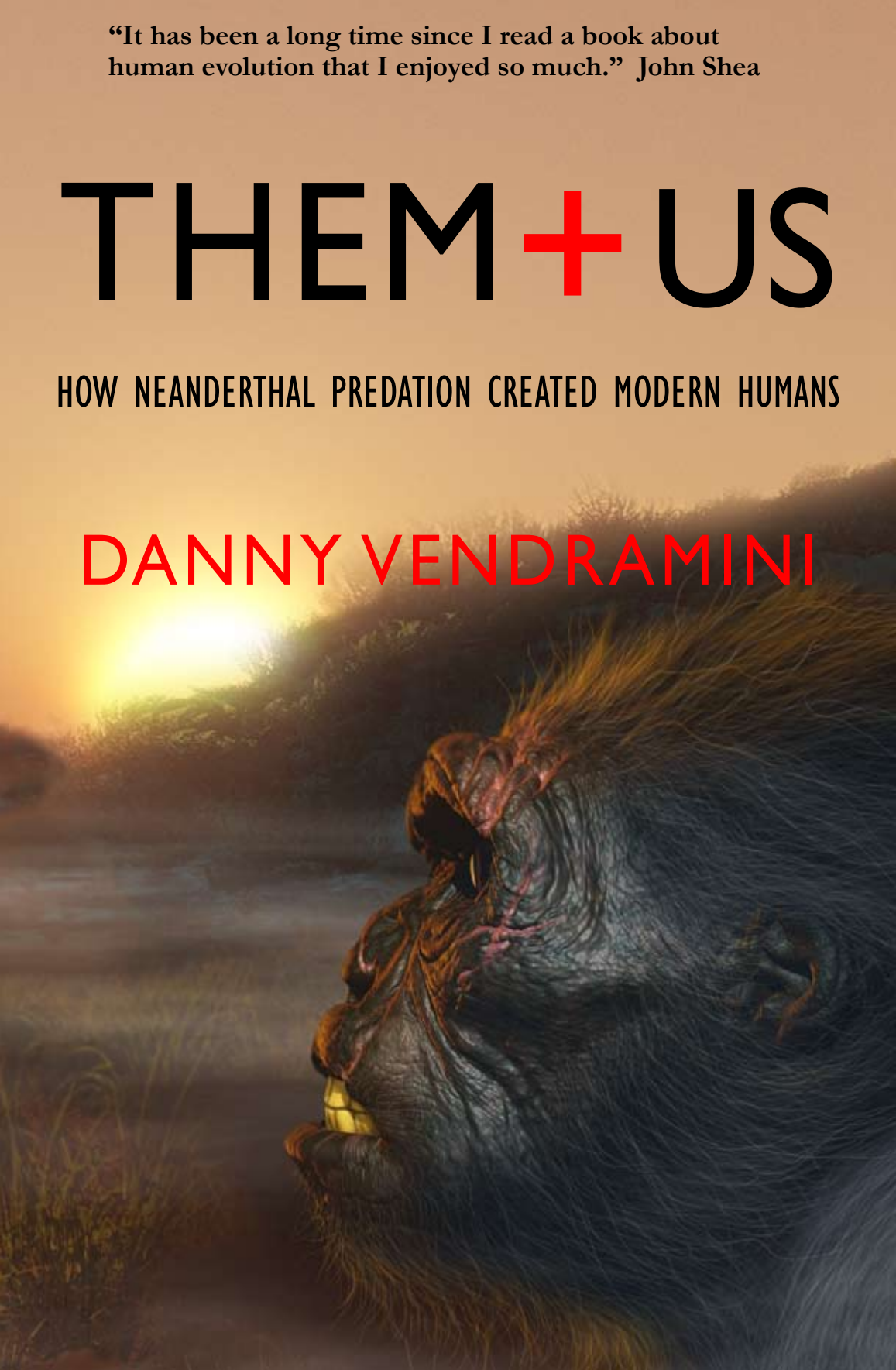
"It has been a long time since I read a book about human evolution that I enjoyed so much." John Shea

THEM + US

HOW NEANDERTHAL PREDATION CREATED MODERN HUMANS

DANNY VENDRAMINI



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DANNY VENDRAMINI

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To my father, who said, “Be intuitive.”

And to Rosie, who said, “Be rigorous.”

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ILLUSTRATIONS

To reproduce the forensic reconstruction illustrations of the 'La Ferrassie' Neanderthal in Chapter 8 and on the covers, refer to our website for conditions.

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PREFACE

I've always loved movies about mythic heroes battling the forces of evil, but in the 1970s, when I heard that George Lucas had based *Star Wars* on ancient hero myths, my lifelong fascination with mythology really took off.

In 1999, inspired by American anthropologist Joseph Campbell's work on universal myths, I started researching a book on the relationship between myths and movies. I wanted to explore why widely disparate cultures, often with no contact with one another, somehow came up with virtually identical mythic stories. From ancient Mesopotamia to modern Manhattan, from Amazonian Indians to American matrons, humans appeared so viscerally attracted to the same mythic themes—good and evil, sex and violence, heroes, quests, perilous journeys, dragons and other monsters—it was as if they had been hardwired into our genes.

I wanted to include one chapter in the book to explain exactly how these heroic tales came to be so universal that audiences around the world all responded in much the same way. But when I went to the literature I couldn't find a satisfactory biological explanation. Yes, there was Jung's theory of the collective unconscious—but for my purposes, that appeared too steeped in a quasi-spiritual ethos to provide a scientifically valid explanation.

I eventually realised there was a serious gap in the biological model—something missing—which I found so intriguing that I put the book aside. Instead I began researching how humans and other animals acquire new instincts, innate behaviours and emotions.

Six years later, the British journal *Medical Hypothesis* published the results of my research, "Noncoding DNA and the Teem theory of inheritance,

emotions and innate behaviour". The paper presented a radical new theory of the evolution of behaviour to explain how animals acquired new instincts and emotions. Its central proposition was that high intensity emotional experiences (usually caused by traumatic events like predator attacks, accidents and natural disasters) can, under certain circumstances, be permanently encoded into an area of an animal's genome called nonprotein-coding DNA. This is the part that is usually dismissed as 'junk DNA'.

It soon became apparent that 'Teem theory' was a kind of master key that could open other doors, for instance, explaining how humans acquired the repository of innate behaviours and emotions we call human nature. When I applied Teem theory to what transformed humans from stone-age African hominids into fully modern humans, why we look and act the way we do, and even why we're obsessed with sex and violence and good and evil, it proposed a single simple explanation that was both extraordinary and unexpected.

The result is a unified theory of human origins called Neanderthal Predation theory (or NP theory) which is based on a fundamental reassessment of Neanderthal behavioural ecology. Exciting new evidence reveals Neanderthals weren't docile omnivores, but savage, cannibalistic carnivores—top flight predators—who hunted, killed and cannibalised our archaic ancestors in the Middle East for 50,000 years. What's more, Neanderthals were also sexual predators, who raided human camps to rape, and abduct young females, leaving a trail of half-cast 'inbreds.'

This multi-faceted predation eventually drove our ancestors to the brink of extinction. Genetic evidence reveals that at one stage our entire ancestral population was reduced to as few as 50 people.

The only humans to survive the predation were those born with mutations for 'survivalist adaptations'—modern human traits like language capacity, Machiavellian intelligence, coalition building, creativity, risk-taking and aggression. These traits effectively transformed them from a prey species to a virulent new hunter species—*Homo sapiens*.

Armed with these new attributes, the first modern humans systematically exterminated their former predators, firstly in the Middle East and then in a blitzkrieg invasion of Europe. They then spread out to colonise the world. Guided by an innate sense of *them and us*, hyper-aggressive men killed anyone who looked or behaved even remotely like a Neanderthal, including hybrids and other humans. It was this lethal process of artificial selection that gradually unified human physiology and behaviour.

It's a fairly radical theory, but its strength lies in its predictions and

ability to explain aspects of human evolution, physiology and behaviour that have frustrated philosophers, biologists and anthropologists for centuries.

The book has been written for a general readership which has an interest in how we got here. I've included 'boxes' to explain peripheral subjects and there's a glossary of ancillary terms at the end. But to help academics evaluate the theory, I've also included my references—all 800 of them.

Because the evolutionary events I am investigating happened so long ago, some aspects of the scenario I propose are speculative. For instance, I speculate on the psychological impact that Neanderthal predation had on our ancestors, how the menfolk felt seeing their women abducted and raped. I do this because the psychology of ancestral humans had a direct bearing on our evolution and needs to be considered as part of a holistic theory.

For some scholars, though, the use of speculation and the imagination are anathema—but historically there has always been a legitimate place for the imagination in science. A scientific model can be subjected to rational debate and analysis only once it exists in a tangible form. The day before Einstein conceived his theory of relativity, there was nothing to think about. It existed in a netherworld beyond deductive reasoning, and required an act of imagination to bring it into existence.

Einstein is famously quoted as saying, "Imagination is more important than knowledge" and he explains, "For while knowledge defines all we currently know and understand, imagination points to all we might yet discover and create."

For radical, big-idea science, imagination isn't just ancillary to the scientific process, it is an indispensable ingredient.

With human evolution, it could be argued that the reluctance of academics to imagine alternative evolutionary scenarios, or to encourage lateral thinking beyond the narrow pathways of orthodoxy, has hampered progress of this field.

While imagination played a role in the formulation of NP theory, the resulting evolutionary scenario has, of course, been subjected to an exhaustive six-year process of scientific scrutiny and verification which involved sifting through 3000 scientific papers and other pieces of evidence. Ultimately, the theory's credibility rests on the rigour of this process.

1 MYSTERIOUS ORIGINS

what we don't know

We humans are such a clever species. Our spaceships have landed on the moon and Mars. We have discovered life forms ten kilometres underground and in deep-sea fumaroles. Our geneticists have sequenced over 200 genomes, while our astronomers have discovered earth-like planets on the edge of space-time. We've speculated on the extinction of the dinosaurs, and now physicists at the Large Hadron Collider are close to unravelling the secrets of quantum mechanics.

And yet, when it comes to ourselves, there's an awful lot we don't understand. The brain for example. And how we became human.

Science writer Carl Zimmer wrote in 2003 that, "what we don't know about our evolution vastly outweighs what we do know."

Three main aspects of human evolution continue to frustrate scientists:

- The abrupt transformation—from African hominid to modern human about 46,000 years ago
- Physiology—why, despite sharing 99 percent of our protein-coding genes with chimps, do we look so different?
- Human nature—where did all the unique behaviours that distinguish us from other primates come from?

Let's begin with the mysterious speciation event that suddenly created modern humans. "Few topics in palaeoanthropology", Cambridge University Professor of Archaeology and Human Evolution Paul Mellars observed in 2005, "have generated more recent debate than the nature and causes of the remarkable transformation in human behavioural patterns that marked the transition from the Middle to the Upper Palaeolithic era in Europe."[3]

MIDDLE PALAEOLITHIC AND UPPER PALAEOLITHIC

These terms refer to different stages of human evolution. The *Middle Palaeolithic* denotes archaic humans and hominids, a period before art, culture, symbolic language etc.—in short, the time before we were 'us'. *Upper Palaeolithic* refers to the new 'smart' *homo sapiens*—with a more sophisticated tool kit, representational art, symbolic language and creativity.

Although archaic hominids like *Homo heidelbergensis* had brains as big as ours 600,000 years ago, they never produced art, culture, complex language, symbolic thinking or any of the other tangible indicators of human capacity. This flowering of modern humanity has been described as 'the human revolution', the 'dawn of human culture', and the 'explosion of human capacity', but there is still no agreement on what precipitated it or why.

It is a commonly held misconception that the Upper Palaeolithic

Excavated from a Middle Stone Age cave in South Africa, the 77,000 year-old block of red ochre (left) has been described as the earliest discovered art work. However, true representational art, like the magnificent horse from the Lascaux cave in France (right), did not appear until around 30,000 years ago.

revolution began in Africa. What the latest evidence shows is that a few isolated early examples of modern human behaviour did appear in Africa as early as 300,000 years ago[4] including what may be an example of 77,000 year old art[5](*see previous page*). But none of these isolated flowerings of Initial Upper Palaeolithic culture ever 'took off' on a grand scale across the continent, much less across the globe. While a few isolated tribes made shell beads, others did not. While most of them fashioned crude tools, a small number made more efficient ones. And a few appeared to have used ochre (presumably for decoration) while others did not.

In November 2008, geologist Zenobia Jacobs, from the University of Wollongong in Australia, reported in the journal *Science* that two such Initial Upper Palaeolithic cultures flourished for only a few thousand years before disappearing.[6] One group (the *Still Bay culture*) emerged around 72,000 years ago but vanished about 1000 years later. The second (the *Howieson's Poort culture*) emerged about 65,000 years ago but lasted only 5000 years.

Jacobs notes that, "this burst of innovation ended about 60,000 years ago, returning to a further 30,000 years of relatively crude stone-age technology."[7]

Making shell beads like these from Blombos cave in South Africa is generally considered a sign of modern behaviour, but the people who made them disappeared about 60,000 years ago.
Photo: Chris Henshilwood and Francesco d'Errico.

The fact that these early African Upper Palaeolithic cultures were sporadic and short-lived came as a surprise to many anthropologists because it was assumed that Upper Palaeolithic culture would have spread like wildfire as a result of an increase in hunting and gathering yields. This turned out not to be the case. Data from both the Middle and Upper Palaeolithic reveal quite convincingly that there was actually no significant difference in hunting effectiveness between the two eras.[8,9,10]

This may seem odd because Upper Palaeolithic culture is now so indispensable to our modern lives that we can't imagine life without it. Yet we need to remember that archaic humans had survived more than six million years (since diverging from the primate order)[11] without Upper

Photo: Chris Henshilwood

Palaeolithic culture.

That is not to say the transition to the Upper Palaeolithic didn't result in minor increases in survival and reproductive rates. But while the acquisition of some Upper Palaeolithic behaviours in Africa may have been advantageous, or convenient, or simply pleasurable—and the tools they made more beautiful, like the 71,000 year-old spear points from Still Bay (*left*)—ultimately these behaviours were not so crucial for survival that everyone had to make the transition.

As world authority on the Middle to Upper Palaeolithic transition Ofer Bar-Yosef from Harvard University explains, the isolated occurrences of African Upper Palaeolithic culture "ultimately had no impact on the general trend of human evolution".[12] In effect, these sporadic occurrences of Upper Palaeolithic culture did not spread throughout Africa because they were not essential to survival in that region.

So where did the real Upper Palaeolithic revolution begin? Where did the *founder group* first emerge that was to become today's global population of humans? The archaeological evidence tells us that our founders came from an area in western Eurasia called the Mediterranean Levant (*see map opposite*), comprising present-day Israel, Lebanon, Syria, Palestine, the Sinai Peninsula and Jordan. It was these African immigrants, now living in the Levant, who made the transition to an Upper Palaeolithic culture and it was this specific culture that then dispersed across the globe.

This seminal transition occurred around 46,000 to 47,000 years ago.[13] It was then that a selection of Upper Palaeolithic behaviours suddenly appeared in a population of Middle Palaeolithic people living at Tachtit Boker, in present-day Israel. Within a few thousand years, this vibrant new Upper Palaeolithic culture had spread to Europe, Africa and Asia.[14,15,16,17,18,19,20]

This places the Mediterranean Levant at the geographical epicentre of humanity—the starting point for humanity's global colonisation of the planet.

The speed of the Upper Palaeolithic revolution in the Levant was also breathtaking. Anthropologists Ofer Bar-Yosef and Bernard Vandermeersch:

> Between 40,000 and 45,000 years ago the material culture of western Eurasia changed more than it had during the previous million years. This efflorescence of technological and artistic creativity signifies the emergence of the first culture that observers today would recognise as distinctly human, marked as it was by unceasing invention and variety. During that brief period of 5,000 or so years, the stone tool kit, unchanged in its essential form for ages, suddenly began to differentiate wildly from century to century and from region to region… Why it happened and why it happened when it did constitute two of the greatest outstanding problems in paleoanthropology.[21]

These are not the only outstanding problems. The abrupt metamorphosis of primitive hominids into modern humans that occurred in the Levant is particularly puzzling given that their ancestors in that region and elsewhere had survived for six million years without art, creativity, high intelligence, civilisation or most of the other attributes of 21st century humans. If they had survived without language for all that time, why did they suddenly acquire it (as many researchers now believe) only about 50,000 to 100,000 years ago?[22,23]

Then there are all the peripheral questions. Were Neanderthals and early humans one species? Did they socialise? Did they interbreed? These issues are still being hotly debated, while the big question—why did

Neanderthals die out?—generates dozens of theories but no consensus.

Human physiology is the second big puzzle.

Although we share 99 percent of our protein-coding genes with chimpanzees, the difference in appearance continues to intrigue biologists. Why are women the only primate species to have visibly protuberant breasts, even when they're not pregnant or lactating?[24] It's not that their breasts are full of milk-producing tissue. They are mostly composed of fat. And when obvious signs of ovulation are the norm among female primates (allowing males to know when they're receptive and fertile), it seems *maladaptive* for women to evolve 'hidden ovulation'—making it impossible for men to know when they're fertile.[25] Likewise, it is still not understood why, at puberty, girls develop a layer of subcutaneous fat on the hips and buttocks, when no other primate does.

ADAPTIVE AND MALADAPTIVE

I try to avoid technical terms in this book, but 'adaptation' and 'adaptive' crop up so often and are so central to evolutionary biology that it may be helpful to define their meaning. An adaptation is any kind of inheritable trait, behaviour or feature that, for whatever reason, increases an organism's chances of surviving and reproducing in its current environment. The opposite of adaptive—when something reduces your chances of survival—is 'maladaptive' or deleterious.

Zoologist Desmond Morris highlights another paradox in *The Naked Ape*: "There are 193 species of monkeys and apes, 192 of them are covered with hair. The exception is a naked ape self-named *Homo sapiens*."[26]

The usual explanation for hairlessness is that it helped cool down our ancestors when they migrated from shady arboreal rainforests to the parched African savannah. But that doesn't explain why baboons, lions, camels, leopards, hyenas, tigers and gorillas—all from the hottest equatorial regions on the planet—have retained their body hair.

Equally puzzling is why only humans evolved flat faces, smooth skin, tumescent lips, a pronounced chin, clear eyes and protruding noses. We are also the only primate that is predominantly right-handed. And why is the human penis so much larger (relative to body size) than other apes?

The third major gap in our understanding of ourselves concerns our behaviour. The universal instincts, emotions and innate behavioural proclivities that comprise human nature are so different from those of

every other species that it beggars belief. Why are we the only mammals to wear jewellery, play music, take drugs, make complex tools and weapons, cry tears, gossip and fear the dark? And why aren't any of the other 192 species of apes into body piercing, circumcision, clitoridectomy, tattooing, salsa, parachuting, or building intercontinental ballistic missiles?

"The enigma of war", according to evolutionary psychologist Steven Pinker, is that we still don't know "why people volunteer for an activity that has an excellent chance of getting them killed."[27] It has been estimated that, in the last century alone, 203 million humans were killed by other humans.[28] William S Burroughs observed last century, "We are a war universe. War all the time. There may be other universes, but ours seems to be based on war and games."

Sexual violence is another fraught and enigmatic aspect of human nature. In the United States alone, according to the National Victim Center, 78 women are raped every hour, equating to 683,280 rapes each year. One in three American women will be sexually assaulted in their lifetime. Feminist historians and anthropologists argue this violence stems from an innate male fear and hostility towards women and their sexuality. American feminist Marilyn French does not mince words when she writes that it "cannot be an accident that everywhere on the globe one sex harms the other so massively that one questions the sanity of those waging the campaign: can a species survive when half of it systematically preys on the other?"[29]

Male violence towards women extends to their non-biological children. When Canadian psychology professors, Martin Daly and Margo Wilson investigated rates of fatal battering of Canadian children under five years of age between 1974 and 1990, they found a disturbing pattern—children under five were 120 times more likely to be fatally battered by a stepfather than a genetic father.[30]

Although we've barely scraped the surface of our behavioural oddities, it is clear we are a special species, hard-wired with many 'species-specific' behavioural proclivities that exert a subliminal influence on our decision making. They determine human preferences for specific facial features[31] and the kind of landscapes we prefer;[32,33,34] they compel us to watch the TV news and read newspapers; and they predispose young men to dangerous risk-taking behaviour.[35,36] Woman are inclined to adorn their bodies, be wary of strangers, and disdain excessive sweating, while men tend to speak for longer and interrupt more, are attracted to women with a specific hip-to-waist ratio,[37,38,] and (famously) don't ask strangers for directions. What scientists have not resolved is precisely *why* we have accumulated this disparate assortment of behaviours.

what we don't know *can* hurt us

So, despite the claims of science, despite our own rationalisations, and notwithstanding the balmy reassurances of the church, there is a significant vacuum in the fields of human evolution, physiology, behaviour, psychology and history.

While these gaps may seem of little consequence, it may be argued that what we don't know diminishes our lives, and threatens the viability of the entire planet. Until we understand the evolutionary imperatives that subliminally drive universal human behaviours, xenophobia, superstition, sexism, war, racism, homicide, ecological vandalism, genocide and the nuclear arms race will continue to hold sway over humanity. Because the power of humans to affect planet Earth is unprecedented, understanding *why* is no longer an academic luxury—it is essential to our survival as a species. For these reasons, the assorted mysteries and paradoxes of humanity are incontestably the most important questions facing our generation.

the mother of all mutations?

To date, the most plausible explanation for the major evolutionary event that led to the abrupt emergence of *Homo sapiens* is the 'fortuitous mutation hypothesis' of American anthropologist Richard Klein. Klein suggests that a major genetic mutation occurred in the human lineage between about 50,000 and 40,000 years ago that created the 'fully modern' human brain.[39,40,41]

That the mutational process was crucial to the Upper Palaeolithic transition is axiomatic: after all, the qualities that make us human are all inheritable and therefore must be encoded in genes, which we know are subject to random mutations. The trouble is this transition would take more than a single mutation. Just to change the colour of the eye of a fruit fly requires mutations in 13 different genes.[42]

But even the complex genetic changes required to transform the face of a chimp into that of a human pale into insignificance compared to those required to convert a Middle Palaeolithic hominid brain into an Upper Palaeolithic modern human mind. Recent data from brain scans and molecular genetics studies reveal the neuronal modules that support human capacity, consciousness and other high level cerebral functions are numerous, variable and inordinately complex. For example, researchers at the University of Pennsylvania School of Medicine recently identified 282 separate genes in which a single point mutation (equivalent to one

letter in an entire book) can result in mental retardation.[43] Given that general intelligence is only one of the many psychological aspects of human intelligence and cognition, the Upper Palaeolithic transition would have required mutations to thousands, if not millions, of individual nucleotides, involving unfathomably complex arrays of protein synthesis. To achieve the complexity of the human mind (described as the most complex system in the universe)[44] would require not one mutation, but innumerable advantageous mutations functioning in complex interconnecting chromosomal arrays.

Another problem with Klein's model is that it doesn't accommodate the other behavioural and morphological features—from hidden ovulation to hairlessness—that are an indispensable part of modern humanity.

Finally, even if one individual is born with a favourable mutation, it doesn't mean that everyone else in the population will inherit it.[45,46,47,48] When a mutation or gene does spread to 100 percent of the population, it is called *fixation*, and the gene or mutation is said to be *fixed*. But that's no easy matter. To become fixed, a gene must be constantly and continually selected over multiple generations, and that usually only happens if it makes a strong contribution to *fitness*.[49] (Fitness does not mean being physically fit. Instead, it's a measure of an organism's ability to survive and successfully reproduce in its current environment, and refers ultimately to how many offspring an organism produces.)

Klein's hypothesis does not identify the environmental factors that rendered it necessary for these favourable mutations to keep being selected, generation after generation, until they achieved fixation in every human population—in every corner of the world.

heavy weather?

Another ecological factor that some researchers believe may have impacted on recent human evolution is climate change. And, yes, extreme climatic conditions and fluctuations (like those caused by droughts, floods, volcanic eruptions and asteroid strikes) can result in rapid evolutionary change, and even speciation events.[50,51,52,53,54] So did climate stress play a major role in human evolution? My review of the climatic evidence suggests there is only one plausible candidate—the massive Toba volcanic eruption in western Sumatra 73,000 years ago. Although it occurred in the southern hemisphere, Stanley Ambrose, from the University of Illinois, argues the six-year 'volcanic winter' that followed the eruption may have impacted on population densities in the northern hemisphere.[55,56]

Despite being seemingly plausible, Ambrose's theory has been challenged and rejected by a number of researchers on complex technical grounds.[57,58] Personally, I find it difficult to imagine what adaptations against atmospheric opacity, airborne dust and food shortage could have resulted in modern human physiology and behaviour. Even if the Toba event reduced the population size, that reduction would be across the board—unilateral and indiscriminate—so would not create any specific selection pressure. In other words, there would be no specific trait for natural selection to select for. How could a volcanic eruption create our love of music, or of fashion or sexual jealousy? Besides, there is a 26,000 year gap between the Toba event (73,000 years ago) and the appearance of the Upper Palaeolithic at Tachtit Boker 47,000 years ago.

Based on a review of marine oxygen-isotope data from deep-sea sediment cores, Stony Brook University anthropologist John Shea concludes, "the Middle Palaeolithic/UP transition in the Levant is not correlated with any major shift in the global oxygen-isotope record of climate change."[59]

The final nail in the argument that climate change triggered modern human behaviour came in November 2008. It was part of Zenobia Jacobs' landmark paper in *Science* that dated the rise and fall of the short-lived Howieson's Poort and Still Bay modern cultures in southern Africa. Jacobs' team studied ancient ice-core samples to find out what the climate was like when these two technologically innovative cultures first emerged. They were looking for any extreme climatic conditions or unusual environmental factors that may have been responsible for the appearance of these cultures. They found no correlation with any dramatic climate change.

The commentary in *Science* sums up their findings: "the rise of these industries does not appear to correlate with any known climatic changes, suggesting that these bursts of innovation can not be explained primarily by environmental factors."

Jacobs adds, "The cause of these two bursts of technological innovation, closely spaced yet separated in time, remains an enigma, as does the reason for their disappearance."[60]

So, if climate change did not play a part in the Upper Palaeolithic revolution, what else is left? Certainly no current theory explains how we acquired all our unique modern human features. Nothing explains the suddenness of the Upper Palaeolithic transition or why one instance of it (in the Mediterranean Levant) spread around the world while many other isolated examples of it did not. This suggests there is a need for a new conceptual framework—perhaps even something left field—to break the

impasse. In the absence of a consensus, I put the case for a new theory of human origins.

what killed our ancestors?

In their efforts to unravel the evolutionary origins of humanity's abrupt emergence and its unique physical and behavioural features, anthropologists and archaeologists have traditionally focused on fossilised skeletal remains and artefacts. These include bones, tools, weapons, art, textiles and habitats—physical evidence that can be examined, tested, dated and quantified. But by far the most detailed scrutiny has been directed at the fossilised skeletons of our ancestors, exhumed from ancient sites.

Even though skeletal remains receive the most attention in journals and scientific conferences, I suggest it is not our bones that set us apart. After all, human adults have on average 206 bones, the same number as chimpanzees—they've just changed shape and size slightly over the eons. What really separates us from the other primates are *soft tissue features*—our faces, smooth skin, breasts, buttocks, noses, and hairlessness—and our behaviour. But because these features are not preserved in the fossil record and don't leave physical artefacts, they have been largely excluded from the debate on human evolution.

I think this is unfortunate. When you look at these soft tissue features in isolation, plus all the behaviours and emotions that do not fossilise, they might strike you as relatively minor. Insignificant even. Biologists call them *microevolutionary* features, in contrast to *macroevolutionary* features.

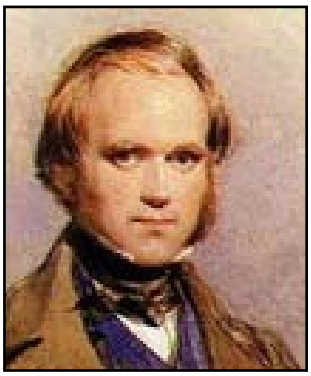
MICROEVOLUTION AND MACROEVOLUTION

In the twenties, the Russian entomologist Lurii Filipchenko divided evolution into two categories: *microevolution* and *macroevolution*. The terms—borrowed from the Greek words *micro*: small and *macro*: large—distinguish small-scale, incremental microevolution (such as a mutation that changes the colour of a pupil) from the more dramatic changes of macroevolution (such as when one species transforms into a new one).

But add them all up and these seemingly minor behaviours and physical features represent an example of *macroevolution*—a major (and rare) evolutionary event that results in the creation of a completely new species. Collectively, these small traits are what define humans as a unique species.

Understanding why these nonfossilised soft tissue features and behaviours evolved in the first place, and how they contributed to survival in the ancestral environment is, I believe, essential to revealing why *Homo sapiens* emerged as a new species.

Clearly these features evolved by *natural selection*—the evolutionary process co-discovered by Charles Darwin and Alfred Wallace—and somehow contributed to survival in the prehistoric environment. In other words, something in their environment made it necessary for early humans to evolve all those soft tissue features.



Charles Darwin (left) gets most of the credit for discovering natural selection, but Alfred Wallace (right) simultaneously arrived at an identical view.

The way an animal's environment appears to demand a new feature is called *selection pressure*. It happens when something in the environment reduces survival rates, usually by prematurely killing off certain animals. This makes it more likely that new traits which help an animal survive this premature death will be selected. For example, by killing off the animals that need lots of water, a drought can create selection pressure—for animals that need less water. This kind of selection pressure created camels. Constant bushfires can create selection pressure for animals that can burrow underground to escape the heat. If there is too much salt in a lake, it can create selection pressure for fish that can tolerate salt. And so on.

In theory, the more animals killed by an environmental factor before they can reproduce, the stronger the selection pressure will be for adaptations to mitigate it.

Interestingly, selection pressure can have a dramatic effect on the appearance of survivors. For instance, selection pressure generated by toothed predators gave the turtle its distinctive thick shell. Similarly, polar bears have a thick fur coat because the freezing arctic climate generated selection pressure for thermal protection.

the mysterious 'factor X'

So, what environmental factors and circumstances in the Levant could have generated selection pressure for humans to acquire all those new soft tissue features? For example, if hairiness is the default state among land mammals, and all other primate species have retained their body hair (including those living in hot, tropical habitats) what particular environmental factor (or factors) made it necessary for our ancestors to lose theirs? What killed off all the hairy hominids and left only the hairless ones?

The challenge is to identify the specific environmental factor—'factor X'. What caused women with flat chests to die out and ancestral males with small primate-sized penises to become extinct, so that only well-endowed men remained? And why was it deleterious to have a flat nose like other primates, so that all our flat-nosed ancestors went the way of the dodo? These are questions that go to the heart of the matter.

the levantine epicentre

The focus of my enquiry turned to the Mediterranean Levant because that is where Upper Palaeolithic behaviours first appeared before they dispersed across the world. The Levant was the geographical epicentre of humanity, so this is where factor X must have been most intense. This is where something in the environment killed off Middle Palaeolithic hominids, so that only Upper Palaeolithic humans survived.

Here is another exciting clue in our evolutionary detective story. Something happened in the Levant that did not happen anywhere else. Some localised environmental factor made it imperative for archaic humans to acquire the accoutrements of modern humans. And, whatever it was, it was absent in Africa and Asia.

But it wasn't just the magnitude of the transition in the Levant that was unprecedented. So too was its speed, and this provides another clue. Natural selection is nearly always a grindingly slow process that achieves results only incrementally over thousands or even millions of generations.[61,62] This did not happen in the Levant. Steven Kuhn and his colleagues from the University of Arizona report the spread of Upper Palaeolithic ornament technologies (modern tools, art, etc.) was "essentially simultaneous" on three continents.[63] What was it about the Levantine environment that made it so imperative for Middle Palaeolithic humans to suddenly become Upper Palaeolithic humans? Why the urgency?

Cognitive capacity, art, complex language, organisation, culture, music, dance and other Upper Palaeolithic behaviours that distinguish modern humans appeared only 46,000 years ago.[64,65,66] If mysterious environmental conditions caused all these behaviours to materialise virtually overnight, did they cause our distinctive physical features to emerge as well: hairlessness, hidden ovulation, rounded breasts and buttocks, full lips, clear eyes, and prominent noses?

This raises the possibility that both the physical and behavioural features that define us as human may have occurred in response to selection pressure generated by unprecedented environmental circumstances—factor X—that occurred in the Levant, but nowhere else. The identification of factor X—something that killed off most of the archaic humans, so that only those that looked and behaved like modern humans survived—becomes paramount in solving the human origins puzzle.

The magnitude and sheer evolutionary potency of factor X is itself a vital clue. Only singular and exceptional forces could create a new species so quickly. What could be so deleterious, so lethal, that only those few individuals who looked and behaved like modern humans could survive?

You may think that identifying that single, highly potent environmental factor would be difficult. But it soon became clear to me there was only one environmental dynamic powerful enough to cause a speciation event in such a short time. Only one environmental factor could direct natural selection to confer art, spoken language, organisation, symbolism, long-term episodic memory, forward thinking, exceptional intelligence and innumerable other uniquely human cognitive traits on one primate species, while the other 192 species remained unaffected. And only one selection criterion could radically alter the visual appearance of humans to make them look so different from every other primate. That single factor is *predation*—the timeless dance of death between predator and prey.

2 OUT OF AFRICA INTO THE FRYING PAN

man the hunted

The conflict between the need for food and becoming food has made predation one of the most pervasive and influential ecological mechanisms in the animal kingdom—the sharpest instrument in natural selection's toolbox.[67,68,69] Predation generates competition, not only between individuals, but also between species. And competition, as we know from Darwin, is the fuel that drives the natural selection engine.

Predation has been fundamental to the evolution of major adaptations like the cobra's venom, the leopard's stealth and the eagle's aerial agility. It created insects that look like leaves, frogs with poisonous skin and fish that can change colour to match their background. It transformed massive terrestrial dinosaurs into petite flying birds and dog-sized mammals into blue whales. Predation gave sharks their optimum aerodynamic shape, porcupines their spines and skunks their terrible smell. It bestowed phenomenal sprint speed on cheetahs, equipped bees with their stings and rhinos with their thick skin.

Nowhere in nature do we see natural selection resulting in so much unbridled creativity as in predator and anti-predator adaptations. It goes beyond the ingenious techniques of camouflage mimicry we see in the insect world. The special colours and markings that warn off predators

are equally ingenious. Predation produced complex strategies, elaborate traps and the sweetest perfumes to lure unsuspecting victims to their deaths. What could be more inventive than the Angler Fish dangling a tiny fishing rod from its head, complete with wriggling bait in its mouth to catch unsuspecting prey?

Given that selection pressure generated by predation has been indispensable to the evolution of a wide range of animals, from snails to whales, it is not unreasonable to suggest that—given the right ecological conditions—predation could result in archaic stone-age hominids transforming into fully modern humans.

But here's the rub. There are two sides to predation dynamics—predator and prey—and although the idea of 'man the hunter'[70,71,72] is deeply embedded in anthropological thinking,[73] the general view of most researchers is that evolutionary scenarios based on humans as predators do not adequately explain our unique evolutionary trajectory.[74,75,76]

While we're accustomed to seeing ourselves as the pre-eminent predator on the planet—residing at the top of the food chain—this view has seriously compromised our ability to think impartially about our lowly origins. My interpretation of the evidence suggests the abrupt transition from Middle Palaeolithic to Upper Palaeolithic, our unique physical appearance and our distinctive behaviour are consistent only with the view that humans evolved—for a period of time at least—as a species of prey.

In other words, the defining physiological, behavioural and emotional characteristics of *Homo sapiens* may be the adaptations of a prey species exposed to systemic long-term predation by a single predator.

My hypothesis argues that, although we are currently one of the few species on Earth to have no natural dietary predator, this was not always the case. It suggests that, like almost all the other 1.5 million animal species on the planet, we too were shaped by the ecological consequences of predation.

and the killer is…

The next step in the hypothesis is to identify the significant predators in our evolutionary history. A number of suspects immediately spring to mind—lions and leopards would probably top the list. During our African sojourn these feline predators undoubtedly took their toll on ancestral hominid populations. So too did snakes, rhinos, elephants, bears, buffalo and any one of the 400 other species known to kill humans.[77] And

although *arachnophobia* is one of the most common human phobias (and we certainly have evolved instinctive 'brush away' reflexes to deal with spiders and other creepy crawlies), spiders did not fundamentally reshape us as a species. Nor did lions, although they probably played a part in chasing our ancestors out of Africa.

My examination of the archaeological evidence from the Levant, plus the latest genetic data from both ancient DNA (extracted from fossilised bones) and from the human genome, lends itself to only one plausible interpretation—that the principal predators of archaic humans were Neanderthals (*Homo neanderthalensis*).

neanderthal predation theory

Neanderthal predation theory (NP theory) argues that Neanderthal predation was the single macroevolutionary factor that transformed archaic hominids into modern humans and that, without it, we would still be a docile stone-age hominid. Everything that defines what humans are today is due directly or indirectly to Neanderthal predation. Just as we have inherited a fear of spiders from our prehistoric ancestors, modern humans have also inherited a primordial dread of Neanderthals—and this daily affects all our lives.

The core hypothesis of Neanderthal predation theory proposes that from at least 100,000 years ago until around 48,000 years ago, in the East Mediterranean Levant, Neanderthals systematically abducted, raped, hunted and devoured archaic humans to the edge of extinction—generating selection pressure for defensive changes in human physiology and behaviour. The resulting strategic adaptations created modern humans. All the major biosystems that make us human—high intelligence, spoken language, art, hairlessness, our distinctive faces—are derived from Neanderthal predation.

neighbours from hell

Obviously, for predation to have occurred, Neanderthals and Middle Palaeolithic humans must have been living in the same place at the same time, long enough for Neanderthals to have altered the trajectory of human evolution. So the first tenet of NP theory, and the first of its predictions, is that archaic humans and Neanderthals lived within the same geographical and chronological context for at least a few thousand years. This prediction can also be used as the first test of the hypothesis.

The Mediterranean Levant during the Late Pleistocene provides the earliest and best evidence of contemporaneous cohabitation. The long stretch of land on the eastern edge of the Mediterranean Sea called the Levant has often been described as a biogeographical 'corridor' between western Eurasia and Africa through which African migrations transited for millions of years.[78]

LATE PLEISTOCENE

The Late Pleistocene stage of the Pleistocene epoch dates from around 126,000 years ago to around 10,000 years ago. That stage is followed by the Holocene which continues to the present.

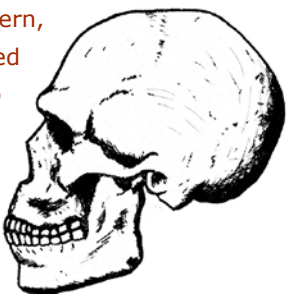
Flint artefacts retrieved from Yiron, in northern Israel, provide the earliest evidence of hominids living in the Levant. At 2,400,000 years old, Yiron is the earliest hominid site outside Africa.[79] The earliest actual skeletal remains from the area are represented by a fragmentary 200,000 year old hominid excavated at the Mugharet-el-Zuttiyeh cave, in Israel. The paucity of the remains makes identification problematical, but they are thought to be that of an early Neanderthal.[80,81]

Based on recent dating of Middle Palaeolithic shell beads from the Skhul cave on the slopes of Mt Carmel, in Israel, anatomically modern humans were living in the Levant from between 135,000 to 100,000 years ago[82,83,84] and possibly much earlier.

Fossils from the nearby Qafzeh cave tell us they were still there 85,000 years ago.[85]

THE SKHUL-QAFZEH PEOPLE

Because the earliest anatomically modern, Middle Palaeolithic people discovered in the Levant came from two adjoining caves on Mt Carmel (Qafzeh *left*) and (Skhul *right*) the term 'Skhul-Qafzeh humans' can be used to describe these ancestors.



While their skeletons were much the same as ours, behaviourally the Skhul and Qafzeh people were still Middle Palaeolithic stone-age hominids, although the shell artefacts found in the Skhul cave suggest they were at least on the cusp of a transition to a more advanced culture—even if their tools were still primitive. As to what they looked like: although their skeletons were relatively modern, it's impossible to say if they outwardly resembled modern humans or some other primate—in all likelihood, they were something in between.

The supposed migration route for the Skhul-Qafzeh humans was through the Great Rift Valley in eastern Africa, along the Nile corridor (between the Red Sea and the Nile) and into the Levant (*left*).[86,87] At the time, the Levant was part of a major migration route for animal species from northeast Africa and southwest Asia.[88,89] For early humans living in the Levant this provided an abundance of prey species, including boar, mountain gazelle, red deer, ibex and aurochs.[90]

Today, that area of the Middle East has a typical Mediterranean climate, with long dry summers and cool humid winters.[91] Judging from pollen records obtained from marine cores, the climate in the Late Pleistocene was cooler, more humid, and punctuated by periods of drought.[92] With the climate relatively stable and food plentiful, the African migrants appear to have adapted well to their new environment. The coastal regions of the Levant had permanent supplies of fresh water and its mountains were riddled with limestone caves (including the Skhul and Qafzeh caves) which the humans occupied as permanent sites. Also, its woodlands were among the richest habitats in western Eurasia,[93,94] and the Mediterranean Sea was close enough to harvest shellfish to supplement their diet.

In these favourable conditions, their Middle Palaeolithic technology—

although rudimentary by our standards—was sufficient for the Skhul-Qafzeh humans to prosper for thousands of years.

All good things must come to an end, and one day a group of these archaic humans came face-to-face with a strange and very different group of hominids they had never seen before—Eurasian Neanderthals who had moved into the Levant from Europe.

This encounter may be the most important single event in human history.

Ostensibly, it was simply two sibling species meeting for the first time. But from a broader evolutionary perspective, that encounter represents the introduction of a major new environmental stressor that would fundamentally impact on early human ecology. On that day, what was to become an interminable selection pressure was exerted for the first time—a pressure that has continued to reshape and redefine humankind up to the present.

meet the cousins

It is thought that some Neanderthals had been forced out of Eastern Europe by one of the periodic ice ages that engulfed the region. Whatever the circumstances of their migration, the Neanderthals from Europe that occupied the Levant gradually developed a few physical variations. To distinguish this sub-species from the parental European population (often called *classic* Neanderthals) the Levantine Neanderthals are usually referred to as *Eurasian Neanderthals*, or *Near Eastern Neanderthals*. In this book, I use the former.

Eurasian Neanderthals are represented principally by fossil material found at a number of caves in the Levant—Amud, Kebara and Tabun—all in Israel. On the basis of dates from both early modern human and Neanderthal sites at Mt Carmel, there is an overwhelming weight of evidence that Skhul-Qafzeh humans and Eurasian Neanderthals occupied the same area of the Levant at the same time.[95,96,97,98,99,100,101,102,103]

As to the important question of how long this coexistence lasted, the imprecision of dates derived from thermoluminescence dating technology and uncertainties relating to provenance make it difficult to say for certain.[104]

One particular problem is the possible *interstratification* of stratigraphic levels relating to one of the Levant hominids (known as Tabun C1). Normally in an archaeological dig, the lower down you go, the older the material is. But sometimes, because of earthquakes, floods, landslides and

other natural phenomena, the levels (and the archaeological material in them) get jumbled and, occasionally, even reversed. This interstratification can make dating difficult.

If the famous Tabun C1 Neanderthal (which was dated at 171,000 years old) comes from Level C, as suggested by archaeologist Nira Alperson and her team,[105] it would indicate Skhul-Qafzeh humans and Neanderthals shared the Levant for at least 70,000 years.

Based on excavations at Geula Cave, Israel, plus the Skhul and Qafzeh fossils, Chilean physical anthropologist Baruch Arensburg suggests a 100,000-year geographic overlap between humans and Eurasian Neanderthals from Tabun, Kebara and Amud.[106] Other scholars date the Levantine overlap at 90,000 years,[107] while several other teams argue the two species coexisted on the eastern shores of the Mediterranean for 65,000 years.[108, 109, 110]

In all likelihood, throughout this period, there were multiple 'trickle' migrations into the area by both Neanderthals and early humans, driven by climatic variability and parallel migrations of fauna into the region from Africa.[111] Ofer Bar-Yosef argues at least one migration of European Neanderthals into the Levant was precipitated by the rapid onset of glacial conditions in eastern Europe and western Asia 75,000 years ago.[112]

While estimates for the length of time both species shared the Levant vary, everyone agrees they did so for many thousands of years. I conservatively estimate Neanderthal cohabitation with the Skhul-Qafzeh

Tabun cave on the slopes of Mt Carmel in Israel, occupied successively by archaic humans, Neanderthals and modern humans. From a Darwinian perspective, this is the real Garden of Eden. Photo: Rotem Hofman

people in the Levant occurred between 100,000 to 50,000 years ago, providing a 50,000-year period of potential Neanderthal predation.

On the basis of 20 years per generation, 50,000 years represents 2500 generations. At 25 years per generation, that's still 2000 generations.

However, I will later argue that the *indirect* impact of Neanderthal predation continued right up to the Late Neolithic Period (a mere 2000 years ago) and even beyond, which would add another 45,000 years of evolutionary pressure. At 20 years per generation, that's 4750 generations of humans that were subject to selective pressures generated directly or indirectly by Neanderthal predation. Considering that only 100 generations have lived since the time of the Romans and ancient Greeks, 4750 generations is more than enough time for a macroevolutionary event to occur.

competition—natural selection on steroids

When it first became evident that humans and Neanderthals had lived in the same region for over 50,000 years, there was a great deal of heated debate as researchers struggled to understand the implications of such a lengthy cohabitation.

Erik Trinkaus and Pat Shipman describe it in *The Neanderthals*:

> This new twist pointed up a fundamental problem that had been there all along, overshadowed by the problems of chronology and phylogeny. It was awkward, if not downright contorted, to try to explain how two groups of humans [*sapiens* and Neanderthals] occupied the same region—either alternately or simultaneously—using the same set of tools to exploit the same plants and animals over a period of fifty thousand years and yet remained anatomically and genetically separate.[113]

But cohabitation of the same ecological niche also has another consequence—it generates *competition*—that great driving force of evolution. Without it, evolution grinds to a snail's pace.

Competition from Neanderthals provides another vital clue—motive. NP theory draws on this maxim to argue that the competition Neanderthals introduced with their colonisation of the Levant kick-started a burst of evolutionary activity among the Skhul-Qafzeh humans that would eventually transform them into a new species. In effect,

Es Skhul cave (cave of the baby goats) on Mt Carmel was home to some of the earliest modern humans. This is where the modern human journey really began.

competition with Eurasian Neanderthals became the catalyst that created modern humans.

Here, though, the competition wasn't between two physiologically different species. It was between sibling species—species that were similar in general appearance and occupied the same ecological niche. This upped the ante, and also complicated things.

There is general agreement among palaeontologists that, because both species had similar needs for food and shelter, from the day Neanderthals arrived in the Levant they would be competing against the local humans for the same resources,[114,115,116] the same cave sites, fresh water, fruit trees, ochre and flint. But the fossil evidence also tells us they were rivals for something much more basic—they were hunting many of the same prey species.[117,118]

From the perspective of the Skhul-Qafzeh humans, the interloping Neanderthals suddenly disrupted the ecological homeostasis humans had enjoyed for at least 40,000 years—and probably considerably longer. From the Neanderthal perspective, the new Skhul-Qafzeh neighbours presented both a direct challenge—and an opportunity.

In *The Origin of Species*, Darwin observes that "competition will generally be most severe between those forms which are most nearly related to each other in habits, constitution, and structure."[119] He goes on to say that, in the struggle for existence:

> ...it is the most closely-allied forms,- varieties of the same species, and species of the same genus or of related genera,- which, from having nearly the same structure, constitution, and habits, generally come into the severest competition with each other; consequently, each new variety or species, during the progress of its formation, will generally press hardest on its nearest kindred, and tend to exterminate them.

The case for lethal inter-species competition is also suggested by Gause's law of competitive exclusion,[120] which states that two species with similar diet and ecological requirements cannot both indefinitely occupy the same environment. Something's got to give. Applied to the Levant, it predicts that Neanderthal encroachment into the Skhul-Qafzeh's habitat would cause ecological instability within the hominid niche.

This elemental evolutionary imperative to out-compete, exterminate or expel a competitor from a common territory pitted Neanderthals and humans against each other. And, clearly, the stakes were high. It was a struggle for survival, and the loser faced extinction.

This raises the most fundamental question: if both hominid species were trying to out-compete each other, who would win? This question encapsulates the most fundamental truths about our species and takes us to the second major tenet of NP theory.

NP theory is extrapolated from a simple premise—Neanderthals weren't the harmless hominids that many anthropologists have presumed them to be—but something else entirely. They were the pre-eminent European-Eurasian predator—what biologists call an *apex predator*—one with no rivals within their ecological niche. As such, they resided at the summit of the food chain.

This predicts that as the more powerfully-built hominid—who had evolved the predatory instincts, strength, ferocity and lethality to pursue and subdue a wide variety of large and dangerous prey over hundreds of thousands of years in the most demanding environments—Neanderthals would quickly assert a strategic dominance over the Levantine early humans.

It also argues that Neanderthal competition acted as an ecological catalyst that generated enormous selection pressure on the Skhul-Qafzeh humans which, in turn, drove evolutionary change.

These hypotheses claim that practically everything we know about Neanderthal evolutionary history (*phylogeny*), habitat, diet, hunting strategies, tool use, sexuality, territoriality and a host of other core factors—and how they affect behaviour (what scientists call *behavioural ecology*)—needs to be reassessed. Importantly, a fundamental reassessment of Eurasian Neanderthal and early human behaviour, physiology and ecology is also the best way to test these hypotheses.

PART I

THEM

If modern humans are the result of inter-species competition then, clearly, we need to understand the nature of the competition. When we comprehend the ecological nuances of our competitors and the nature of the competition they generated, it will be immediately apparent who won and why—and what the evolutionary consequences were for both sides. The next four chapters take a new look at Neanderthal behaviour, physiology and ecology, based on the latest archaeological and genetic evidence.

3 THE PERFECT PREDATOR

shadowy figures

The study of Neanderthal behavioural ecology is a relatively new field and so far hasn't generated a great deal of interest among researchers. And yet, because species are products of their environment, a detailed study of the nuances of the Neanderthals' environment (as inferred from the archaeological and genetic evidence) may answer important questions about how they behaved, what they looked like and why they emerged as a separate species. The kinds of questions this discipline tries to answer include: Did Neanderthals interbreed with early humans? What did they look like? Why are Neanderthal genes so conspicuously absent in modern humans?[121,122] How smart were they? Then there's the big question: What caused their extinction—a subject that currently generates countless theories but no consensus.

But perhaps the most important objective of my reassessment of Neanderthal behavioural ecology is to shed some reflected light on human evolution. NP theory is actually a theory of *coevolution*—the synchronistic evolution of two sibling species living close to each other—so discovering how the environment shaped Neanderthals may also tell us how Neanderthals shaped humans.

Another objective of this reassessment is to correct what I believe to be a distorted anthropocentric bias that has inculcated western thought

on all things Neanderthal. Instead of seeing Neanderthals for what they were, a unique and complex species inhabiting a particular ecological niche, it has been assumed they were essentially a mirror image of ourselves—albeit, not as smart. Perhaps, like children discovering they have a sibling they've never known, we harbour an unconscious longing for some kind of meaningful connection—a reunion of sorts—a sense that we're not alone in the universe. But this oversimplification robs us of the detail—the nuances which conceal the greatest truths. Neanderthals may be our doppelgangers but, until we stand them side by side with other primates and make the objective comparison, we'll never know for sure.

Although the reassessment is consistent with the latest archaeological findings and genetic data from extracted ancestral DNA, some aspects of it are speculative and rely in part on circumstantial evidence (which I will duly note). Fortunately, advances in palaeoecology and genetics over the last few years provide a solid support for the reassessment.

neanderthals 101

Neanderthals were a species of hominids who lived in Europe, western Asia and Britain (which was then a peninsula of northwest Europe, thanks to sea levels being 80 metres lower than today). It is believed they became extinct about 28,000 years ago, although some dates suggest they survived until 24,000 years ago.

NEANDERTHAL OR NEANDERTAL?

The word itself comes from *Neander Thal* (which means 'Neander Valley' in German) where the type specimen (Neanderthal 1) was discovered in 1856. With no 'th' sound Germans pronounce it Neandertal, while in English, Neanderthal, with the softer 'thal' has become widespread. Neanderthal is more commonly used today, but either word is acceptable.

Until recently, Neanderthals were thought to be the same species as us. But over the last decade, geneticists have extracted DNA from ancient Neanderthal bones which, when compared to human DNA, shows conclusively that although Neanderthals were members of the same genus as us—*homo*—they weren't human.[123,124,125] The DNA variation was enough to conclude that Neanderthals were a separate species.

Geneticists are divided about when Neanderthals split from the human

Skull cap from the Feldhofer Neanderthal (right)discovered near Düsseldorf in 1856. Although the third specimen found, it became the 'type specimen' and was dubbed Neanderthal 1.

ancestral tree. Estimates vary between 350,000,[126] 370,000,[127] 500,000[128] and 631,000 to 789,000 years ago.[129] In other words, for maybe half a million years, they were off on their own evolutionary trajectory—forged and shaped by the environments they inhabited during this period.

Although they were slightly shorter than the Skhul-Qafzeh humans, (which probably helped conserve energy in cold climates), the remains of a few tall Neanderthals have been found. In the 1960s, a Japanese expedition excavated an almost complete Neanderthal skeleton at Mt Carmel in Israel. What was extraordinary about this adult male (known as Amud 1) was that he was almost six feet tall—an exceptional height in those days—and ostensibly a giant who would have towered over early humans of the period.

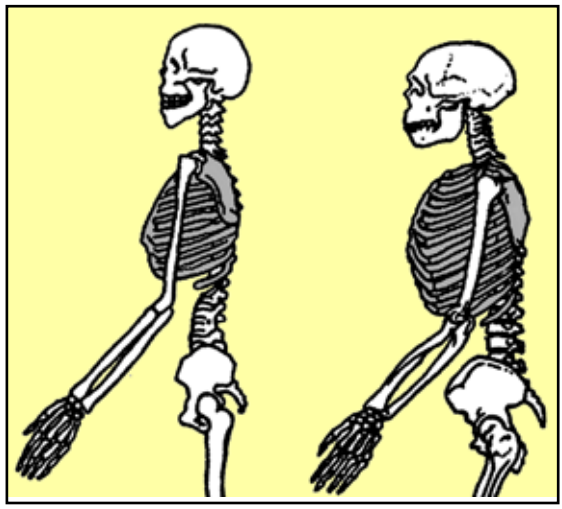
Despite usually being slightly shorter, the average Neanderthal was much stockier, weighing about 25 percent more than a human. They were so heavily muscled, their skeletons had to develop extra thick bones and attachment points to take the strain. With massive barrel chests, arms like Arnold Schwarzenegger and legs like telegraph posts, it has been estimated Neanderthals were about six times stronger than modern humans.

"One of the most characteristic features of the Neanderthals," writes palaeoanthropologist Erik Trinkaus, "is the exaggerated massiveness of their trunk and limb bones. All of the preserved bones suggest a strength seldom attained by modern humans."[130]

James Shreeve, author of *The Neanderthal Enigma,* adds that, "a healthy Neanderthal male could lift an average NFL linebacker over his head and throw him through the goalposts."[131]

It wasn't just Neanderthal adults who were bigger, stronger and burlier than modern humans. Their children were too. "You should see some of the skeletons for these individuals," anthropologist John Shea told *Discovery News*. "The females were big and strong, while a 10-year-old kid must have had muscles comparable to those of today's weight lifters."[132]

On the basis of their stone weapons and tools, preserved remains



The larger, more robust rib cage of the Neanderthal (right) is indicative of far greater upper body strength compared to humans (left). It is more analogous to modern gorilla physiology than that of humans.

of the animals they hunted, and the way they processed carcasses, it is now generally agreed that Late Pleistocene Neanderthals were skilled hunters rather than opportunistic scavengers.[133,134,135,136] A great deal of research, particularly over the last decade, has recognised the cognitive and behavioural complexity of Neanderthals.[137,138,139,140,141] As one study of Neanderthal hunting techniques concludes, "although Neanderthals and modern humans differed in salient ways, the vast behavioural and cognitive gulf that was once thought to exist between them has now narrowed considerably."[142]

a creature of the cold

Although Eurasian Neanderthals and Levantine early humans inherited similar features from common primate and hominid ancestors, the different geological and climatic ecosystems they inhabited for hundreds of thousands of years gradually selected for physical and behavioural differences. We know the coastal environment of the Levant during the Late Pleistocene resembled the African savannah, with over a hundred different varieties of edible plants, so it is not surprising that Levantine humans retained the adaptations they had acquired in Africa over the preceding six million years. That included their omnivorous diet and a preference for savannah habitats.

In contrast, Neanderthals evolved in ice-age Europe, the only hominid species to evolve in a climate of seasonally lethal cold.[143] During their half-million-year occupation of Europe, they gradually acquired a range of physical and behavioural adaptations to protect themselves against the

cold. One of the main adaptations to the periglacial environment, which has been described as one of the harshest and most inhospitable habitats ever occupied by hominids,[144] was the adoption of a high protein animal meat diet. Steve Kuhn and Mary Stiner, from the University of Arizona, say that few plants could survive in that cold climate and that those that did were not nutritious enough, or required too much effort to collect and process relative to their low nutritional yields.[145]

Because of their considerable weight and energy expenditure, not to mention the need to maintain body temperature within functional levels, Neanderthals had to regularly find and consume enormous amounts of protein which was converted to body heat. It has been estimated the average Neanderthal consumed about 1.85 kg (4.1 lbs) of fat-rich meat every day.[146] That's equivalent to the meat in 16 McDonald's Quarter Pounders. Early Neanderthal scholars assumed they were simply dumb cavemen who probably scavenged most of their meat from other animals, but we now know this was not the case. In fact, there are no exclusive mammalian scavengers. That is because the time and energy it takes to scavenge enough food is simply too high compared to hunting. And most predators vigorously defend their kills, so a scavenger is always at risk from being injured or killed.[147]

All this leads to the conclusion that Neanderthals were not scavengers. As Erik Trinkaus explains, "Neanderthals were not randomly wandering around the landscape, stumbling on an animal they could kill or a carcass they could scavenge."[148]

Only fresh meat could provide Neanderthals with the high protein, energy-rich diet they needed to maintain their large body mass and energy expenditure. Because fishing wasn't practised in the Middle Palaeolithic,[149] and there is no evidence of Neanderthal fishing technology, the only way they could have obtained a constant supply of fresh meat was by hunting terrestrial prey.

Just as modern Inuit residing in glacial habitats have adopted a high protein diet of animal flesh, European Neanderthals abandoned the omnivorous diet of their African ancestors for a carnivorous diet of animal flesh. Such a fundamental switch in their diet would create a substantial ecological divide between the Neanderthals and humans. When European Neanderthals abandoned their hunter-gatherer lifestyle and became hunters, their whole evolution was focused on becoming better hunters. And that, I suggest, had profound implications for human evolution.

a taste for flesh

You might think it would be virtually impossible to tell what your average Neanderthal ate for breakfast or dinner 100,000 years ago but that is not so. Researchers have discovered that the chemical composition of animal bones is affected by what they eat. When geneticists began analysing isotopes of bone collagen in Neanderthal bone specimens, they found that the Neanderthal diet consisted almost entirely of meat.[150,151,152] In one French study, calcium ratios extracted from 40 Saint-Césaire Neanderthal samples revealed the Neanderthal diet was composed of about 97 percent (in weight) of meat.[153] These and similar findings are summarised by English palaeoanthropologist Paul Pettitt who concludes that Neanderthals ate "meat for breakfast, lunch and tea".[154]

By comparison, even though our African ancestors who migrated into the Levant were hunter-gatherers, the reality is that they were not so much hunters as gatherers. The fossil evidence tells us that early humans resolutely maintained their African omnivorous diet, which consisted mostly of gathered food—berries, roots, tubers, fruit, nuts and plants. In fact, the majority of their energy intake was supplied by uncultivated fruits and vegetables.[155] Analysis of Middle Palaeolithic human remains shows that archaic humans had only limited hunting abilities, captured only small to medium-sized or weak game, avoided dangerous prey and supplemented their diet by scavenging.[156,157,158,159,160] Even today, modern hunter-gatherers such as the !Kung people of the Kalahari Desert obtain only 33 percent of their daily energy intake from hunted animals.[161]

Although diet may seem an inconsequential matter in the great panoply of events and circumstances that led to the evolution of our species, in reality, how a species evolved its unique diet and acquired the adaptations to maintain it successfully has far-reaching evolutionary consequences.

the top of the food chain

Social predators (predators that hunt cooperatively in packs) use their own claws, talons, teeth, stings, poisons and beaks to disable and kill prey. Neanderthals represent the rare example of a predator intelligent enough to hunt collectively *and* use complex weapons.

Ample evidence exists to show that Neanderthals and their Middle Pleistocene European predecessors were practised in using stone-tipped wooden spears to hunt prey.[162,163,164] In Lehringen, Germany, the broken tip of a Neanderthal spear was found still embedded in the ribs of an

elephant skeleton, while at Umm el Tlel in Syria, a Neanderthal spear point was recovered from the cervical vertebra of a horse.[165]

Neanderthals did not hunt rabbits, rats, hedgehogs and other small game. We know from the bones littering their caves that Neanderthals were using their flint-tipped thrusting spears to bring down the largest and most dangerous species in Europe—woolly mammoths, giant cave bears, woolly rhinos, bison, wild boar, wolves, antelope and even cave lions.

Back then, these animals were considerably larger than their modern-day equivalents. The Eurasian cave lion stood 1.5m tall at the shoulder, about as tall as a Neanderthal. The animals the Neanderthals were attempting to kill were among the largest and most dangerous on earth. We must presume they mustered up the courage to hunt them because there was no alternative. Only these large mammals provided enough of the high protein meat they needed to survive. If they couldn't bring them down, they would starve.

The wild animals that roamed the glacial tundras of ice-age Europe not only fed and fuelled Neanderthals, they moulded them. Their ferocity, their will to live, their own acquired lethality raised the bar and forced Neanderthals to become tougher, smarter and more aggressive. These wild beasts helped transform Neanderthals from a docile African hominid to the fiercest European predator.

While courage does not fossilise, we need to at least briefly consider how important it was to Neanderthal survival. The major animals Neanderthals hunted were physically larger, stronger and tougher than them. Some were predators themselves. What courage would it take to attack a towering mammoth, or a cave lion, or a woolly rhino, approaching close enough to stab it repeatedly with a stone-tipped spear—while it was desperately flaying with its horns, teeth, talons or claws—and to keep attacking until the thrashing beast was finally stilled?

Courage was not the only essential attribute. Natural selection also favoured the smartest individuals—the ones who survived because they could fashion weapons and use them to gain a strategic advantage, to outwit and out-manoeuvre animals ten times heavier.

Just as wolves, lions, hyenas and other carnivorous pack-pursuit predators evolved specialised sensory, behavioural and physiological adaptations that increased capture rates and improved killing efficiency, so too would Neanderthals acquire and hone similar predatory adaptations. In other words, hunters evolve to become more efficient and lethal. They acquire increasingly refined adaptations to locate, stalk, track, capture and

kill their preferred prey—whatever it is. Being a predator defines its own evolutionary path.

High intelligence, guile, cunning and stealth only emerge at the pointy end of natural selection—the dangerous prey that killed off thousands of early Neanderthal hunters gradually shaped them to be the best predators they could be—relentless, stoical, ingenious, duplicitous and able to detect and interpret the tell-tale signs and scents of their quarry. Gradually, the gored, gutted, torn-apart, trampled-on individuals who lost their lives in the hunt gave way to a new breed of super-smart, hyper-aggressive killers.

A final line of evidence that Neanderthals evolved as a predator species is the thickness of their skulls. These were unusually chunky—at least compared to those of early humans. This chunkiness is called postcranial hyper-robusticity and has been interpreted by Valerius Geist, from the University of Calgary, as an adaptation to close-quarter hunting confrontations with large mammals.[166] It is another one of those things that gets selected—over time only the thick-skulled Neanderthals survived. Just as over time the demands of predation bestowed on Neanderthals their massive trunk and limb bones and their exceptional strength.[167]

An accepted method of testing scientific theories is to generate predictions from the theory and test them empirically. If Neanderthals were carnivorous predators engaged exclusively in hunting large, dangerous animals, this generates several predictions that can be tested. For a start, life at the top of the food chain would not have been easy, so Neanderthals would suffer more physical injuries than early hunter-gathering humans. This violent lifestyle would also mean that they did not live as long as humans. Both these propositions are corroborated by a plethora of scientific evidence.[168,169,170,171]

Judging by the high frequency of bone fractures in Neanderthals,[172,173] their close-quarter encounters exacted a heavy toll in physical injuries. In his study of trauma injuries among Neanderthals, Erik Trinkaus found that almost every adult Neanderthal skeleton ever examined reveals some evidence of skeletal trauma.[174] In one examination of 17 Neanderthal remains, Trinkaus found 27 skeletal wounds. And there would have been many more soft tissue injuries that were not preserved. While some of these injuries may have come from interpersonal violence,[175,] others must have been suffered in the course of predatory encounters.

On the basis of microscopic and chemical analysis of their bones, scientists have been able to estimate how old each Neanderthal was when they died. From this data, it has been established that Neanderthals

rarely lived beyond the age of 40, which is considerably less than Upper Palaeolithic modern humans.[176] Life at the top of the food chain was incredibly tough.

A picture begins to emerge of Neanderthals, not as the popularly portrayed dim-witted scavengers, but as cunning, formidable predators—two-legged, big-brained versions of lions and sabre-toothed tigers—and, like other top-level carnivores, possessing specialised hunting strategies to maximise their killing efficiency. John Shea provides an apt conclusion: "Once seen as dull-witted cavemen, new evidence indicates Neanderthals were intelligent, adaptable, and highly effective predators."[177] Elsewhere, the Stony Brook University anthropologist describes them as the "superpredators of the Ice Age".[178]

For a species that evolved in the frigid wastelands of ice-age Europe and survived that punishing environment for 500,000 years, being tough, stoical, resilient and aggressive was part of a tried and tested survival strategy. These attributes are the hallmarks of a top flight predator which, in conjunction with their amazing predatory prowess, allowed the Neanderthals to claim the position at the apex of the food chain. In Europe, Neanderthals became the perfect predator. And when some of them migrated to the Levant (to become the Eurasian Neanderthals) they brought with them all their predatory skills and attitudes—the whole gambit of their ferocious lethality.

GLOSSARY

ACCULTURATION: Cultural change that occurs in response to extended firsthand contacts between two or more previously autonomous groups.
ADAPTATION: Any heritable characteristic of an organism that improves its ability to survive and reproduce in its environment.
ADMIXTURE: Transfer of genes between two populations that had previously been isolated from each other.
AGONISTIC BEHAVIOUR: Aggressive, negative behaviours, such as fighting, threatening and fleeing.
ALLELE: One of the alternative forms of a gene.
ANCIENT DNA: A DNA sequence retrieved from a biological sample of a dead organism.
ANTHROPOLOGY: The study of humanity: divisions are physical anthropology, archaeology, ethnology, and anthropological linguistics.
ANTHROPOMORPHIC: 'Human-like'—used to describe artifacts or art work decorated with human features or with a human-like appearance.
APEX PREDATOR: A predator which is not itself preyed upon as a species.
ARTIFACT: Any object manufactured, used or modified by humans. Common examples include tools, utensils, art, food remains, and other products of human activity.
ARTIFICIAL SELECTION: The process by which humans breed animals and cultivate crops to ensure that future generations have specific desirable characteristics. It can also include 'lethal selection'—killing individuals to remove an unwanted trait or characteristic.
ASSEMBLAGE: A group of artifacts recurring together at a particular time and place, and representing the sum of human activities.
ATLATL: A wood or bone shaft implement, held in one hand, and used to propel a spear. The tool functions as a lever, giving greater thrust and distance.
BC: Before Christ.
BP: Before Present.
BEHAVIOURAL ECOLOGY: The study of the ecological and evolutionary basis for animal behaviour, and the role of behaviour in enabling an animal to adapt to its environment.
BIG-MAN: A form of leadership in tribes where the leader achieves power and influence based on ability.
CANNIBALISM: Consuming the flesh of the same species. Among humans, this can occur in the context of warfare, as part of a funeral rite or, rarely, in cases of extreme dietary stress.
CARNIVOROUS: Eating only meat. Carnivorous animals are carnivores.
CENTRAL NERVOUS SYSTEM: An organ system, composed of a network of cells called neurons, that allows an animal to monitor its internal and external environment, and to move voluntarily or in response to stimulation.
CHERT: A fine-grained rock formed in ancient ocean sediments. It can be shaped into arrowheads by chipping. It has often been called 'flint', but true flint is found in chalk deposits and is blackish in color.

CLADE: A group comprising a single common ancestor and all the descendants of that ancestor.
COEVOLUTION: Evolution in two or more species, such as a predator and its prey or a parasite and its host, in which evolutionary changes in one species influence the evolution of the other species.
COGNITIVE: Relating to cognition, the mental processes involved in the gathering, organisation, and use of knowledge, including aspects such as awareness, perception, reasoning, and judgment. The term refers to any mental 'behaviours' where the underlying characteristics are abstract in nature and involve insight, expectancy, complex rule use, imagery, use of symbols, belief, intentionality, problem-solving, etc.
COMMON ANCESTOR: The most recent ancestral form or species from which two different species evolved.
CULTURE: The learned patterns of behaviour and thought that help a group adapt to its surroundings.
CUNEIFORM: A style of wedge-shaped writing common in the Middle East which pre-dates letters by 1500 years. Writing was scribed into soft clay using a specially shaped tool.
DARWINISM: Darwin's theory that species originated by evolution from other species and that evolution is mainly driven by natural selection.
DEMOGRAPHY: The study of the distribution, density, and vital statistics of populations.
ECOLOGY: The study of interrelationships of organisms and their environment.
ELECTRON SPIN RESONANCE (ESR): A chronometric dating technique based upon the behaviour of electrons in crystals exposed to naturally occurring radioactivity; used to date limestone, coral, shell, teeth, and other materials.
ETHNOCENTRISM: Judging other cultures by the standards of your own, which you believe to be superior.
ETHNOLOGY: A subset of cultural anthropology concerned with the comparative study of contemporary cultures, with a view to establishing general principles about human society.
ETHOLOGY: The branch of zoology that studies the behaviour of animals in their natural habitats.
FIXATION: A gene has achieved fixation when its frequency has reached 100 percent in the population.
FLAKE: A fragment removed from a core or nucleus of fine-grained rock by percussion.
FOSSIL: Most commonly an organism, a physical part of an organism, or an imprint of an organism that has been preserved from ancient times in rock, amber, or by some other means.
FOUNDER EFFECT: The loss of genetic variation when a new colony is formed by a very small number of individuals from a larger population.
GENE POOL: All the genes in a population at a particular time.
GENE: A sequence of nucleotides coding for a protein (or, in some cases, part of a protein); a unit of heredity.
GENETIC DRIFT: Changes in the frequencies of alleles in a population that occur by chance, rather than natural selection.
GENETIC: Related to genes. A gene is a sequence of nucleotides coding for a protein (or, in some cases, part of a protein); a unit of heredity.
GENETICS: The study of genes and their relationship to characteristics of organisms.
GENOME: The full set of DNA in a cell or organism.
GENOTYPE: The genetic profile of an individual.
GRAVE GOODS: Tools, weapons, food, or ceremonial objects placed with a burial.

HEREDITY: The process by which characteristics are passed from one generation to the next.
HERITABLE: Partly or wholly determined by genes; capable of being passed from an individual to its offspring.
HOLOCENE: The post-glacial period, beginning about 10,000 years ago.
HOMO ANTECESSOR: An extinct hominin species dating from 1.2 million to 800,000 years ago,
HOMO ERECTUS: A species of hominid that lived between 1.8 million and 30,000 years ago; the first Homo species to migrate beyond Africa.
HOMO: The genus in which all humans are classified.
HOMOLOGOUS STRUCTURES: The structures shared by a set of related species because they have been inherited, with or without modification, from their common ancestor. For example, the bones that support a bat's wing are similar to those of a human arm.
HOMOLOGY: A character shared by a set of species and present in their common ancestor.
HYBRID: The offspring of two separate species.
HYPOTHESIS: An explanation of one or more phenomena in nature that can be tested by observations, experiments, or both. In order to be considered scientific, an hypothesis must be falsifiable, which means that it can be proven to be incorrect.
HYPOTHETICO-DEDUCTIVE EXPLANATION: A form of explanation based on the formulation of hypotheses and the establishment from them by deduction of consequences which can then be tested against the archaeological data.
IN SITU: In its original place.
INDUSTRY: All the artifacts in a site that are made from the same material, such as the bone industry.
INHERITANCE OF ACQUIRED CHARACTERS: Historically influential but incorrect theory that an individual inherits physical traits that its parents acquired during their lifetimes.
ISOTOPIC ANALYSIS: An important source of information on the reconstruction of prehistoric diets, this technique analyses the ratios of the principal isotopes preserved in human bone; in effect the method reads the chemical signatures left in the body by different foods
KILL SITE: A type of special activity site where large game animals were killed and butchered.
LINEAGE: A unilineal descent group composed of people who trace their genealogies through specified links to a common ancestor.
LITHIC TECHNOLOGY: The process of manufacturing tools etc. from stone. Most frequently refers to stone flaking.
LUMBAR LORDOSIS: An inward curving of the lumbar spine (just above the buttocks).
MANDIBLE: A part of the bony structure of a jaw. In vertebrates, it is the lower jaw.
MESOLITHIC: An Old World chronological period beginning around 10,000 years ago, situated between the Palaeolithic and the Neolithic, and associated with the rise to dominance of microliths.
MITOCHONDRIAL DNA: DNA found in the mitochondrion, a small round body found in most cells. Because mitochondria are generally carried in egg cells but not in sperm, mitochondrial DNA is passed to offspring from mothers, but not fathers.
MORPHOLOGY: The form, shape, and structure of organisms.
MOUSTERIAN CULTURE: Flaked hand axes and tools from the Middle Palaeolithic period that appeared throughout Europe after 250,000 and before

30,000 years ago. Mousterian artefacts are associated with Neanderthals.
MUTATION: A change in genetic material that results from an error in replication of DNA. Mutations can be beneficial, harmful, or neutral.
NATIONAL CHARACTER: Studies based on the assumption that collectively members of a society have a distinctive set of psychological qualities.
NATURAL SELECTION: The differential survival and reproduction of organisms that differ from one another in one or more heritable characteristics. Through this process, the forms of organisms in a population that are best adapted to their local environment increase in frequency relative to less well-adapted forms over a number of generations.
NEOLITHIC REVOLUTION: A term coined by VG Childe in 1941 to describe the origin and consequences of farming (i.e. the development of stock raising and agriculture), allowing the widespread development of settled village life.
NICHE: The ecological role of a species; the set of resources it consumes and habitats it occupies.
NONPROTEIN-CODING DNA (ncDNA): DNA that does not carry the information necessary to make a protein.
PALAEOANTHROPOLOGY: The study of the fossil record and archaeology.
PALAEOECOLOGY: The study of the relationship of extinct organisms or groups of organisms to their environments.
PALAEOLITHIC: The archaeological period before c.10,000 BC, characterised by the earliest known stone tool manufacture.
PANGENESIS: Charles Darwin's flawed theory of heredity that proposes an organism's physical traits are passed on from one generation to the next in the form of particles called 'pangenes' given off by all parts of an organism, and which get passed on to offspring via sperm or egg.
PHENOTYPE: The physical or functional characteristics of an organism, produced by the interaction of genotype and environment during growth and development.
PHEROMONE: A chemical substance produced by organisms and emitted into the environment to communicate with others of the same species. They are used to mark out territories, attract mates, lay trails, and promote social cohesion and coordination in colonies. Pheromones are usually volatile organic molecules which are effective at very low concentrations, as little as one part per million.
PHYLOGENY: The study of ancestral relations among species, often illustrated with a "tree of life" branching diagram, which is also known as a phylogenetic tree.
PHYSICAL ANTHROPOLOGY: The scientific study of the physical characteristics, variability, and evolution of the human organism.
PLEISTOCENE EPOCH: The sixth geological epoch of the Cenozoic Era. The Pleistocene occurred approximately 1.81 million to 10,000 years ago. This was mostly a time of world cooling punctuated by three or four major ice ages. Most human evolution took place during the Pleistocene.
PREHISTORY: The period of human history before the advent of writing.
PROTEIN: A molecule made up of a sequence of amino acids. Many of the important molecules in a living thing—for example, all enzymes—are proteins.
PROVENIENCE: The three-dimensional location of an artifact or feature within an archaeological site, measured by two horizontal dimensions, and a vertical elevation.
RADIOCARBON DATING: A process that provides absolute dates by counting the radioactive decay of carbon in the remains of once living plants and animals (i.e., charcoal, wood, bone, shell).
REPRODUCTIVE ISOLATION: Two populations are considered reproductively

isolated from one another if they cannot together produce fertile offspring.
SEDENTARY: A term applied to human groups leading a settled, non-migratory lifestyle.
SELECTIVE PRESSURE (SELECTION PRESSURE): Environmental forces such as scarcity of food or extreme temperatures that result in the survival of only certain organisms with characteristics that provide resistance.
SETTLEMENT PATTERN: The spatial distribution of cultural activities across a landscape at a given moment in time.
SEXUAL SELECTION: A selection of mating behaviour, either through competition among members of one sex (usually males) for access to members of the other sex; or through choice by members of one sex (usually females) of certain members of the other sex.
SPECIATION: the study of the layers of deposits at archaeological sites.
SPECIES: An important classificatory category, which can be variously defined by the biological species concept, cladistic species concept, ecological species concept, phenetic species concept, and recognition species concept.
STRATIGRAPHY: The archaeology definition of spatial evidence is the cultural remains and natural deposits form layers over time. Stratigraphic excavation is the digging out of an Area by completely clearing each strata layer before going any deeper.
SYMPATRY: Living in the same geographic region.
THEORY: A well-substantiated explanation of some aspect of the natural world that typically incorporates many confirmed observations, laws, and successfully verified hypotheses.
THERMOLUMINESCENCE DATING (TL): A chronometric dating method based on the fact that some materials, when heated, give off a flash of light. The intensity of the light is proportional to the amount of radiation the sample has been exposed to and the length of time that has elapsed since the sample was heated. It has much in common with electron spin resonance (ESR).
TOOL KIT: The set of all weapons and tools that was created and used by a person or group of people.
ZOOLOGY: A branch of biology that is concerned with the scientific study of animals, including their biology, distribution, and identification.

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