over the hill, he jumped up on his hind legs and stared across the valley into the distance, as if he had seen a predator. His challengers stopped and stared in the same direction, instead of pursuing their attack.

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When they surveyed the primatological literature, Whiten and Byrne found that deception was part of life in all monkey and ape families. It typically took the form displayed by the adolescent baboon, boys in playgrounds and slapstick comedians, of attempts to manipulate the attention of others.[25] The reason the trick is still part of human culture, millions of years after it first evolved, is that it can still work if the cheat can produce a convincing impression of an involuntary response. A look of alarm and a spasm of muscular recoil may trigger an involuntary response on the part of the victim, that makes him wonder for a fraction of a moment whether there really is a monster behind him; and a fraction of a moment's uncertainty is all a clever cheat needs.

With deception so deeply ingrained in primate life, it is not surprising that vervet monkeys are unusual in having signals with specific meanings. It is probably a condition of their existence that these signals are tuned to the delivery of messages which are likely to benefit all the individuals who hear them. Chimpanzees lack

predators, apart from humans, and so would not have common interests in alarm calls of the vervet type. Their overwhelming concern is with each other, and their intelligence is needed to keep up with greatly elaborated Machiavellian challenges of the type demonstrated by the cunning baboon. Their intelligence resides largely in their Machiavellian capacities, but these very faculties prevent them from developing anything like a lexicon of signals. As Chris Knight puts it, they are too clever for words.

The fact that several chimpanzees have proved able to use symbols devised by humans, amounting to visual words, only highlights the question of how humans, alone among living primates, have established the basis of trust for symbolic communication. This was surely the most fundamental of transformations in the process of becoming human as we know it. But it does not imply that before trust hominids lacked language entirely. Whatever forms their societies took, all would be different to greater or lesser degrees from those of

chimpanzees. The marked differences between bonobo and common chimpanzee social relations illustrate how much a relatively minor shift in the balance of power can influence the quality of life. As hominids acquired the capacity for more sophisticated forms of behaviour, the benefits of co-operation may have increased. By the later Acheulean period, hominines appear to have anatomical adaptations for speech. The debates over the extent of early language capacities are baroque, highly strung, and best avoided if possible. This account sticks to the Darwinian point that, whether hominines had words, syntax or both, they were limited by the extent to which cheating could manipulate their communication systems.

In the case of the Acheulean juvenile who cried wolf, the group would have been presented with a message about something on which it would not be particularly easy to agree a meaning. A wolf would not have the same implications for middlebrow hominids as a leopard for vervet monkeys. For vervets, a leopard is a predator, posing a straightforward threat. Although it would be going too far to claim that hominines had no predators, the threat they faced from wolves and other carnivores would have been more equivocal. Wolves would have learned to respect the defensive capabilities of intelligent hominines who used weapons and threw missiles. They would have been opportunistic rather than regular predators, snatching juveniles when hungry enough to make the effort worth while, or when the odds happened to favour them. Hominines and wolves would often, however, have been competitors for the same meat. So wolves would always have been of interest to hominines, but the appropriate response to a sighting would vary greatly according to circumstances. Among vervets, the alarm system is completed by the response rather than whatever the monkeys understand by the signal. In that sense, the call triggered by a leopard means 'climb a tree' rather than 'leopard'. Without such an urgent and unequivocal

message, hominines would be unlikely to develop a sign for 'wolf'.

Whether their brains are large or small, then, primates are confined to the same frame of reference. If they can see an object, they can and often must refer to it; if they cannot perceive it, they cannot refer to it. Primate communication systems will remain earthbound until their signals break free from the concrete objects they represent. According to Merlin Donald, this happened when hominids developed a mimetic faculty, which required them to have access to their memories at will. According to Chris Knight, on whose fundamental insight about trust this discussion is based, the next stage in the liberation of signals required the invention of deities. What the Acheulean juvenile needed was a god to swear by.

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In his book *Blood Relations,* published in 1991, Chris Knight recalls how he came to appreciate the powers of sociobiology. He had by then spent more than twenty years following twin tracks of political activism, rooted in Marx, and studies in cultural anthropology, based on Lévi-Strauss. Precisely because of its radical calculating individualism, Knight saw in sociobiology the same kind of revolutionary power that Marx had seen in capital. In an incandescent passage of the *Communist Manifesto,* Marx and Engels hailed the achievements of the bourgeoisie, which had destroyed feudalism and 'drowned the most heavenly ecstasies of religious fervour, of chivalrous enthusiasm, of philistine sentimentalism, in the icy water of egotistical calculation'. Sociobiology's ruthless cost-benefit calculations, Knight realized, had a similarly devastating impact upon 'well-meaning' theories of selection for the good of the group. Its achievements, he wrote, 'are the corrosive acid which eats away at all illusions, all cozy assumptions about "the welfare of the community" or the "brotherhood of man", all unexamined

prejudices about how "natural" it is for humans to co-operate with one another for the good of all'.[27]

A few years later, Daniel Dennett hit upon the same metaphor to convey the power of 'Darwin's dangerous idea'. He compared the idea of evolution by natural selection to universal acid, an imaginary substance with which he and his friends would playas schoolchildren. Universal acid dissolves everything, and so cannot be contained. Like it, Darwin's idea 'eats through just about every traditional concept, and leaves in its wake a revolutionized worldview, with most of the old landmarks still visible, but transformed in fundamental ways'.

Dennett affirms that culture is grist like anything else to the mill of Darwinian selection. His thoughts are mostly of memes, the loose equivalent of genes in the world of ideas, and how Darwinian processes may underlie their spread. Knight's focus is on how culture could have been created by animals that were subject to Darwinian processes in the conventional biological sense. Dennett speaks of 'good tricks' that evolutionary design will often employ. Knight and his colleagues have constructed a trick of extraordinary cunning, which they propose as the means by which Darwinian animals reconciled their interests enough to make possible language and symbolic culture.

Blood Relations is an extraordinary work, in which imaginary creatures and magical events are orchestrated on a global scale, from Australia to Amazonia, into a single vision of how humans created humanity. Speaking at an event billed as a 'Great Sociobiology Debate', for the motion that 'Darwinism can explain the origin of culture', Knight declared that it was not the use of tools by chimpanzees that needed explaining, but how a species comes to be able to distinguish between water and holy water. Nobody is more impressed by the power of capitalism than a Marxist, and perhaps likewise it takes a Catholic upbringing to realize just how far Darwinism can go.

Though Knight does tend to resemble a shaman with a spread-sheet, he is not concocting some syncretic

religious brew of Darwinism and tribal initiation rites. He is every bit as materialist as Dennett or Dawkins – ultra-Darwinian, in Stephen Jay Gould's terms – but unlike them, he has an intuitive understanding of the sacred. The trick here is to retain one's sense of magic after one stops believing in it. *Blood Relations* appreciated the importance of sacred ritual, and of sociobiology, the better for being able to stand outside them. Writing under the influence of *Primate Visions,* Donna Haraway's feminist interpretation of primatology, Knight felt able to refer to his own narrative as myth, and free to bring his own props to the sociobiology show. 'If you could have calculating, maximizing capitalists operating in human origins narratives, why could you not *also* have militant trade unionists?' he asked. 'If you could have profits and dividends, why not also industrial action, pay bargaining and strikes?' Culture, he proposed, was the settlement that followed the world's first strike.

Women's reproductive cycles have several distinctive features that add up to a unique combination among primates. There is no signal to indicate that ovulation has taken place, but halfway between ovulations, bleeding occurs. In contrast to females of other species, women may mate at any stage in their cycles. And the mean length of the cycle, 29.5 days, is the same as that of the Moon's cycle from full to dark.

Although imperceptible ovulation is a distinctive feature of human sexual physiology, it is not a unique one. It seems to have arisen a number of times in different primate lineages. Birgitta Sillen-Tullberg and Anders Møller surveyed the mating systems used by species in which ovulation is concealed, to weigh the balance between two competing explanations for this concealment.[28] One school of thought has argued that concealed ovulation promotes monogamy by inducing a male to remain around a particular female for longer, in order to increase the chances that mating will take place during a phase when an egg is present for fertilization. It is thus a device for

increasing a father's confidence about who his offspring are.

The other school argues just the opposite: that concealed ovulation is a Machiavellian tactic to confuse the issue of paternity. If a male is uncertain whether or not he is the father of a juvenile, he is less likely to harm it. Concealed ovulation is thus a device for making males behave better. Sillen-Tullberg and Møller concluded that it might have evolved once in a monogamous species, or not at all, whereas it seems to have evolved between eight and eleven times in species with non-monogamous systems. The evidence therefore supports the Machiavellian hypothesis, rather than the monogamous one. On the other hand, the researchers found that of the seven times that monogamy itself evolved, four to six of these events took place in the absence of ovulatory signs. So once concealed ovulation has evolved, even if it has done so as an adaptation to a non-monogamous mating system, it is then conducive to the evolution of monogamy.

Under mating arrangements that are far from monogamous, such as a harem system in which a single male exercises a reproductive monopoly, it would suit the male for the females' reproductive cycles to be unconnected to each other. If all the females reached the fertile phases of their cycles at the same time, the male would probably succeed in impregnating far fewer of them than if their windows of reproductive opportunity were randomly distributed. Conversely, females could thwart reproductive monopoly by synchronizing their cycles. A trend towards female synchrony would be attractive for males even when more than one of them had already

achieved reproductive success. If males were staying with single mates, they would be competing less with each other.

In 1979, Nancy Knowlton published a paper which pointed out that cycle synchrony could be a strategy for encouraging males to invest in their offspring. If all the females in a group have synchronized cycles, there is little point for a male in abandoning a mate once her fertile period has finished, since none of the other females will be

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fertile either. He will do better to stay with her and invest his energies in the welfare of their offspring, and he will be the more inclined to do so because of the increased likelihood that he really is the father.[29]

Applying the logic to the chimpanzee-like primates he took to be at the root of the hominid lineage, Paul Turke then devised a scenario for the evolution of distinctively hominid female reproductive cycles.[30] If females signalled their fertility conspicuously, as female chimpanzees do with the genital swellings which accompany oestrus, males of high rank would mate with the most conspicuously fertile females. Lowlier males would mate with females with lesser signs of oestrus. Although the lowly and the less obviously fertile would not be the mates of first choice, both would have attractions of their own as a result. A male whose mate had muted signs of oestrus would face less interference from other males. A lowly male would be more likely to stay with a female, having less chance of success elsewhere.

Turke suggested that a female whose oestrous signs were lower key but longer lasting than those of others could extract higher levels of investment from a mate than her rivals. She would attract a low-ranking mate, who would be less likely to leave her to pursue other opportunities. The longer her oestrous period lasted, the longer he would be likely to stay, driving a selective trend towards what is questionably described as 'continuous receptivity'. Synchronizing with other females would complete a package adapted to securing male investment, by promoting tendencies towards monogamy. Turke's model encapsulates what sociobiology did for females. A radically individualist paradigm, based on conflicts of interests, placed the interests of females at the centre of the stage; and showed how individual interests could be reconciled into collective ones.

Ovulation in women is undoubtedly concealed, even from women themselves, as the difficulties of encouraging or preventing conception without artificial means affirm. Menstrual synchrony is another matter. In

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humans, rather than rats or golden hamsters, it has proved an elusive phenomenon. Martha McClintock first described it in 1971, but it has still to be accepted as real by many scientists.[31] There are two main reasons for the enduring scepticism. One is that while many studies have detected synchrony, many have not. A review published by Leonard and Aron Weller in 1993 gave a tally of sixteen studies reporting synchrony, and eleven which failed to find it.[32]

Even in studies with positive findings, it is impossible to say why some women synchronize their cycles and others do not. In a survey the Wellers conducted on lesbian couples, ten of the couples did not synchronize cycles and ten did. The only thing that the researchers could find which appeared to encourage synchrony was eating together.[33]

Roommates, friends, workmates, mothers and daughters have also been studied. Thanks to a Bedouin nurse who conducted interviews among women of her village in northern Israel, the Wellers were able to obtain information about synchrony under conditions they regarded as optimal: the Bedouin women lived together for many years, were segregated from men, were extremely unlikely to have sexual relations with men outside marriage, and hardly ever used oral contraceptives. Among these groups, the data indicated a shift towards synchrony of 20 to 25 per cent. The Wellers then went back to lesbians, studying thirty couples, and found no sign of synchrony. Combining their results with those of other published papers, they concluded that overall, the literature failed to demonstrate menstrual synchrony in lesbians. In the light of this conclusion, and the modesty of the effect in the Bedouin study, they suggested that 'prolonged and very intensive contact may not be conducive to menstrual synchrony' after all.[34]

The other major reason why scientists have their doubts about synchrony is that it has been an effect without an established cause. In her original paper, Martha McClintock suggested that it might result from the

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action of pheromones, hormones which are broadcast through the air to act on other individuals, instead of remaining within the body that secretes them. Although pheromones have become a household word, they have done so despite the absence of proof that they actually exist in humans. It was not until 1998 that McClintock published a paper claiming to deliver this proof, by showing that pheromones from one woman (from her armpit, to be precise) could exert an effect on another. Samples taken from women in the early phases of their cycles shortened the cycles of women who inhaled them, while samples from women at the point of ovulation lengthened other women's cycles. These experiments met one of the main objections which the studies outside the

laboratories had faced, that a substantial proportion of cycles in a group of women will align with each other by chance.[35]

McClintock's paper was hailed as the inauguration of a new research programme, offering all manner of insights into human behaviour. There were suggestions that feelings from sexual attraction to xenophobia might be triggered by chemicals which people cannot consciously smell.[36] Instead of 'The Naked Ape', welcome to 'Your Life As A Dog'. As far as the origins of culture are concerned, though, her results are useful as evidence that a capacity for synchrony evolved at some stage. The Wellers' reconsidered views about close contact may also be helpful to the case. Pleistocene females did not sleep in dormitories or work in offices. They spent most of their waking hours in the open, and probably slept in spaces which were covered rather than enclosed. In France, for example, the rock shelters show signs of habitation, but although people painted the deep caves, they did not live in them. If menstrual synchrony research now moves away from situations of close contact, it may be more likely to identify mechanisms which could plausibly have operated in ancestral environments. Such mechanisms need not be powerful today. The selection pressures behind them would have slackened once they had helped

establish a symbolic order, in which representations of menstrual blood assumed more importance than the real thing.

Menstrual blood signals that a woman will soon be fertile. To a male hominid, it would sort females into two classes; those who were cycling and those who were not. Although the fertility status of some would be obvious, because they were visibly pregnant or had infants attached, others might be infertile because they were in the early stages of pregnancy or the later stages of lactation, or in poor health. Together, the currently infertile would probably constitute a large majority; while any female who menstruated would become a centre of attention. Males would be alert to blood because it signified both life and death.

It would not, however, help them to pursue an ultra-male strategy of maximizing the number of mates and minimizing investment. In order to benefit from the signal, a male who homed in upon a female because she was menstruating would have to guard his position against competitors at least until she reached the point of ovulation. Since he would not know when this had occurred, it would be in his interests to stay rather longer. While she had his attention, his mate would be in a strong position to bargain for signs of commitment, and his responses would help her to decide how good a prospect he really was.

At this point, according to Camilla Power, deception enters the picture. As a means of leveraging male energy, menstruation would be so useful that females would try to fake it. A female could sham menstruation by daubing herself with the menstrual blood of others, which it would be in her sisters' common reproductive interests to provide. In this shared deception is the germ of ritual.

Sham menstruation would serve to safeguard the interests of the majority of females against possible competition from individuals who were in a position to trade on the resource of potentially fruitful sex. In the

scenario developed by Power and her colleagues, a female who begins to menstruate is immediately claimed by the others in the group. They assert bonds with her, by painting themselves in menstrual red, and thereby assert influence over her. She could harness more male labour power than the others by trading sex for it after her menses finished, but this would not be in her longer-term interests. For much of her life, she would be in the majority position; infertile at just the time she needed male assistance most, and for the same reason. If she had gone it alone, when her sexual currency was at its most valuable, she would not subsequently be supported by the other females when her ability to trade on this resource became limited. As disloyalty would not pay in the long run, the game of sham menstruation could go on. Menstrual signals would work in concert with synchrony, instead of disrupting it.

Although the sham would have to be convincing, it would not have to be realistic. A male might suspect which females were really menstruating and which were not, but he would not be able to do anything about it. The message of the sham was that the menstrual coalition had established a solidarity which was not worth challenging. It was a deception of a kind unknown among modern non-human primates, in having a collective rather than an individualistic basis. 'As such,' observed Camilla Power and Leslie Aiello, 'it represents a vital step towards sustaining an imaginary construct and sharing that construct with others - that is, dealing with symbols.[37]

To convince its intended audience, the deception had to be expensive rather than accurate. The more the signal was amplified, the more believable it would be. Females could build it up by making a noise, gesturing, or using substances that would amplify the message of menstrual red. This was the function of the red ochre that is such a striking feature of early modern human sites. In the process of becoming human as we know it, females invented cosmetics.[38]

The process of becoming anatomically modern continued the expansion of the brain, ratcheting up the costs of reproduction that females had to bear. They became less inclined to range widely in foraging parties, encumbered as they were by increasingly dependent young, and they began to remain at home bases in order to conserve energy. Whereas sham menstruation had worked by encouraging males to hang around, in the hope of guarding mates successfully, this now became a disadvantage. Females needed more male labour power. Increased productivity was indicated. The males had to be induced to embark on hunts that were sustained until success was achieved.

Gradually, the sham became detached from hormones, and settled into a rhythm of its own. Perhaps all it took was a little synchrony and a lot of amplification; perhaps they were even able to entrain their rhythms to the phases of the Moon, whose cycle coincides so uncannily in length with those of women. It became a monthly ritual, cued by the Moon, regardless of whether anybody in the coalition was menstruating or not. The female coalitionists had created something whose meaning was not tied to a physical referent. This primal abstraction became a 'morally authoritative intangible', through which right and wrong behaviour could be ordained.[39] It was the first step into the imaginary world, and towards the gods.

Now the ritual served to impose a monthly rhythm under which labour was divided between the sexes. Women's displays, loud and vivid and emphatic, inverted the normal message of sexual assent. To confirm the possibility of mating, an animal needs to verify that the potential mate is of the right sex and species, and that the time is right for fertile sex. The message of the women's ritual was 'wrong sex / wrong species / wrong time'; or, in a word, 'No!'. They were refusing sex, collectively, unless men went out to hunt and returned with provisions. Individual contracts were not to be permitted to breach this solidarity. Although monogamy was favoured as the

underlying relationship between the sexes, the ritual urged the men and the women to go their separate ways until the hunt was done and the Moon was full.

In order to deter the hunters from eating some of their kills in the bush, the network of beliefs drew on the power of blood to proscribe eating raw meat. Women, consolidating their home bases, were in a position to assert control over cooking, the process through which meat ceased to be bloody. By creating the symbolic distinction between the raw and the cooked, they exerted influence over men at a distance.

This was the strike that launched culture, and also the birth of taboo. Menstruation, blood, meat and sex were linked into a network of powerful ritual laws, whose traditions endure to this day.

Archaeologists have identified threads of continuity in South African San culture that stretch back 25,000 years. Knight and his colleagues have traced them back even further, to culture's inaugural rituals. They noted the flowering of a recognizable culture that seems to follow the emergence of modern humans, with their sudden appetite for red ochre, beads and other signs that their lives had become more than practical. The new way of life is first seen in Africa, from around 50,000 years ago.

Its founding traditions remain at their strongest, according to Knight, among Africa's last hunter-gatherers. The taboos are still widespread among San groups and the Hadza, hunter-gatherers who live in Tanzania. Not only are San men discouraged from having sex while their wives are menstruating, or from hunting at that time, but abstinence is also prescribed before they go off to hunt big game, or if they are about to resume tracking a wounded animal. Hadza men are also warned not to have sex or hunt during their wives' menstrual periods. The Hadza believe that full moon is the best time for hunting in the dry season, and that women align their time of menstruation to the dark moon. Hadza groups come together during the dry season, and on each night of the

dark moon, all fires extinguished, they hold their most important religious ceremonies. One of the themes of *epeme* dances is the resolution of the sexes' conflicting interests, which are elsewhere obtrusive; the festival is considered vital to ensure good health and successful hunting.

The colour of blood is given ritual significance, as when a 'new maiden' of the /Xam (a San group persecuted to extinction in recent times) marked her first menstrual cycle by presenting all the other women in her band with pieces of blood-red haematite ochre, which they used to colour their faces and cloaks. In the Eland Bull Dance, San women surround the new maiden and present their buttocks to her, pantomiming the courtship behaviour of eland cows. The association of 'wrong sex' and 'wrong species' with 'wrong time' is underlined by the Zu/'hoasi (!Kung) identification of the new menstruant as the 'Bull Eland'.

Though the more recent accounts of the 'Human Symbolic Revolution' have concentrated on southern African ethnography, resting as it does upon 100,000 years of ochre, *Blood Relations* describes an imaginary world that spans the real world, installed by humans as they explore one part of the globe after another. Even in the last continent they reach, they continue to paint themselves with red ochre and pigment, so that when explorers from another continent happen upon them thousands of years later, they become known to the newcomers as 'Red Indians'.

In the process of the imaginary world's expansion, its stories evolve and its fauna mutates. Australian Aboriginal myths tell of a Rainbow Snake which creates the world. (One of its names, Uluru, is becoming known to tourists as that now preferred for Ayers Rock.) Knight is scornful of Western scholars' attempts to confine the meaning of this uncontainable symbol into compartments such as 'water', 'phallus', or even the water-python *Liasis fuscus* Peters [sic]. A snake is the most liquid of animals; it flows like water, or menstrual blood. It is the most elastic, swallowing objects whole. In the Rainbow Snake, these qualities assume supernaturally limitless

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proportions. In Knight's words, it is 'paradoxical to the core', both male and female, occupying the heavens and the deep. It seems to be the great intangible that can enfold all the contradictions of the human world, and as such is the descendant of the first intangible, signifying fertility, morality and ritual power.

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Fantastical ideas are the kitsch of human origins. One group of e-mail discussion forums specifically prohibits 'Bizarre Theories', along with creationism, racism and rudeness, because these are the things that are fatal to a constructive discussion of how we came to be what we are.[40] Many of Chris Knight's peers seem to have assumed that his is just another wild hobby-horse, and have therefore let it pass them by. Others may be familiar with the ideas but do not know quite what to do with them, as one reviewer observed.[42]

Robert Foley and C. M. Fitzgerald have paid Knight's theory the compliment of treating the adaptive value of synchrony as a testable hypothesis. They conclude, however, that it is an unlikely one. With a touch of Darwinian one-upmanship, they observe that their computer simulation introduced 'a measure of the costs involved' for ancient hominine females who synchronized their cycles. Their model set a probability of infant mortality, causing offspring to die each month. The mortality rate ranged between 50 and 40 percent in the first five years of life – in

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the real world, a rate of 30 per cent has been recorded among the Hadza, and of 30 per cent in ten years among the Zu/'hoasi or !Kung. By dying, the offspring provided opportunities for their mothers to reproduce again before the time set by the group's collective cycle. In the terms of the model, this is 'cheating', by stealing a march on the group.

Foley and Fitzgerald found that females who cheated, by not waiting until the collectively determined time, would end up with more surviving offspring than those who maintained group synchrony. The higher the rate of infant mortality, the greater was the advantage of cheating. Synchronizers only reproduced more than cheaters if the infant mortality rate was below 15 per cent. To achieve a rate that low, females would probably have secured high levels of paternal investment already. Under conditions in which reproductive synchrony could evolve and remain stable, it might not be necessary anyway.

Camilla Power, Catherine Arthur and Leslie Aiello replied that the model Foley and Fitzgerald had tested was not in fact Knight's theory at all, but Paul Turke's model of ovulation synchrony. They mounted a defence all the same, countering that the conditions of the test had been unrealistic. Foley and Fitzgerald had envisaged grand synchrony, with at least seven out of ten females reproducing in concert. Power and her colleagues objected that it was hard to see how female hominids could achieve synchrony at such a level without harming their reproductive interests. If a female in Foley and Fitzgerald's model were to lose a child, and wanted to obey the synchrony rules, she would have to suspend sexual contact for a long period. This would prevent her from harnessing the powerful energy source of 'mating effort' - the effort males are prepared to make in the pursuit of copulation. 'Males who could not gain fertile matings within a band of females for several years might be inclined to search elsewhere rather than persist in mating effort,' observes the reply, and indeed they might.[43]

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To produce a model in which synchrony is a stable strategy, Power and her colleagues at University College, London, introduce an element of seasonality. If births are concentrated in a particular season, the costs of synchrony are reduced. A female who loses an offspring has only to wait until the next breeding season, not until all the other females are ready to reproduce again. Nor are mysterious forces needed to impose a seasonal bias on births. Food shortages appear to have this effect, as may periods of exertion that deplete the energy available to women for sustaining pregnancy. Among the Lese, who rely upon the gardens they plant in the Ituri forest of north-eastern Congo, formerly Zaire, conception rates decline in the period following the harvest. But no such effect is seen among the Efe, their pygmy neighbours who live by foraging.[44]

In the seasonal version of the model, female synchronizers only gave birth during a window of three months each year. The infant mortality rates ranged from the 'low' 30 per cent in ten years of the Zu/'hoasi to 54 per cent

in ten years, as recorded among chimpanzees. Under these conditions, synchrony was much more viable. The UCL researchers concluded that it could become a stable strategy if synchronizers could secure a reduction of infant mortality of less than 5 per cent; which they suggested could be achieved through the concentrating effect of synchrony on male attention, or by making the most of food resources through giving birth at the optimal time of year. The refinement of seasonality has now been incorporated into the theory. Foley remains unpersuaded, objecting that humans are not seasonal breeders in the sense that the simulations demand.[45]

Knight and his colleagues make it clear that this is how they want to proceed. Their theory is to be treated as science, not as a work of imagination. It should be assessed and modified on the same criteria of truth as it would if it dealt just in biology. Commenting on one of their papers, Robin Dunbar praised them rather faintly with the

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observation that 'it is often more important to be interesting than to be right'. 'But we are not too interested in wrong hypotheses,' they retorted. 'Had we been wrong – had females not "literally" pursued the strategies we model – we doubt we could have seemed interesting at all.[46]

They would not have learned their own lessons if they had responded otherwise. When the interests of signaller and receiver do not coincide, the signal must be loud if it is to overcome the receiver's scepticism. According to the theory, the menstrual coalitionists had to amplify their message with noise, dance and red pigment. According to scientific protocol, the equivalent procedure for the theory's proponents is to declare the soundness of their science as forthrightly as possible.

In doing so, they turn its very improbability into a virtue. The fact that the theory's predictions are so specific and exceptional, they argue, makes it easier to test. 'Our model will fall under the weight of positive evidence it cannot allow – examples being pre-hunt rituals prescribing indulgence in marital sex; menstrually potent women cooking meat; rock art traditions focused on the human pair-bond,' they declare. 'We await falsification of the predictions our model actually specifies.'[47]

By asserting this proud positivism over ethnographic and archaeological data, they show how radical their programme is. Anthropology, they insist, is capable of generating testable hypotheses. Cultural evidence can be taken and subjected to the same kind of procedures as biological data. If anthropological material is admitted as sociobiological evidence, in order to improve on 'Darwinism's simplistic treatment of symbolic data', anthropology also will be transformed.

Symbolic data, however, are often at the mercy of interpretation. It may be that a southern African rock painting depicts a menarcheal girl in a ceremonial shelter, or that the wavy band joining two Australian rock figures between the legs represents menstrual flow. Proof is impossible, though, and acceptance depends on the shifting weight of opinion in rock art theory.

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The symbolic revolution theory also has to address the question of whether some of its key evidence, the ochre, is symbolic or not. Ian Watts has assembled a strong case for symbolism through his exhaustive study of ochre archaeology in South Africa and elsewhere. Various practical roles for ochre have been suggested, such as insect repellent or antiseptic, but one which has attracted particular attention among archaeologists is that of hide preservative. The metal oxides of ochre may block the action of collagenase, the enzyme which breaks down the stuff that holds skin together.

One metal oxide should be as effective as another, though. If early humans were collecting ochre to stop their cloaks and windbreaks from rotting, they should not have been fussy about the colour. Instead, as Watts shows, the southern African deposits show a preference for red over the other colours available. Judging by studies of hide use in the Kalahari, it is also doubtful whether there would be much point in trying to slow down bacterial decay, because hides would probably succumb to wear and tear long before they rotted. Moreover, if ochre was part of a clothing and covering industry, it should be more prevalent in deposits laid down in a cold climate, but there is no such pattern in its distribution.[48]

Watts's study of ochre illustrates the potential of the ritual symbolism theory to inform specific archaeological and anthropological issues. The theory's principal and compelling impact, however, is in defining the problem that must be addressed by any theory of how humanity in its recognizable form came to be. This is much more than being merely interesting; but neither does it require the literal truth its authors claim.

Robert Foley has remarked that primatologists are particularly inclined to what he calls 'vacuum' theories of human evolution.[49] Ignoring the context in which evolution takes place, they deny that there is anything to explain, or that any fundamental transformation has occurred. We have no uniquely human traits, they aver, just ones that

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are present in other primates, writ large. Thus the Last Common Ancestor used tools at the same kind of level as chimpanzees, who poke sticks into termite nests, and hominids gradually worked their skills up through stone-

knapping to silicon-etching. Knight and his colleagues are justifiably scathing about theories which envisage human evolution as an accumulation of little improvements, through which hominids found themselves able to do all the things that humans can do. The imperative truth they assert is that any theory of human evolution must show how human phenomena, such as culture and language, can be stable evolutionary strategies. Whether these phenomena developed piecemeal or in accelerated bursts, humans did not just drift into humanity.

As Knight points out, Darwinian theory shows that cheating is likely to result in higher fitness than co-operating - and the greater the rewards of co-operation, the greater the unearned benefits to the freeloader.[50] Any theory of how language, symbolism or culture originated has to show how a system based on cooperative agreement could have developed without being destabilized at any stage by the pursuit of individual interests. This, not the exotic content of the menstrual ritual theory, is the criterion for any rival account.

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Brains trebled in size over three million years, the curve of expansion rising particularly steeply in the period during which *Homo sapiens* emerged; the phase in which the handaxe handicap model winds up and the female ritual theory begins. The best working assumption is that they grew mainly in response to the challenges they set each other, and so it follows that the more of each other they had to deal with, the larger their brains would be. There are advantages in large groups, such as improved protection against attack from predators - or among primates, from other groups - and perhaps improved efficiency in hunting or gathering food. If there were benefits to be had from coming together in larger numbers, though, hominines would have had a price to pay in expensive brain tissue.

Robin Dunbar has found a strong correlation in primates between mean group numbers and the size of the neocortex, the most recently evolved part of the brain, relative to the rest of the brain. For the species, the neocortex indicates the cognitive ceiling to the size of the social groups that its members can maintain. For an

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individual primate, neocortex size limits the number of other individuals with which it can maintain social relationships.[51]

Its principal means of doing so is to groom the individuals it favours, a sensually pleasurable experience for the recipient (even across the species barrier between monkeys and humans, according to Dunbar). This requires not only effort but time; up to nearly 20 per cent of a group's waking hours. Primates appear not to be able to increase this percentage any further, presumably because the rest of their time is taken up with life's other essentials. Dunbar proposes that language evolved as a kind of virtual grooming, which can be applied to several individuals at once, allowing humans to maintain larger groups. And he argues that she stuff of their conversation was gossip, the verbal equivalent of grooming. Like their descendants, the earliest people were interested above all in each other.

Dunbar points out that grooming sends a message of preference – about who to groom, and of commitment – in the time grooming takes. Camilla Power argues that this exposes a flaw in Dunbar's model. With the power of speech, a hominid can attend to three relationships simultaneously for the price of one, 'but the very fact that you can chatter to three people at once reduces the indication of commitment to each grooming "partner" to a third'.[52]

The other thing wrong with gossip is, of course, its unreliability. Although gossip about third parties may be highly valuable, it offers more opportunities for deception than perhaps any other form of communication. Listening to it could become a costly exercise if every piece of information had to be checked. Conversation about other people would have to be limited to the immediately verifiable – lending indirect support to the suggestion, mooted by the actress Lily Tomlin, that the first sentence ever spoken was 'What a hairy back!'.[53]

Power suggests that it was sham menstruation practices that provided females with the necessary basis of

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trust, since these locked their participants into mutual arrangements that had to be sustained for a long time if the benefits were to be enjoyed. Menstrual ritual was, in fact, the equivalent of grooming.

Speech and ritual have opposite qualities. Ritual deals in repetition and invariance, whereas speech is a means to create novelty. Words are cheap and soft. They correspond to a style of signalling that John Krebs and Richard Dawkins have described as 'conspiratorial whispering', in which senders and receivers have reached an agreement to lower the cost of their signals.[54] As well as being costly and loud, ritual is anything but a matter of agreement. It is coercive and exploitative, designed to overcome resistance, and has nothing to do with the fair exchange implicit in whispering. 'Ritual, like warfare, cannot afford to assume that there are any rules,' Chris Knight observes.[55]

Ritual also has a direct relationship to warfare. In creating a collective representation, like 'Eland Bull' or 'Rainbow Snake', it creates group identity. Developing this identity by aligning the interests of its members, it directs hostility outwards. In-group solidarity is built at the expense of out-groups. With a host of mutually hostile grouplets, internally united and mutually divided by the colour red, the early cultural landscape would have borne something of a resemblance to the far Left of recent times.

Among the means that ritual can employ to overcome its audience are night, fire, dance, drumming, chants, hallucinogens and sexual display. It may use violence, too, in representations of sacrifice or sacrifice itself, and in initiation rites. Initiatoty pain reaches its apogee in the widespread Australian Aboriginal practice of sub-incision, which involves cutting along the length of the penis on its underside, up to the urethra, and then flattening the organ out. A boy thus wrenched into manhood paid a visibly high price to become part of his symbolic community. His commitment assured in this way, he is worthy of trust. He will not need to make his everyday signals costly in order to be believed.

Although initiation rites allow costs to be paid in advance, religions typically require their adherents to affirm

their commitment by frequent and regular ritual practice; a principle better appreciated by Muslims, obliged to pray five times a day, or Orthodox Jews, with their complicated and demanding observances, than by the virtually deconsecrated Anglicans who glance at their watches if the sermon lasts more than five minutes. Several religious traditions link language to divinity. In the beginning was the Word, says the Bible; the Indian deity Indra is said to have created articulate speech; similar themes occur in Norse mythology, while Plato has Socrates saying that the gods gave things their proper names. And each dollar bill links divinity to reliability, affirming that 'In God We Trust'.

Knight compares ritual to a bank and words to banknotes. The bank's authority gives value to the pieces of paper it issues, which are worthless in themselves. He also suggests that the Word does more than authorize words. From ritual, he argues, can come the whole of language: grammar, cases, tenses and all. The key to this process is pretend play, which is considered to be integral to the development of language in young children. A child pretending holds two meanings in mind at once: the actual events and objects with which the game is played, and the imaginary things they represent. An adult holding a religious belief must likewise understand the world in two ways at the same time, to see a rock as both a rock and a deity, or to tell water from holy water.

The mimetic displays proposed as the costly precursors of speech were also a kind of pretend play. With a symbolic register established by the grand pretence of ritual, it became possible to reduce the costs of the mimetic displays. Pretend-play routines could be abbreviated, to the point where they became single utterances, or words. Some went further, to be truncated and conventionalized into grammatical markers. Now that people could exchange ideas about things which were not physically present, either at the time or at all, there was a need to create signs indicating tense and case. At the same time, a new momentum developed, as people became

interested in knowing new things in new ways. Language was elaborated by metaphor, the process of making one thing stand for another. The process will continue as long as people speak, striving against the dulling effects of familiarity to hold their listeners' attention.

Classical Greek drama grew out of ritual, as Knight notes, echoing the original drama in which the creativity of speech was made possible by ritual, its opposite. And if he is right, then at every modern theatrical performance, a shadow play re-enacts the beginnings of language.

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As well as explaining what we cannot fail to recognize as symbolic behaviour, a theory of symbol origins should have something to say about the enigmatic marks which survive from before the great flowering that came with modern *Homo sapiens.* The idea of a symbolic order based on trust does not imply that all symbolic behaviour was impossible until it was established. By allowing symbolic behaviour to be shared, though, the framework of trust allowed it to be sustained.

It seems likely that the Berekhat Ram 'figurine' at the Golan Heights was deliberately inscribed, more than a quarter of a million years ago, and possible that its maker had perceived a resemblance between the piece of rock and a human form. The act of scoring the pebble to make it look as if it were human could be seen as a moment of pretend play. But without an external system of support, such insights would have been symbolic mayflies, dying the day they were born. Each would be a private initiative, which might enjoy some local success, but would inevitably peter out.

A few distant outliers like Berekhat Ram apart, we are really back to the vexed old question of how human the Neanderthals were. Their brains were as large as modern ones, if not larger; they seem to have buried their dead; some of them seem to have collected objects without practical value, and some showed an appreciation of personal ornament in the modern style. The strongest hint of symbolism is in the burials, since the ornaments were associated with late Neanderthals who probably encountered modern humans. But Neanderthal burials were plain affairs. Without unarguable evidence of ritual behaviour, the parsimonious assumption is that they did not represent religious ceremonies. They may well have been more than a way to dispose of a body, though. There are easier ways to get rid of a cadaver, but making it invisible might help to reduce the distress felt by those with an emotional bond to the deceased.

Mostly, the Neanderthals have left no traces of artefacts other than practical ones, and there are no signs that they developed any forms of symbolism peculiar to themselves. The obvious inference, and one which is currently in scientific favour, is that they were just that bit less cognitively capable than modern humans, who had a competitive edge in their ability to plan and organize their activities.

An evolutionary account of symbolism offers a way to make sense of what we know about Neanderthal capacities, without necessarily inferring that their disadvantage relative to modern humans was innate. They were able to meet the costs of large brains with a suite of adaptations that did not include symbolism. Modern humans developed an adaptive package which proved more effective, but it may have been more like the later behavioural shift towards farming, which increased population densities without the use of a mutation. As the menstrual synchrony model suggests, the path to symbolism may have been a tortuous one. Perhaps Neanderthal females

just did not hit upon it, or make the right moves when they did; whereas modern females struck lucky, and capitalized on their advantage. But as long as Neanderthals were on their own, their strategies were viable. There was nothing inevitable about becoming human in the modern sense.

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