

The effects of metabolic changes in pleistocene hominids.

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Preconceptions: We tend to see ourselves as the prime achievement of evolution; our intellect sets us apart from all other creatures. Including Neanderthals, we like to believe. And that seems to be confirmed by the fact that they became extinct, in spite of their great strength and physical adaptation to the European climate. Boule convinced us that the brow ridges, low cranial vault and the receding chin were signs of mental weakness. And Stringer and Gamble argued that Neanderthals stayed behind in their cultural achievements because they lacked the ability for symbolic thinking.

Although these viewpoints are generally accepted, they are in fact far from scientific. For no anatomist in his right mind, would measure the shape of your chin to establish your intelligence. Nor would any anthropologist assess your intelligence by looking at your cultural background. In the effort to confirm our presumptions however, the end seems to justify the means.

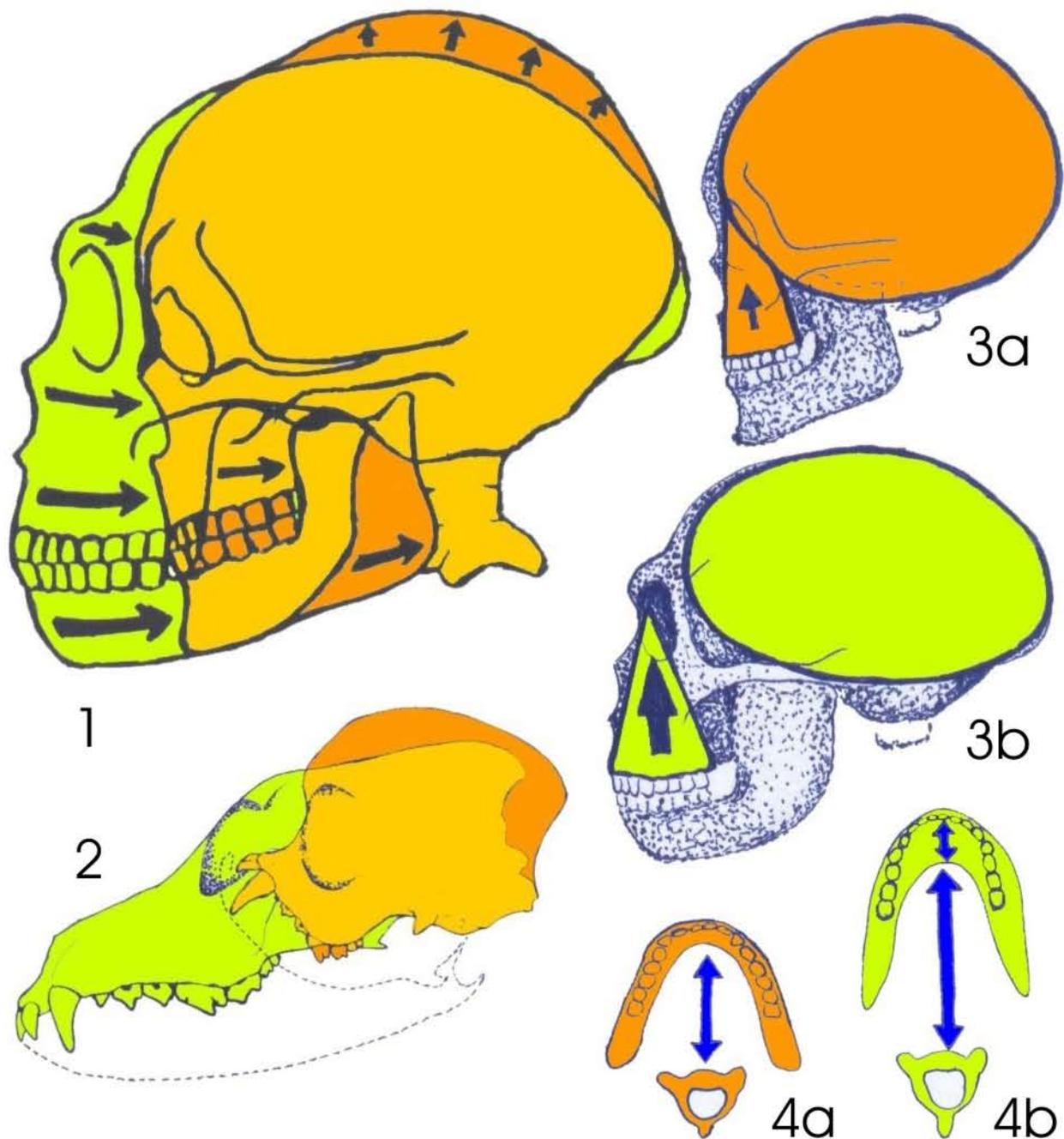
As a veterinarian I look at the archeological record with an open mind. In my view the most striking difference between us and our extinct pleistocene hominid contemporaries is our metabolism. In the following I will explain how the effects of metabolic changes in pleistocene hominids can explain the direction and timepath of the evolution.

High metabolism: Neanderthals were strong, clues to this can be found in their limb bones. These had a very strong thick cortex and the places where tendons and muscles were attached were large. This points to a very strong development of the muscles. But even their skulls demonstrate strength; for instance in the development of the supraorbital fossa where the strong muscles of the neck were attached. The large protruding face is also an adaptation to the Neanderthals greater strength and higher energy consumption. Darwinism tricked us into believing that this face was ape-like, indicating that Neanderthals remained at a “lower ape-like level”*. And we are brought up to believe our modern faces were created in God's image, so we are at the higher level. My veterinary education in functional morphology and comparative anatomy however, leads me to a very different conclusion; the Neanderthal face was in fact designed for high performance. The jaws were large and strong for maximal food processing and the nose was designed to maximise airflow. This was necessary to provide the powerful body muscles with ample energy and oxygen. *: How subjective the comparison to apes is, becomes the more clear if we take a look from the Neanderthals viewpoint. The face of a modern adult bears more resemblance to a Neanderthal child (Teshik Tash) than to an adult Neanderthal. So their conclusion would be that the moderns were thrown back at a “lower baby-face level”, whilst they were at a higher performance level. Clearly there is no real lower or higher level of development, instead the differences are only adaptations to a different level of metabolism.

Metabolic changes: Like all ancients, the European Heidebergs had a high metabolism, and that did not change as they developed into the classical Neanderthals. On the contrary, high performance was the main selection mechanism for Neanderthals, the strongest survived the European climate, so the ruggedness increased. We understand this, for we all want to be fit and strong.

But surprisingly the modern hominids took the opposite evolutionary route! That all started around 200.000 years ago, the African Heidelberg hominids (or if you prefer: Homo Rhodesiensis) at that time had a high metabolism just like the European Heidebergs and their Asian contemporary, Homo erectus. But about 200.000 years ago a few African Heidebergs developed a lower metabolism. This immediately gave them very important advantages, these hominids could survive with less food, were in less danger of overheating in the hot climate and lost less water through evaporation. That turned out to be ideal in the arid and hot parts of Africa. As the mitochondrion is the cell's engine, it is a reasonable assumption that this lowered metabolic rate was anchored in the mtDNA. This produced what we call the modern mtDNA. I certainly accept the claim made by geneticists that our modern mtDNA originated in Africa about 200.000 years ago. But I do not accept the black Eve hypothesis (Cann and Wilson), when it portrays the first hominids with modern mtDNA as the first all-modern humans. In my view the fact that these Africans developed our modern mtDNA does not imply they already looked completely like us. For then we would have to believe that the chromosomal DNA (which determines the way we look, for instance the DNA that determines the thickness of the cortex in limb bones) changed at the same moment, overnight as by some divine interference. It is much more credible that black Eve looked exactly like all other Heidelberg hominids, had exactly the same intelligence and ‘crossbred’ with them. The only thing that really set black Eve apart was that she had a lower metabolism resulting in far less muscle strength.

Adapting our anatomy: These black Eve type economized Heidebergs most certainly had problems with their anatomy. Just imagine yourself with such a heavy skull on your weak body! Actually we know what that was like, from an experiment in which runners had their heads weighted to resemble Neanderthals (Daniel Lieberman in NOVA). It turned out that the runners had a hard time trying to stabilise their weighted heads; as a result even their vision was affected. Lieberman concluded that Neanderthals were poor runners, but that makes no sense to me; if we were to repeat the experiment with the weight of a horse's head, should we then conclude that horses cannot run? Neanderthals clearly had sufficient muscle strength to keep the movement of their heads perfectly under control, these muscles might explain the supraorbital fossa and the occipital bun might have played a role in balancing the head, but I am sure Neanderthals were great athletes. But the descendants of black Eve on the other hand would indeed have had problems with their heavy skulls because they had a lower metabolism; weaker muscles. As a stroke of luck these black Eve descendants quickly met up with relatives of the 200.000 year old Ngaloba 18 fossil (or perhaps descendants from KNM-3884 found at Ileret-Guomde dating back to 270.000 years, or from the 250.000 year old Florisbad hominid). These had a higher cranial vault than the common Heidelberg type, resulting in a shortening of the base of the skull (figure 1; figures 1-4 are shown in the Jpeg image ‘skulldrawings’). This short base moved the centre of gravity backward, it now came almost directly above the vertebral column. This greatly relieved the neck muscles, so the low metabolism hominids functioned much better with this high vault.



- 1: To reduce the strain on the neck muscles the braincase was shortened, creating a higher vault, and the face was reduced.
- 2: Such differences can also be observed in dog breeds, these breeds have the same intelligence and are one species. The protruding faced dog performs better than the pekinese.
- 3: In Neanderthals the bite force is greater and directed in front of the braincase, brow ridges stabilise the maxillar-frontal suture.
- 4: Shortening the mandible led to: a wider arch to make room for the throat, the protruding chin to make room for the tongue, lowering of the larynx and loss of the retromolar gap.

Ever since Boule, a higher cranial vault was associated with intelligence. But as a veterinarian I see the high cranium for instance in the pekinese or bulldog (fig. 2), this clearly cannot be associated with any change in intelligence. Now that we understand our higher skull** has a biomechanical reason, we should no longer link this to intelligence.

The maxilla (upper jaw) is connected to the frontal bone (braincase) in the eye sockets. In ancient hominids the enormous chewing muscles put a lot of pressure on this connection. Strengthening the palate or the nasal bones would be of no use for pressure always has most of its effect on the outer side; strong eye sockets with heavy brow ridges were the best solution (fig. 3). In moderns the jaws are situated underneath the frontal bone, so the brow ridge lost its function. Furthermore, the less muscular Eves offspring was glad to lose the extra weight. Seemingly modern skeletal features were readily available as a result of the plentiful variation; for instance the short flat face can already be found in the Dali skull (China, 200.000 BP). Since replacing old features by favoured 'modern' types through selection can happen in a few generations (Relethford), it is not surprising that the combining of chromosomes had already produced a fully modern skeleton around 160.000 years ago (Herto and Singa).

** : Actually the high cranial vault only results in a "higher skull" if we project the eyes at the same level. The major differences are not found in the cranium but in the face; in moderns the face was reduced in size. So it would be better to say Neanderthals had "a lower chin and higher eyebrows". This becomes obvious when we join the left side of la Ferrassie 1 and the right side of Cro-Magnon 1 (Jpeg 'skullphoto'). Both have the same 1600 cc cranial capacity. The size of the face indicates the capacity to eat and to breath; the level of metabolism.

Troubleshooting: Turning the rugged*** hominids skull into the modern type was much like turning a wolf into a bulldog; such adaptations created new problems. The bulldog for instance has problems with his throat, and so do we. The modern low position of the larynx is considered to be a precondition for speech. But actually it is a troubleshooting attempt; resulting from the shortening of the mandibles. To reduce strain on the neck muscles, the lower jaw was pushed back underneath the braincase. Even to the point where the opening of the jaw had to become wider to make room for the neck (fig. 4)! That meant the tongue got pinched in between the vertebrae of the neck and the receding chinbone. It needed more room, so the chinbone, at the suture, had to make way. But if you simply shorten the suture between the left and right mandible the chin becomes fragile. That is why the protruding chin (a ridge on the outside) was developed. But the tongue still needed more room to articulate; so it pushed the larynx out of the way. Unfortunately, pushing the larynx down made us snore more and choke sooner. And shortening the jaws also made the open space behind the last molars (retromolar gap) disappear, causing dental problems. And when the skull came further above the vertebral column, the brain became constantly exposed to the shocks caused by walking or running. This might be why none of the ancients really took to the idea of a high cranium, they rather kept their heads forward so the neck could compensate the movement. In order to absorb the shocks modern man developed a double-s-shape with four bends in his spine. It worked, but many people pay the price by getting back aches.

*** : Alan Thorne commented: "with big noses to permit warming cold airI dont see Neanderthal heads as robust, merely big with large sinuses that are a unique way of adapting to cold climates". I believe eskimos and polar foxes have only small noses, Atapuerca 5 and

Nariokotome boy (temperate to warm climates) on the other hand do have large noses. In my opinion their high metabolism required a large airflow. Since the metabolism required strong chewing muscles, the structural integrity of the face had to be supported by the brow ridges and by "large sinuses".

Crossbreeding: Before 160.000 B.P. black Eves offspring crossbred and evolution selected the traits that made us anatomically modern. The moderns commonly mixed with the Heidelbergers in Africa between 160.000 and 100.000 years B.P. The small faced hominids Omo Kibish 2 (Ethiopia 130.000 years) and Djebel Irhoud (Marokko) that show a low vaulted cranium could be examples of interbreeding. And the moderns could have interbred with the Homo erectus in Asia as well. But after 100.000 years B.P. the interbreeding became less obvious. It appears as if especially the Neanderthals became a clearly different line, and it is often questioned if they mixed at all with the moderns.

When we look at the skulls from Skhul and Qafzeh (100.000 B.P.), these are high vaulted and therefore considered modern. But they have the ancients protruding faces and brow ridges. Some believe that makes them hominids in a halfway development stage. The protruding jaws without doubt provided a lot of room for the tongue and larynx, so there was no reason at all to move the chin even further forward. Still most of these skulls do show a protruding chin. That was a completely useless feature in the protruding face stage; just like a fish growing feathers 'on its way to become a bird'. The logical conclusion is that these hominids were the result of crossbreeding between moderns (who were already fully developed 60.000 years earlier in the Awash Valley) and Neanderthals.

Other examples of crossbreeding with Neanderthals are the 35.000 year old Oase fossils and the 24.500 year old child buried at Lagar Velho (Joao Zilhao, Trinkaus). It strikes us that such examples of crossbreeding are rare in the fossil record. If there was interbreeding, we need to ask why clear examples were only this rare. I believe the reason lies within the incompatibility of the Aurignacian and Mousterian cultural patterns, as you can read here later. Exceptions occurred when a 'different' child was found or stolen, and matured in the group, or when groups met in favoured places. However rare**** these occasions might have been, they were still responsible for introducing genes in the Aurignacian population that gave us typical European features. So in that sense: 'I am a Neanderthal' (Wolpoff).

****: Alan Thorne commented: "As for your comment about the rarity of interbreeding, it seems to me that this is belied by the frequency of willingness to breed in living people, especially modern males, and all over the world numbers of newcomers made their presence felt in terms of physical variation in a short time." Was there, in spite of the cultural differences, more interbreeding than the fossil record seems to indicate?

Links to metabolism: I have shown that the anatomy of modern man is linked to his lower metabolism. And it seems logical that there is a link between metabolism and mitochondrial DNA, for these are the cell organelles in which oxidative phosphorylation takes place. In other words this is where the combustion takes place. The black Eve mtDNA proved to be highly functional when combined with anatomical adaptations, hence all other mtDNA types disappeared***** in times of scarcity. *****: Alan Thorne commented: "I like the ideas you have about metabolic change, where the processes in Neanderthals are seen within our species. By the way I dont have a problem with Neanderthal "disappearance" as there are many example where groups of modern people in Tasmania, the Pacific and many other places



were made “extinct” because they have been added to by a continual stream of incomers for 200 years and more.” As he points to the newcomers numerical advantage, Alan Thorne actually asks us: why did Eves descendants become so numerous in such a short time? Why did ‘one womans mtDNA’ outnumber all the African Heidelberg, the Asian erectus and the Neanderthals? I believe the metabolism theory explains this, in accordance with the fossil record.

We can even find links to the metabolism in many cultural patterns as I would like to demonstrate in the following part.

Cultural patterns: Heidelberg man and Neanderthals knew how to make balanced spears (i.e. Schöningen). So they must have known how to throw a spear. But the best way to make a kill of course was by holding the spear and driving it deep into the animals chest. The Neanderthals often did this, as we may conclude from the (healed) fractures in their fossil bones (Trinkaus). They were very successful at this, but the moderns were to weak to take to this close contact hunting style. As a result the moderns performed less, and had to become inventive. That did not happen overnight due to a sudden outburst of intelligence, it still took tens of thousands of years before the moderns invented spearheads (Blombos). But one invention led to another and gradually things started to speed up, pre upper paleolithic blades were invented and harpoons. The moderns created ideas, created stories, created art, created culture. It is obvious that culture speeded up with the moderns, many prehistorians consider this to be proof that the moderns were more intelligent than their contemporaries. But than we must have become even more intelligent when we learned to write, for protohistorians can tell you culture really speeded up at that time. And (material) culture is still speeding up.... So in fact the intelligence-hypothesis (‘symbolic thinking’) is only about prehistorians searching to confirm their presuppositions. There are better ways to explain the rapid development of culture; I believe it has got to do with better communication, better ways to pass on ideas. We know that the lower metabolism led to a growth rate in modern children that was only half as fast as in rugged hominids (as a veterinarian, I am not surprised by such differences within one species; the growth rate in chickens differs much more!). Initially this only gave Eves children a chance to develop on less food (per day). But more importantly this low growth rate ensured that children stayed with their parents for a longer time, this improved communications and enhanced the development of cultural patterns! I am sure that language existed in Neanderthals and was used in hunting strategies. But due to the lower growth rate, modern children had more time to learn language, this must have caused language to develop, and this again increased cultural development. The lower strength and lower growth rate clearly enhanced cultural development. So even if we cannot

prove that Neanderthals had the same intelligence as the moderns, there is just as little proof that they were less intelligent.

The puzzle: The moderns reached Australia (Malakunanja) 60.000 years ago. Most Asian and Australian scientists believe this was mainly the result of gene flows (regional continuity). This implies that all hominids were the same species, but in that case; why was there no flow of modern genes into Europe? That seems to present us with a puzzle, Neanderthals showed no gradual tendency to become modern. And they were abruptly replaced by moderns, the mtDNA and cultural evidence leaves us no doubt that Europeans descended from the Aurignacians that migrated into Europe from Africa. Most European scientists therefore believe Neanderthals were a different species. If so, the same was probably true for the Homo erectus; than there were no gene flows at all (out of Africa 2 hypothesis). No wonder there is a sharp debate.

My theory solves this puzzle. The real reason why Aurignacians replaced the Neanderthals so suddenly, again has to do with the effects of metabolic change. And it happened following the timepath we see, because of one important cultural factor: shelters!

Shelters: The ancients were tough, wind and weather hardly troubled them. But the low metabolism made modern man and his slow developing children much more vulnerable, black Eve could never survive in glacial Europe. Even her geneflow could not enter Europe because this would have weakened the Neanderthals. So the barrier between the two races, that prevented the Neanderthals from modernising was not genetic but climatic! Even in Africa and the Middle East, the vulnerable moderns felt the need to take shelter whenever they could. Out of necessity, in time, the Aurignacians developed their own shelters; huts or tents had become a constant factor in their culture around 40.000 B.P.. And this turned out to be the critical step that enabled them to migrate north! For exposed to wind and weather, the Aurignacians could never have survived the European climate, but they could survive in the micro-climate they created inside their tents. Aurignacians raised their children inside the tents, and this gave the Neanderthal children a threefold disadvantage. For the ancients were allways on the move, whilst modern children rested in their tents. Even worse, Neanderthal children lived under glacial conditions, whilst the moderns kept warm in their huts. So the Neanderthal children were burning up their last reserves and on top of that had to grow twice as fast because they matured in only half the time. The Neanderthals were adapted so well, that they had survived the extreme European climate for over 150.000 years. But after the moderns came none of that mattered any more, for the Aurignacians simply did not compete on even terms: they brought their own micro-climate.

Trapped: We ask ourselves why the ancients did not adapt, why did they not 'learn' to build their own tents and raise their children in the micro-climate of a tent? It is easy to blame it on their intelligence, but the real reason is very different. Neanderthals needed a lot of food, so they must have been very successful hunter-gatherers. For that reason they were not about to give up their very successful old habits, like close contact hunting and their great mobility. So to them, a tent was just an obstacle, it slowed the group down during hunting and gathering. Why pay that price if you don't feel you need tents? Besides, Neanderthals were free roamers, their culture was so different that they would have felt like a bird in a cage if they were confined amidst the fleas in a stuffy smelling tent.

It has been assumed that Neanderthals lived in huts, there are claims for their 'huts' and even older ones, but Kolen and Roebroeks showed that these floor plans are in fact coincidental patterns of postholes and rocks or centrifugal living patterns (where rocks and debris were simply pushed aside to make room for the hominid group, often resulting in fireplaces that lay in the middle of assumed walls). Neanderthals were, as Kolen called them: hominids without homes. In my opinion this is not because they lacked intelligence (some apes even make nests), but due to their high metabolism! The Neanderthals were simply trapped in their high energy consuming bodies, and therefore trapped in their energy consuming outdoor lifestyle.

Tents provided a micro-climate, but also brought other changes. For instance Neanderthals didn't carry much with them besides their clothes and flints, tents stimulated the moderns to develop small furniture. Semipermanent fireplaces led to the invention of baked clay. Living in tents meant staying in one place for weeks, so the Aurignacians had to get rid of the deceased (their rotting corpses) by burying them. To them and to us that felt like sheltering the dead (pay attention to the word shelter). But for the free roaming Neanderthals a grave would feel like a prison. Whoever said Neanderthals lacked culture or just didn't care about their dead because they did not stuff them in a hole, has got no understanding of Neanderthal culture and compassion.

The moderns brought only one thing Neanderthals could put to use; the blade technology. It seems this resulted in the Châtelperronian blade culture. This started a debate whether or not the Neanderthals developed this culture independently. And whether or not this was a sign of intelligence. But as I showed, the real struggle for survival was never about intelligence. Even if Neanderthals had been more intelligent than us, they would have died out due to their high metabolism. The last trace we saw of them was in the Gravettian halfbred child from Lagar Velho and then they were gone.

Conclusion: Multiregionalists have presented measurements in fossils as arguments for their theory, but this is not accepted as definitive proof. Geneticists have shown that no living people exist with old mtDNA; all living men share 'black Eves' mtDNA. Many consider this to be definitive proof for the Out of Africa 2 hypothesis, I have shown this to be incorrect. The ancient mtDNA could easily have disappeared from a mixed and interbreeding population due to natural selection in favour of low metabolism. In Africa and Asia this happened gradually and relatively slow (around 150.000-50.000 BP). The metabolism rate changed cultural patterns (most importantly the use of shelters). This explains the relatively late and sudden (around 40.000-30.000 BP) disappearance in Europe of the old mtDNA and anatomical features that we consider to be typically Neanderthal.