More on Cannibalism and the Development of Early Human Society

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ABSTRACT

A substantial body of archaeological research over the past 25 years supports the proposition that Paleolithic and Neolithic cannibalism was a sub-optimal survival strategy. This is because early modern humans had to compete with non-human scavengers and predators for meat, and so plant food became essential for survival. We now know that 'man the hunter' was successful in relatively few hunts, and so probably lived on the margin until foraging skills developed sufficiently to provide nutritious supplements not available from meat. Seasonal variations in food animals caused food stress, thereby depressing women's fertility. This probably promoted intergroup co-operation, rather than cannibalism.

Keywords: *cannibalism, dietary effects on hunters, butchering and defleshing human remains, nutrition, body fat and female fertility, low probability of cannibalism for human survival.*

INTRODUCTION

'Cannibalism' commonly evokes responses of repugnance, amusement or 'we don't do things like that' in most people. For the researcher into the question why evidence of cannibalism has been found in Europe, the Americas, Micronesia and Oceania, but only a few instances in Africa, at least until the revolt against British colonialism in Kenya in the 1960s. Cannibalism thus raises a scientific challenge, namely to explain why the phenomenon left its imprint on so many archaeological sites in Europe.

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In an earlier article, I argued from a social anthropological viewpoint that during the late Pleistocene, cannibalism was a sub-optimal survival strategy for several socio-demographic reasons. Since then, I have become aware of a substantial body of meticulous archaeological research that supports my original conclusion, and raises several interesting avenues for further research. This paper is divided into sections that deal respectively with how early hominins fitted into the overall predation system, in which predatory species were significant competitors of anatomically modern humans (AMH), their efficiency as hunters and scavengers, seasonal changes in the availability of prey, and nutrition, including the nutritional effects of cooking. Also discussed are the 'proofs' of cannibalism, the relationship between body fat and fertility, environmental constraints on human predation, especially climatic change, and how changes in early human physiology may have influenced whether or not early hominins ate each other persistently.

Together these factors also compel the conclusion that persistent cannibalism was a sub-optimal survival strategy.

HOMININ AND NON-HOMININ PREDATION PATTERNS IN THE ARCHAEOLOGICAL RECORD

Anatomically Modern Humans (AMH) were omnivorous predators who competed with other carnivores for meat, obtained by hunting and scavenging. The availability and types of prey animal early man hunted or scavenged successfully, naturally depended on several factors, including climatic and environmental change, adaptive cognitive, physical and behavioural changes in both hominins and their prey, and the degree of competition for specific types of prey or dead meat. The amount and types of mammalian prey that early man ate depended on his hunting techniques, his toolkit and his weapons. Finally, after killing his prey, early man's sociological development was also important, especially where large prey animals were successfully hunted in groups, and required the transportation of the meat from the hunting site to the consumption site. During six months' research among the Dobe !Kung in 1970, the author witnessed how, after large prey, like a giraffe, had been killed, one of the hunters went to fetch porters from the camp while the others protected the corpse while butchering it into narrow long strips that were hung up in tree branches to dry, so as to lighten and preserve the meat. John Marshall's 1957 film 'The Hunters' provides a good example of these processes (Foley 2009: 3, 5–6).

This reveals the importance of an understanding of scavenger behaviour, particularly of avians, who tend to be forgotten by researchers, since they are seldom found in close proximity to humans. This situation was likely to have obtained during and after the late Pleistocene. Additionally, the size and social organization of the hunting band must have influenced both the division of the spoils of the hunt, its women's fecundity and the amount of manpower available to it for obtaining food and providing mutual protection.

Thus, early Paleolithic hominin hunters were part of a complex, dynamic ecosystem of predation and scavenging, which determined their caloric intake, cognitive and physical development and the evolution of their social organization. Developments in tool making indicate the increased mental development and cognition, physical growth, and the nutritional and cognitive benefits of increased meat intake. We may add to this the supposition that trade, inter-marriage (Heyer *et al.* 2011: 62–64, 73), and the dissemination of knowledge, propagated these cultural developments as hominin populations in specific areas interacted and probably co-operated in hunting, intermarriage, trade and defence (Kurland and Bekerman 1985: 73). If the research on hunting societies published over the past 60–70 years is any indication, an important component of hunters' store of knowledge is their understanding of the reproductive practices of their prey, and the long-term impact of over-hunting on their diet.

In the early 1970s, the possibility of overhunting was a common topic of conversation among !Kung hunting bands in Namibia, as they planned their hunting strategy for the following week's hunt, and for the rest of the season. During the dry season certain types of *cervidae* disappeared until the first rains, so there were substantial seasonal changes in the composition and plants of their diet. The importance of this point is that the variety of osteological and other relics (such as fossilized pollen) found in archaeological excavations, is partly the result of hunting and scavenging preferences, and partly the result of seasonal changes. Here there was a major difference between Africa and Europe: Africa, especially the northern and southern regions, was substantially more arid than Europe, a factor that affects hunting and scavenging among the few extant groups that still subsist on these activities. Finally, the !Kung were also aware of the different composition of different types of meat, which was reflected in the prey they preferred.

In the Kalahari Desert there are far more scavengers than competing predators. The scavengers, both mammalian and avian, can strip

a 200-kilogram animal in less than an hour and a half. This raises a point seldom discussed, namely that if contemporary man's most efficient competitors in hunting are scavengers and not other predators, the same might well have been true of late Paleolithic man as well. We should remember that scavengers like hyenas and African Wild Dogs are serious competitors to hunters using relatively primitive technology. Thus, the osteological relicts that archaeologists uncover and analyze with ever-increasing accuracy probably do not represent the full amount of the actual prey killed by the group's hunters. If the Dobe San are anything to go by, hunters lose up to a third of the animals they kill (Gerald D. Sack, Unpublished Research Notes, 1971-2).

In competition with avian scavengers and predators, early hominins must have been at a particularly big disadvantage, given birds' long-distance vision and rapid arrival at the kill site. At the same time, smaller scavengers like foxes are easily driven off, but nevertheless, the bones discovered in hominin home bases, must have been far less than the actual osteological residue that would have accumulated, had all the prey been successfully recovered. A final point to consider is the quantity of successfully hunted and retrieved prey that is consumed on the hunt. Again, the Dobe San are opportunist hunters, happily killing and consuming small prey which are not worth bringing back home, since the individual shares would be very small indeed (*Ibid*). The nutritious value of such small prey is of high utility to the hunters, particularly while they are running down their prey. Since the poison used by the San on their arrows is relatively slow-acting, a large wounded animal can lead the hunters on a merry chase for as long as 7–10 days, in the case of a giraffe, for example (*Ibid*).

Naturally, this discussion is obviously not a critique of paleoarchaeologic methodology, but simply raises points that are not always taken into consideration.

THE IMPACT OF CLIMATIC CHANGE ON HUNTING AND SCAVENGING

To a large degree, late Pleistocene hunters and gatherers in Africa were also subject to similar endogenic changes in their subsistence system, which, however, were probably more frequent and more extreme than those in Europe. It was axiomatic when I was an anthropology student in the late 1960s, that the lower the rainfall in any area in Africa, the greater its annual variability, and the more likely it was that prolonged droughts would occur. European rainfall is both higher and more regular, which would have provided late Pleistocene hom-

inin hunters and gatherers with congenial hunting and foraging habitats. John D. Speth contended that in regions where there is a marked difference between hot and cold periods of the year, groups accustomed to high animal-protein intakes during one season, were likely to suffer from 'food stress' and the depletion of their body fat reserves during the winter (Speth 1987: 20–22). This may have led to persistent changes in the timing of births.*

Another point not always considered regarding hominin predation, is that it favoured specific traits by promoting the selection of those most conducive to good health and predation (White 2001: 86–88; 93; Olshansky, Carnes and Butler 2003: 50–55). One of the points made by Olshansky *et al.* (2003: 95), is that

> Designs that seriously hamper survival in youth will be weeded out (selected against) because most affected individuals will die before having a chance to produce offspring. More important, anatomical and physiological quirks that become disabling only after someone has reproduced will spread (*cf.* Lieberman 2013: 16–18; 20–21; 23).

The high nutritional quality of meat was thus crucial to the physiological, mental and social development of early man. A 'bioenergetic' model developed to evaluate the energy requirements of AMH, especially his brain metabolic requirements (Leonard and Robertson 1992: 179–180), showed that they were surprisingly high among the young, but declined with age (*Ibid.*: 180). Also unexpected was the contention that after the age of two years, when at rest, the brain requires more energy than the body in order to develop (*Ibid.*: 181–182).

The emergence of *homo erectus* and its descendants, therefore, required a substantial increase in both the quantity and quality of food, and in the amount of energy expended in food collection in order to support the increased energy requirements of the developing human brain (*Ibid.*: 186–191). The point here is that a higher quality diet, therefore, was a *sine qua non* for the development of *homo sapiens*, precisely during the period when east Africa was becoming drier. This obviously meant that substantially larger quantities of protein and carbohydrates were required just when their harvesting became more energy demanding. One possible solution could have been cannibalism, which would have provided closely matched edible energetic solutions to what the human brain required. The fact that cannibalism seems not

to have been widely practiced in Africa at that point in time, then, raises an important but still unanswered question.

If the solution was cannibalism, it would have been either endocannibalism (the consumption of group members), or exocannibalism (the consumption of non-group members) (White 2001: 88). Exocannibalism was logically preferable for group survival. If exocannibalism was practiced on the relatively young, they could potentially make lengthy contributions to the bands' acquisition of vegetable and animal food. This suggests that the consumption of elderly group members would be both efficient regarding the investment of energy in food getting, and the number of mouths participating in the proceeds of the hunt and gathering. Interestingly, among the Siberian Chuckchi in the contemporary period, this was a major rationalization for 'voluntary death' (suicide with the assistance of lineage members) (Willerslev 2009: 693–694).

The potential drawback to endocannibalism of the elderly, of course, is the loss of their knowledge and experience. The evolution from *homo erectus* to *homo Neanderthalensis* and *homo sapiens* took a long time – between 1.6 million to 800,000 years. It is thus possible that the increased increments of metabolic energy required for the completion of early man's cerebral development were sufficiently spread out, as to make the process sustainable with only relatively small increments in the quantity and quality of the food required, thereby obviating the need for cannibalism that at first seemed necessary.

We cannot establish whether late Paleolithic man persistently practised endocannibalism or not. However, the analysis of the sexual and age composition of cave-dwelling groups should provide insights into the role endocannibalism might have played in the complex biological, ecological, climatic and predatory system in which man developed and competed with other predators and scavengers. This is particularly true of the competition for the high-quality food that gave him the evolutionary advantages, of longevity and cognitive development.

To assess the impact of primitive exocannibalism would require DNA testing of a vast quantity of paleosteological material. The question is whether the investment in time, effort and material would be worthwhile, something I am not qualified to comment on. Speaking as an anthropologist, however, there is a tantalizing hint regarding potential endocannibalism of the elderly, which derives from Chuckchi and Innuit 'voluntary suicide', that is, suicide of the elderly performed with the assistance of kinsmen (Willerslev 2009: 693–694). Research-

ers into the topic, however, argue about the 'reason' for the practice, namely whether it derives from an altruistic concern for the well-being of the band, or is a religious ritual, as Willerslev contended. Still other researchers, however, think that this type of suicide was rare among the Innuit, though having similar motivations. It appears that the religious motivation derives from Innuit beliefs in the afterlife (Willerslev and Vitebsky 2015: 1–23).

Sandgathe *et al.* (2011: 248–250) and Rendu *et al.* (2014: 5), showed that already in the late Paleolithic period and among Neanderthals, there was evidence of purposeful burials, without evidence of associated cannibalism. This suggests that both purposeful burials and cannibalism were selected, purposeful acts, rather than unplanned and episodic events. Both sources hint at the absence of other non-human bones in the 'graves'. This deliberate separation of human from non-human remains also suggests a different attitude towards the remains. While this point is seldom specifically raised in instances of reported cannibalism, its absence would appear to suggest that cannibalized corpses were regarded as food, rather than items to be respected or revered. Moreover, both reports specifically note that non-cannibalistic burials were of complete corpses, in specific poses, relatively 'untainted' by other non-human bones, while cannibalized bones were scattered and mixed up with animal bones (*cf.* Saladié *et al*. 2015: 3–4). They stated (2015: 18), that

> In general, most descriptions of European prehistoric cannibalized assemblages describe a butchering process that is similar for humans and animals, as a result of a consistent pattern in the exploitation of meat, bone and brains of the bodies. The only possibly ritual processing described in any of these cases was that applied to the skulls in some of the assemblages that contained anatomically modern human remains.

This, together with the cave bear skulls found in Polish (Zbiorowa 1989; Baca *et al.* 2012) and French sites (Joachim 2002: 58; Montelle 2022), suggest a direct link between the skulls and ritual attitudes towards them. Karavanić (1993: 100–102), Wunn (2001: 459–460) and Bednarik (2010: 14–17) cite earlier research linking cave bear ritual sites to human cannibalism, but both warn that most of the previously published material was more speculative than scientific (Chase 1987: 6–9). Similarly, it has been argued that the reported evidence for at

least some purported Neanderthal burials is suspect (Dibble *et al*. 2015: 649–657; Trinkaus 1985: 203–216).

David W. Frayer *et al.* (2006: 519–524) argued that many of the defleshing marks on skulls could not have been made in order to scalp or deflesh for eating purposes, and concluded that there was little evidence for cannibalism in the Krapina cave. Later, (Frayer *et al.* 2020: 714–5), however, the researchers suggested that the identifying mark of cannibalism was the smashing of bones to get at the marrow or brain. If this was absent, the defleshing was probably for mortuary purposes. This seems logical, as opposed to arguing that cut marks must be either mortuary or evidence of cannibalism. It is, of course, also conceivable that the defleshing was for both ritual purposes and consumption in some cases (Ullrich 2005: 249–261). Tony Phifer and Joshua Zaffos (2019/2020) came to the same conclusion, after an examination of the defleshing marks on several bones, and thought the 'cut marks' could have been produced by natural means. In sum, at present the debate remains open.

HOW EFFICIENT WAS HOMININ PREDATION?

Most research into the development of hominin predation assumes that AMH were efficient hunters, otherwise they would not have spread and colonized Europe and Asia. There has, in fact, been rather little research into hominin predation, and what was apparently the first such investigation into the topic, that of Schaller and Lowther (1969: 307–341), had only a minor impact on subsequent research into 'man the primaeval hunter'. The author remembers reading the article as an undergrad, and finding it thought provoking, but did not pursue the topic further then.

In the context of this examination of whether (AMH) practiced cannibalism, however, it is relevant. Schaller and Lowther were interested in non-human carnivorous predators' hunting patterns and degree of successful hunts in order to evaluate how efficient early hominid predation and scavenging had been. They showed how AMH's degree of success in hunting and scavenging influenced their evolution, particularly their fecundity and cerebral development. Schaller and Lowther also found that group hunting was more productive than individual hunting (*Ibid.*: 314), and that the relationship between group size and group territory was important (*Ibid.*: 319–322). Since human hunting and gathering societies are not completely dependent on meat for survival, there was probably little benefit for Paleolithic hunters in defending the territories in which they hunted.

Schaller and Lowther (1969: 312–315; 319–323; 325–329) made several other important observations: first, both carnivores and Paleolithic hominids probably had flexible band composition. Second, the extent of hunting domains determined band size; third, their degrees of success in both hunting and scavenging prey could not provide the large amounts of meat required for the female members of hominid hunting bands to be continuously fertile, and to ensure continued cerebral and cognitive development. Finally, neither hominid nor non-hominid predators could have survived solely by scavenging, so both scavenging and predation were essential for AMH's survival, mainly because his competitors for scavenged meat were numerous and efficient.

Haws (2004: 50–106) and Speth (1989: 329–343; 2010: 64–65), similarly, but from different viewpoints, questioned the assumption that AMH specifically targeted mammalian prey, because meat was a 'high quality' food. Speth even contended that the excessive protein consumption consequent on persistent and successful hunting would have had deleterious health effects on successful hunting societies (Hardy *et al*. 2022: 103105; Sack 2021: 34–35). This is because high percentages of protein in the human diet can be toxic, especially where water is scarce. Speth (2010: 66–68) also contended that lean meat is less nutritious than fatty meat, and that there was a degree of variation in the fattiness of animal prey successfully hunted by the Hadza.

The latter contention is important for our purposes, since it suggests an adaptive advantage for cannibalism, if Ubric's contention is correct. Again, in Africa, the ethnographic and archaeological data suggest that this requires more study. A study of the Aboriginal diet in Australia, bore out Speth's contentions (Smith and Smith 2003: 39–52).

Thus, AMH were part of a complex system of predation, scavenging, group composition, and territorial behaviour, which permitted them to survive and develop. Group living, Schaller and Lowther (1969: 315–316) thought, had both advantages (mainly the opportunity for young members to learn the most efficient scavenging and hunting behaviours), and disadvantages (mainly the requirement for relatively large quantities of meat, which made a sexual division of labour as critical for group survival as it was among non-human predators).

Regarding the significance of this for cannibalism, we may note that hunting (and consuming) hominid competitors in a shared territory, had both a major advantage (more food), and a major disadvantage (less trade and potential spouses). We cannot determine which was the

more important, but I tend to agree with what Dart thought (in discussions we had in his laboratory in the early 1960s): it was likely that *Australopithecus Africanus* preyed on the less-developed *A. robustus*, at least in Southern Africa. Similarly, more modern gracile Australopithecines in Central and Eastern Africa, may well have preyed on *A. bosei*. The fact that evidence for these behaviours is absent, requires more investigation, but suggests that cannibalism may not have been necessary in Africa, in order for hominin survival. It also suggests that since the AMH population was so small, co-operation rather than competition for food was more likely.

Several recent examinations of European Neanderthal sites containing evidence of cannibalism (Sutton 2022) raise the possibility that Neanderthal cannibalism was part of their violent social behaviour, since not all osteological relicts with signs of breakage were consumed. Gat (2015), for example, argued that intergroup violence was prevalent among many hunter-gathering societies reported on during the last 150 years, as well as in many of the Neanderthal groups reported on in the professional literature. Both Sutton and Gat were wary of concluding that cannibalism followed inter-group violence, however, and tended rather, to stress that injuries resulting from violence show, in both prehistoric and historic societies, that hunters, gatherers and agriculturalists fought over territory that they needed for survival. Gat (2015: 113) even made the unexpected observation that in some recorded instances of intergroup violence in 'traditional societies,' a higher percentage of woman were killed than men, and were frequently also abducted in raids (Gat 2015: 117–118). He ascribed these actions to the fact that 'women were another vital and inherently scarce resource under competition' (2015: 123).

This assertion, however, rests on an unproven assumption, namely, that women were a scarce 'commodity.' If this was the case, why were (and are) so many non-Western societies polygamous? Additionally, as Slater showed many years ago in her hypothetical model of AMH reproduction, women were likely to produce three surviving children, on condition that they mated with men from groups other than their natal ones (Slater 1959: 1042–1059). Moreover, contemporary birth statistics show that in most countries, female children outnumber male children at birth, and the sexual imbalance increases with age. In other words, men are the scarce resource!

Hortolà and Martínez-Navarro (2012), proposed an alternative hypotheses, namely that the numerous non-African sites excavated that revealed signs of violent death and cannibalism, were part of the

Quaternary Megafaunal Extinction, in which many large mammalian species simply disappeared, including the Neanderthals, who were probably hunted to extinction in a rapidly changing environment. The Quaternary changes, they hinted, made women foragers extremely important for AMHs' survival, without mentioning that they were in short supply.

Degioanni *et al*. (2019) argued that a small decline in Neanderthal women's fertility – of only about 4 %, – would have been sufficient to lead to their extinction in the face of competition with the cognitively and technologically superior *homo sapiens* colonizers of Europe. Bocquet-Appel and Degioanni (2013), refined this analysis by modelling a relatively small Neanderthal population in Europe (*cf*. Gilpin *et al*. 2013; Melchionna 2018). Thus, it appears that some of the bones with marks indicating butchery may have been instances of intergroup conflict, probably over food-producing territory, although cannibalism may have occurred.

SEASONAL CHANGES IN HUNTERS' FOOD SUPPLY

The !Kung draw our attention to an important point that is sometimes forgotten, namely that the availability of prey animals changes seasonally (Speth 1987: 22), so collections of animal bones in archaeological sites provide indications as to in which season they were hunted. It seems logical to suppose that after the breeding season in spring or early summer, the supply of animal food was at its most plentiful and hence most varied. As autumn and winter approached, there were both fewer prey animals and fewer different types of prey available, until most of them disappeared (*i.e*., migrated elsewhere to more clement climes) until early spring. The supply of plant foods, similarly also would have varied with the changing seasons. Europe was probably blessed with more varieties of plant food than Africa, and possibly more abundant large prey animals, including the auroch, which had no counterpart in Pleistocene Africa in terms of its size, apart from the elephant or rhino. The latter were not seen as prey animals either by the !Kung or the Zulu, whom I studied between 1970–1978.

At the same time as prey animals increased in types and numbers, so the predator populations must have increased and decreased seasonally. The African predators and more particularly pack hunters like hyenas, African Wild Dogs, and lions were probably more dangerous competitors than most of the European predators, because of their relatively high kill rates. In contrast, solitary predators like leopards, cheetahs, civets and other large feline hunters, who were less efficient, nev-

ertheless increased the competition with human predators in a fashion similar to sabre-tooth tigers in Europe. Finally, the scavengers in Africa and Europe while similar in some respects, especially hyenas, jackals, leopards, vultures and buzzards, would have taken their toll of hominin-killed animals, perhaps more so in Africa, where their numbers are (and probably were) substantial. The author observed a mature kudu stripped of meat by scavengers in as brief a period as 30 minutes, so pursuing hunters would have had relatively meagre pickings. These factors suggest that hunting as a way of life exerted strong evolutionary pressures on early hominin hunting societies (Garriga *et al*. 2016: 19–26).

I would also venture to suggest that eating fresh water fish in Africa was probably less common than in Europe, as many African fish live in muddy water, and are consequently less palatable than European fresh water fish. This may partly explain why most South African Bantu-speaking tribes have taboos on eating fish, notably the Zulu. Finally, in Africa there are dangerous predators that make riverine fishing more hazardous than in Europe, notably crocodiles, and the hippopotami, which, while not predators, are territorial, aggressive and dangerous.

The Thonga are a neighbouring tribe of the Zulu, whose diet is markedly different to the Zulus': the Thonga ate both a lot of maritime fish, and legume soup, and the most visible testimony to these items' nutritious effect, was the absence of the protuberant bellies and reddish tint to the hair so common between 1970–1978 among the Zulu. The Zulus' malnutrition was due to rural poverty and the absence of most family heads at work during the ploughing season. Since Zulu women could not handle cattle, this meant that nutritious traditional foods were not cultivated, and were replaced by an exceptionally high carbohydrate diet, principally composed of bleached maize, purchased from White traders.

NUTRITION

Human nutrition is an exceptionally complex subject, that requires an interdisciplinary approach, and so some of the common assumptions we have discussed above will probably require modification. A particularly clear explication of the complexity of human nutrition and food requirements is that of Leonard (2012: 251–324). Additionally, the increasing use of ethnographic studies of extant hunting and gathering societies elucidate the evolutionary implications of an overly rich protein diet, subject to the caveat, of course, that their contemporary behaviour is probably more the outcome of their being pushed out of

their previous hunting preserves as a result of colonialization and the modernization of contemporary agriculture.

It is important to remember that high carbohydrate diets are not necessarily bad, despite what is commonly thought today. The fact is that carbohydrates constitute between 3 % and 50 % of the diets of many contemporary hunter-gatherer societies, but this did not prevent them from surviving several thousand years on such diets. Thus, we may conclude, carbohydrates are not necessarily 'bad', depending on their constituent elements, especially if their source is natural, as opposed to processed carbohydrates (Ströhle and Hahn 2011: 429–435). There is also an interesting 'relationship between carbohydrate intake and different ecoenvironments' (*Ibid*.: 433), with moderate carbohydrate intakes characterizing forager diets at latitudes between '11°–40° north or south of the Equator' (*Ibid*.: 433). Low carbohydrate diets characterized forager societies north or south of these latitudes, with meat being the major food consumed there (*Ibid*.: 433). The authors concluded that it appeared that low carbohydrate diets developed at these latitudes 'late in human evolution (*i.e*., between 46,000 and 7,000 years ago)' (*Ibid*.: 433).

In Paleolithic East Africa, Ubick (2016) argued that a species of AMH developed, which had the ability to store the excess body fat necessary for reproduction. This thesis is developed further below; here, we may remark that carbohydrates provide the human body with more fat than meat does, so a mixed foraging-hunting diet would reduce the necessity for cannibalism as a survival strategy. Since humans are 'limited in their capacity to convert protein into energy', it has been suggested that Neanderthal man developed

> a 'bell' shaped thorax and a wide pelvis … at least in part, as an adaptation to a high protein diet. A high protein diet created a need to house an enlarged liver and urinary system in a wider lower trunk (Ben-Dor *et al*. 2016: 357–368; *cf.* Ben-Dor *et al*. 2021; 1–30; Brand-Miller *et al*. 2015: 252–268; Carrera-Bastos *et al*. 2011: 15–35).

An enlarged liver was required to process the high percentages of protein in the Neanderthal diet, as after metabolizing the protein into energy, the waste had to be eliminated. Because of the severe winters in North America and northern Europe, there was probably less vegetable protein available then than in Africa, hence the protein-rich meat diet required anatomic and metabolic physiological changes. The authors also made the important point, often forgotten, that the Neander-

thals probably also prepared quantities of preserved meat for the winters, in the form of pemmican, to replenish the decreased fat they got from their prey from winter hunting. Similarly, the !Kung of Namibia sun-dried excess meat to make 'biltong' from hunts for 'snacks' when it was too hot to hunt (Gerald Sack, Unpublished Research Notes, 1970-5), but this was a minor part of their diet. Another source has attributed the persistent increase in Type 2 diabetes to modern dietary changes from high protein to high-carbohydrate diets, for example (Brand-Miller *et al*. 2012).

Obviously, the nature of the environment influences hunting and foraging: Kurland and Beckerman (1985: 73) contended that the exchange of information between foraging hominid groups was important in the African savannah, which was a 'patchy environment', and consequently, '… selection would have favored increased gregariousness and cooperation on the part of early hominids' (*Ibid.*: 73). If this contention is correct, we may broaden it for our purposes, to suggest that these behavioural traits would probably have reduced the necessity for cannibalism, at least in east Africa.

A final type of competitor for food in Africa that was probably less significant in late Pleistocene Europe, was the large number of rodents, foxes, pigs, large mammals like elephants, rhinos and hippos, which seem to have existed in smaller numbers in Europe. In sum, we can be reasonably sure that the late Pleistocene hunting hominins that survived must have been efficient hunters and gatherers and possessors of a remarkable degree of behavioural adaptability and development. Given the competitive constraints mentioned above, occasional cannibalism would have provided both additional food and reduced the number of hominin competitors in a specific area. This is also the conclusion of a chapter of Mussini's (2011: 226–246) doctoral thesis in *Anthropological Biology*, which is the most comprehensive and meticulous treatment of cannibalism I have encountered to date.

Human flesh falls in the mid-range of mammalian stored body-fat, so there would be no adaptive benefit to persistent cannibalism (Wells 2006: 184–185). I would venture the guess, based on contemporary anthropological information on the intra-group killing of non-contributing members, that the consumption of group members who contributed the least to the communal food supply, would have been those most frequently eaten; for example, the Innuit and Chuckchi (Leighton and Hughes 1955: 328–329, 335). Willerslev (2009: 693), called this 'voluntary suicide'. Naturally, these examples derive from a lengthy

process of forced marginalization and acculturation of hunters, so parallels require carefully evaluation.

An often-forgotten final point regarding nutrition that needs to be made, is the fact that all foraging societies so far reported on cook their food and meat, because 'many plant foods are too fiber-rich when raw, while most raw meat appears too tough to allow easy chewing' (Wrangham, and Conklin-Brittain 2003: 35). It would therefore seem potentially fruitful for archaeologists to develop a way of establishing if human meat was cooked before being eaten: there may be specific signs on bones of having been cooked.

THE TYPE OF HOME BASE

A final possibly significant difference between African and European late Pleistocene hominin hunters is the type and location of their home bases. It seems that in Europe, though seldom remarked on, most hominin hunters lived in caves, while in Africa many lived in the open in simple shelters, and relatively few in caves. The early South African australopithecines, especially *A. africanus* and *A. Sediba*, were cave dwellers, but the relative scarcity of the remains of *homo erectus* and *homo ergaster* suggest that they lived in the open. The reason could have been that caves in Africa attract many types of predators, especially after the females have littered. Some of these predators, while not competing with man, are dangerous, like snakes, honey badgers, civets and large felines, while in Europe, the animal cave users were probably most commonly hyenas, wolves and bears. In addition, the hilly and mountainous areas where European archaeological research has been carried out provided the possibility of finding alternative caves if the ones first investigated were occupied. European caves are also often near permanent water supplies, while water sources are less frequent in Africa, where most prey animals congregate in the savannahs (plains), and relatively few are found in hilly and mountainous areas.

We may sum up this section as follows:

1. Since the late Pleistocene, AMH subsisted on hunting, scavenging and gathering, and so was subject to a wide variety of influences, competition and restraints in these three categories of subsistence activity. These influences, in turn, had nutritional – and hence reproductive – implications on his long-term chances of survival and population increase.

2. Competition with pack and solitary animal predators was probably more intense in Africa, where there were both larger numbers of species of prey animals and more predatory species than in Europe.

3. Given that Africa is far more arid than Europe, early Pleistocene African hominids may have been compelled to be more mobile than their European counterparts were, and so did not invest much time, energy or resources in developing and maintaining permanent home bases. Seasonal and climate factors, therefore, influenced not only the availability, but also the location of the preferred prey animals hunted and scavenged.

4. Among inland African hunters and scavengers, fish played a relatively minor part in their diets, while the excavated sites of prehistoric coastal groups show consumption rates of oceanic species, as high as European ones. The consumption of fish also seems correlated with cave residence. This may be because there were fewer *cervidae* species in seaside areas, to attract competing predators. A comprehensive survey of the function and availability of different dietary elements is clearly needed.

5. Since there are few reports of cannibalism among late Pleistocene hunters in Africa, it is likely that the previously mentioned factors and constraints may have restricted group size. This, together with the great variety of animal and plant foods available, made cannibalism less necessary than in Europe. Additionally, if the supposition that African late Pleistocene and subsequent hunters were very mobile, the likelihood that relics of cannibalism would have survived or been sufficiently concentrated, is clearly much lower than was the case in Europe. This may explain its relative absence.

6. The extent and richness of early hominins' knowledge of their prey and botanical larders has not received the same degree of attention paid to their hunting. For example, the San identified close to 200 different types of potential faunal and animal food, but only consumed about 40 of them regularly (Lee 1968: 35). When I was in the area several years later, the situation was the same (Gerald Sack, Unpublished Research Notes, 1970). Paleoarchaeologists can only infer things from the refuse that survived to be excavated and analyzed. At least part of the plant foods collected by hunters were consumed during hunts, hence traces of them do not appear in large quantities in excavated sites.

BODY FAT AND FERTILITY

If groups had sufficient food to survive, cannibalism would have been unnecessary, as abundant food would have promoted food collection and tool-making specialization, as well as ensuring the sociological adaptations necessary to optimize hunting and gathering, activities

that unfortunately do not leave traces. Therefore, a wide range of cognitive, motor, linguistic and symbolic abilities, as well as improved reproductive capabilities have not left their traces. Howell (1979) argued that the percentage of females' body fat significantly influenced female fertility. This seems an important selective factor: those females who collected or hunted most efficiently would be those most like to bear children. Ubick (2016: 3) also argued that

> Across cultures, lean women carry almost twice as much body fat relative to total body mass as lean men of the same age, weight and height (*e.g.*, Brown and Konner 1987). Female fertility is contingent on body fat stores (*e.g.*, Frisch 1983).

Ubick's thesis is that *homo sapiens*, before migrating to Europe, had developed the ability to accumulate large deposits of body fat, even in inclement environmental conditions. Brown and Konner estimated that women have almost twice as much the amount of adipose tissue then men do (1987: 31–32). They also argued that both hunters and gatherers and agriculturalists suffered from frequent food shortages (Ubick 1987: 36–38), which show that accumulating excess adipose tissue was an important survival adaptation, especially in women, since it impacted on their fertility, lactation and the survival chances of their infants (Ubick 2016: 38–39), and hence also on group survival. Frisch contended that women require at least 17 % by weight of body fat in order to have their menarche, and thereafter at least 22 % body fat to ensure regular ovulation (Frisch 1983).

Ubick argued that AMH with the ability to store excess adipose tissue originated in East Africa 75,000 years ago, in the Upper Paleolithic (2016: 2–5, 6–7). While nearly all mammals are able to store fat, she argued that only AMH had the ability to do so in inclement conditions, such as major climatic and ecological changes (2016: 14–16). Since female body fat is a prerequisite for pregnancy and suckling, Ubick argued that the ability to store fat even in inclement conditions gave AMH an adaptive advantage by being able to increase its population in difficult conditions. Since the Neanderthals lacked this ability, *Homo sapiens* simply 'outgrew' the Neanderthals and replaced them in Europe (2016: 14–18; Lieberman 2013: 151). Lieberman reminded us that in the Upper Paleolithic period, new foods were added to the hominid diet, like fish, shellfish, small mammals and birds, which could be collected by even young children. It needs to be remembered, however, that the assumption that hunters and foragers have to work

hard for a living is erroneous: Lee (1968: 37) observed that the !Kung, for example, worked only about 4 days a week, and I observed even less, even though it was during the sixth or seventh year of a serious drought.

Moreover, since 65 % of the brain is fat (Ubick 2016: 18–19; O'Brien and Sampson 1965: 543–544), the ability to store larger amounts of fat in the AMH body, also influenced cerebral and therefore cognitive development, which were further important adaptive benefits. Additionally, as just argued, stored structural fat is necessary for sexual maturation, the menarche and ovulation. Human females store much more fat in their bodies than males. This determines their reproductive potential, irrespective of climate, ecology and individual variability (Ubick 2016: 19–21). This fat enables them both to carry their foetuses to term, and to develop the brain and nervous system of the foetus (Ubick 2016: 22). Breast-feeding is costlier in terms of women's stored fat (energy, in other words), than gestation (Ubick 2016: 22–23). This may be the reason that many instances of cannibalism note the probable consumption of brain tissue, which is the fattiest part of the human body. Finally, high levels of maternal stored body fat mean that their new-born infants are more likely to have high birth weights, and hence a higher survival rate than infants born to mothers with relatively low levels of stored body fat (Ubick 2016: 23).

The data just cited show that Slater's model of 'primitive' reproduction mentioned in my previous article, was grossly under-optimistic, if Brown and Konner's and Ubick's nutritional estimates are valid. For our purposes, namely to evaluate whether cannibalism was a viable strategy in the late Pleistocene, the answer must be that it was quite likely in certain conditions, but probably physically unnecessary.

Ströhle and Hahn (2011: 431) observed that hunters in desert or tropical grasslands consumed the least carbohydrates, because their meat consumption was probably higher than that of European hunters. They theorized that this led to European hunters being less susceptible to '… many chronic and nutrition-related degenerative diseases, such as obesity, type 2 diabetes mellitus and coronary heart disease' (*Ibid.*: 432–433). At the same time, they pointed out that at latitudes above 40 degrees north or south of the equator, fewer carbohydrates and more animal protein were available to contemporary hunters and gatherers. This was '… was mainly a consequence of temperature effects on primary biomass (a measure of the productivity of a given habitat)' (*Ibid.*: 432–433). This seems rather naïve and deterministic: as anyone

who has lived for even a short time with hunters and gatherers will have noted, individuals' preferences for specific foods guide their hunting and collecting strategies no less than their need for food. That is, they hunt and gather selectively as much as possible, given the climatic constraints and conditions. We may, however conclude that there does seem to be a marked preference for meat, both for its taste, high nutritional value, and because hunting is a status endowing activity, open only to men.

Thus, there are several important aspects to the Paleolithic diet: first, the importance of carbohydrates for abdominal fat secretion to promote and ensure women's fertility. Second, to ensure persistent ovulation, and third, to ensure timely menarche, a mixed diet was essential. Fourth, in different environments, the contribution of carbohydrates varied according to the climatic conditions, which explains their differing rates of consumption at different latitudes. Fifth, since meat consumption was highest in grassland regions, especially in 'desert grasslands', increased meat consumption in these areas might well have been necessary, given the high amounts of energy expended in hunting. For example, the !Kung hunters could spend two hours running down a relatively small antelope in temperatures well above 35 degrees Centigrade (Gerald D. Sack, Unpublished research Notes, 1970).

Similarly, women's gathering activities, especially during the hot summers, was also physically arduous, involving digging up to a metre down for water-rich roots, thus expending a lot of energy for a gain of relatively few calories while collecting rare desert berries. The !Kung had an important fairly accessible calorie-rich resource in the form of *mongongo* nuts, which were easy to collect. In short, they consumed a lot of meat simply because that was their optimal survival strategy. This, if Ubick, Brown and Konner, and Frisch are right, would have depressed women's fertility, in the relative absence of excess vegetable carbohydrates in their everyday diet. This would have made periodic cannibalism a potential survival strategy whenever there was a lack of prey animals.

Bearing in mind that in the Kalahari Desert a 'drought' is up to 12 years without rain, it is surprising that there have been no reports of cannibalism among the !Kung, even given the fact that animal and avian scavengers abound and are extremely efficient in decimating carcasses. The Sans' practice of infanticide, however, is well-known: if a woman falls pregnant during a prolonged and serious drought, she will frequently choose to abort the foetus, or, if she is near term, will

kill the newborn. This is because, as it was explained to me, the mother does not know how long the drought will continue, and is well aware of the fact that the consequent physiological stress of undernutrition, will probably prevent or shorten lactation. It is therefore more humane to kill the newborn, than to have him die later. Additionally, the !Kung were well-aware of the deleterious effects of suckling a baby only to lose it due to lack of milk. It is interesting that they never raised the possibility of cannibalism as a possible stopgap. Finally, Ströhle and Hahn (2011: 431), noted that

> … the energy derived from carbohydrates in the diets of most hunter-gatherer societies was markedly different (lower) than the amounts recommended for healthy individuals [today].

Since non-archaeological evidence on cannibalism (including travelers' tales and anthropological accounts collected from informants), is less reliable than other sources, this section concentrates on paleoarchaeological sources, with other sources used to illustrate or support the former. Most evidence regarding Paleolithic cannibalism derives from the types and location of the microscopic features of cut marks on bones associated with butchering for consumption purposes (Bello *et al*. 2016: 722–743; Cole, n.d.). After reviewing postmortem cut marks on human bones in four archaeological sites, the authors of a recent paper ascribed 25 % of the cut marks at Atapuerca in northern Spain to cannibalism (*Idem*; White 2001: 91). Bello *et al*. (2016: 722), concluded that

> A distinction between cannibalism and secondary treatment of human bodies can be made based on frequency, distribution and micromorphometric characteristics of cut marks.

To these words, I would add also the significance of the location of cut marks, since dismembering a corpse in order to consume it, would probably be rather different from ritual defleshing. For example, if the brain or long arm and leg bones were consumed, they would show concussion marks of the blows to the cranium to open them up, which would not be the case in some of the other postmortem modifications to corpses (*cf*. Bello *et al.* 2016: 722–724). Bello *et al* ascribed 65 % of the human remains with signs of defleshing or gnawing in Gough's Cave in the UK and in three sites in Serbia to cannibalism (*Idem*: 722). Carbonell *et al*. (2010: 539–548) suggested that there were signs of persistent cannibalism over time on several European

sites, with signs of cannibalistic cuts and bone-smashing on between 10–29 % of the bones recovered. So, they concluded that in the Atapuerca caves in Burgos at least, cannibal was nutritional rather than ritualistic. Saladié *et al.* (2012: 682–684) reviewed cases of infant cannibalism from nine different archaeological sites and among chimpanzees, and concluded that the cannibalism was both nutritious (in the case of exocannibalism, and mortuary (in the case of endocannibalism). They also thought that exocannibalism was prompted by hunting competition in overlapping ranges.

Rougier *et al.* (2016: 6) found several indications of cannibalistic consumption of femurs and tibias, which they characterized as 'the bones with the highest nutritional content (meat and marrow).' These were also the most frequently eaten animal bones, which raises the question whether the choice of what human parts to eat were instrumental, *i.e.,* the most 'profitable' parts of both animal and human prey (*cf*. Defleur *et al.* 1999, who contended that 'The assessment of cannibalism in a prehistoric context depends on the demonstration that faunal and hominid remains were subjected to similar treatment'). If so, this would suggest that the concept of 'ritual cannibalism' may need further consideration. There are also numerous indications that Anasazi cannibals ate human brains (White 2001: 92).

The timing of the signs of defleshing is also important: they may be immediately or soon after death, or after some decomposition, and the differences are observable and can be evaluated (Santana *et al.* 2019: 36; Bello *et al*. 2016: 723). It therefore seems logical to regard immediate postmortem defleshing as ascribable to cannibalism, if we assume hunting human prey for its meat. At the same time, it is possible that the defleshing could have been ritual. What probably would have distinguished, these two types of butchering, may have been the degree of violence: it is unlikely that mortuary butchering would have included violent damage to the corpse, such as smashing open the cranium, as ritual cannibalism would have taken place in an atmosphere of reverence or, at the very least, respect.

CONCLUSIONS

The material cited in this paper constrains the conclusion that late Paleolothic human's East African origin and fat-storing genetic mutation made cannibalism at best an extremely marginal likelihood, perhaps even only something to add some variety to their diet, and not by any means a vital necessity. This would also explain why there are so few reports of cannibalism in Africa. Moreover, we need to bear in

mind that because our Paleolithic ancestors were not very numerous, food shortages were probably unlikely or relatively rare, and even a small increase in AMH's reproduction rate would have enabled him to displace Neanderthal man from his place in our history, without the necessity of consuming him. Similar to Villa *et al.* (1986) early study, Cole's analysis of the nutritional value of human bodies led him to conclude that just as today incidents of cannibalism have complex motivations, so too, Late Paleolithic and subsequent forms of pre-*homo sapiens* probably also had complex motivations for their episodes of cannibalism (Cole 2017). Cole seems to plump for the simplest explanation, namely 'nutritional cannibalism' (see his table on page 3), giving us ample food for thought.

Finally, as Ubick suggested, AMH may have been in some way aware of the (survival) benefits of their mates' unique ability to store the largest amount of fat than any mammal, as witnessed by their Venus figurines, which gives them an added non-symbolic meaning.

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[*] The author is indebted to a Zulu informant for this insight, in response to the question 'What is the most important change in Zulu life consequent on White contact?' He pointed to the fact that most Zulu men in his district worked in cities, coming home mainly on their Christmas leave: 'Therefore we have the new phenomenon of October babies,' was his wry conclusion, 'instead of spaced births.' He was referring to the traditional Zulu lengthy suckling period of three years.

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