Early Homo Foodways: Habilis & Rudolfensis

INTRODUCTION

Before we move into the next stage of our evolution, with the emergence of the various Homo's, lets first reconsider our learning about Australopithecus, so we can maintain our sense of continuity. With the change in the climate and geography, towards more open and treeless terrain, we see that Australopithecus adapted by increasing the efficiency of his locomotion--thereby allowing him to cover more terrain and gather more food. At the same time, we see the morphological differences in his teeth and mouth, suggesting an adaptation to tougher and harder foods; and at the same time, we see his gradual and incomplete adaptation to more terrestrial foods in the form of seeds and tubers, which equates to switching from fruits to starches--and thereby consuming more glucose in the diet. At the same time, in the absence of more tender leaves, they may have started to consume more animal foods, especially marrow, brain and likely other animals as well, such as insects, turtles, shellfish and other animals.

While certain physiological changes may have occurred in their evolution, such as better adaptation to digest starches, it appears that their size, encephalization metabolism and digestion all stayed about the same as our common ancestor--and therefore the nutritional requirements probably stayed about the same as well. In other words, for millions of years, we basically stayed about the same as our common ancestor.

**Author Notes: There is now some evidence to indicate that brain expansion started long before the emergence of Homo--A. africanus at 2.5 million years ago (half million years before the earliest Homo) had ~23% greater endocranial capacity relative to modern chimps. A. africanus, and presumably other australopithecines, also appear to have already had some cortical reorganization within their brain to more closely resemble the human brain. This supports the theory that cortical reorganization preceded the major cortical expansion seen with Homo.

CHANGING ENVIRONMENTS & EVOLUTION OF HOMO

About 2.5 millions years ago, all of the Australopithecus became extinct when the environment started to change more dramatically. As the earth switched from the Pliocene to the Pleistocene, otherwise known as the Ice Age, Africa started to trend even more towards colder and dryer. While even more of the trees were disappearing, displaced mostly by grasslands, shrublands, savannah and even desert, it is important to note that pockets of trees continued to exist in certain areas. The environment also became even more unstable, fluctuating between colder and dryer, during the Glacial Maximums, and warmer and wetter during the Interglacials. During the Glacial Maximums, much of Europe was covered in glaciers, which sent hoards of flora and fauna south into Africa, creating tremendous strain and competition for resources. During the Interglacials, the climate became more like it is today.

Overall this instability was placing tremendous strain on living things, including the Hominoids, to constantly adapt to the changes--similar to the effects of Global Warming of our own times. In other words the environment changed even more from the proverbial Garden of Eden of most other primates, with most of the trees--and their traditional fruits, leaves and other foods--disappearing even more. However, it is important to note that pockets of trees evidently remained throughout Africa that could continue to harbor our ancestors.

EXTINCTION OF AUSTRALOPITHECUS

We have already guessed at what caused the extinction of the previous Australapithicus. At the beginning of the Pleistocene, the climate becomes colder, causing most of Europe to become glaciated which, in turn, drove more species into Africa, creating greater competition for limited resources; this in turn caused greater stress on flora and fauna, as many dispersed to other regions, became extinct or adapted in new or changed organisms. Most mammals during this time tended to become considerably larger so while the Hominoids stayed about the same size, their predators became larger and perhaps even more abundant. When all this happened, the Bosei and other C4 feeders probably became extinct due to greater competition, perhaps even from grazers, for tubers, seeds and corms and greater predation; they may have lost some of their staple foods as well. Many of the C3 feeders, still dependent upon the trees, saw even more of their terrain disappear and this in and of itself caused some degree of extinction.

But then one or more of these Australapithicus, probably one of the ones already feeding in the trees, settled into some select areas that were still forested. However, with all the changes, they were still not adapted to survive: they still may have had greater competition and predation both on the ground and in the trees. Furthermore the nature of the trees may have changed: perhaps, for example, the trees produce more nuts and fewer eatable fruits or leaves: or perhaps the fruits became smaller and tougher, forcing them to adapt new and different ways of gathering and processing their food. At the same time its conceivable that during their time of development into another species, they encountered numerous fluctuations in their environment, from warm to cold and back again, that may have altered their food supply.

As we have seen nearly all of the Australapithicus were dependent upon the trees, both for food and protection from predation, so when they started to disappear, the Australapithicus were probably finding it difficult to cope. Though an improvement upon knuckle walking, their bipedalism was probably not efficient enough to help them travel the distances between their splotches of food. And they may not have processed the intelligence to track and find their food over these larger territories. Furthermore, with fewer trees, they were all the more subject to predation--even the ones, such as the Paranthropus Bosei, that consumed greater amounts of foods outside of the trees. Finally, as the environment was likely creating increasingly tough and hard foods, they probably did not have the jaw and gut morphology to process these foods--even with their wide molars thick with enamel. They may, too, have faced greater competition from other animals, including the next line of Hominoids, for the same food resources. In other words, they were losing the energetic equation--and likely became increasingly weakened, then subject to predation--and eventually extinct.

However, one of them likely evolved into another Hominoid--the first of what we call the Homos, which was likely Homo Hablis. While scientists may have some ideas about which of the Australopithecus evolved into Homo, we just do not have enough data to say for certain; but it was likely one of the Australapithicus was east Africa, because that is where the Homo's emerged.

In this section, we will be discussing various forms of Homo in the approximate order in which they likely evolved: Homo Habilis, Rudolfensis, Erectus, Heidelbegenesis, and Neanderthalensis, before we finally arrive at Homo Sapien in future sections. But for now we are concentrating on the two Hominoids, Homo Habilis and Homo Rudolfensis. Though these Hominoids are extremely important in understanding our evolution, since they become the first of the Hominoids to really define ourselves--that is, as creatures with larger brains who likely regularly used tools, we nonetheless know little about them, because the fossils are so scarce and broken; For Hablis, for example, we have one relatively complete cranium, some other pieces of three craniums, one lower jaw and some pieces or arms and legs; for Rudolfensis, we have even less. At the same time, debates abound around how to precisely classify these and other future Homos; but, for the sake of clarity, we will stay away from these arguments.

HOMO Habilis & Rudolfensis

ENVIRONMENT
Habitats of Paranthropus & Homo ~3-2.5 million years ago

From about 4 million to around 2 million years ago there is a widespread shift from closed to more open habitats. Thus when the hominins known as Paranthropus and Homo appear sometime between 3.0 and 2.5 million years ago, they are confronted with a habitat in flux composed of more open habitats then has yet been inhabited by the hominid lineage. During the time period before 2.0 million years ago these two hominids exploited the open woodlands, bushlands and shrublands often accompanied by wetlands that had come to characterize parts of Africa. These habitats came with large river and lake systems that would have helped to supply water in the dry seasons.

While Africa was becoming increasingly treeless around two millions years ago, with the advent of the Pleistocene, these early Homos, paradoxically, were the last of the Hominoids to stay designed for the trees. As such we can assume that they may not have inhabited Africa at large with all of its grasslands but only smaller pockets of terrain where trees continued to thrive. At one or even several points in the prehistory of Homo Sapiens, we were only able to inhabit small parts of Africa, like certain parts of East and South Africa--and unable to survive in the harsher and drier conditions that settled over the rest of Africa. Its conceivable that early Homo was in this same situation; in fact the evidence, though slim, does support this; for example we do not find their fossils scattered about Africa but only in certain places and at least one of those places. Furthermore, when scientists have conducted chemical studies on what's called the soil and vegetation analogs from regios where Australapithicus and early Homo thrived, they concluded that their environment was not grasslands but rather "riparian forests" or "grassy woodlands."

Evidence: “Interpreted with reference to modern East African soil and vegetation analogs, carbon isotopic ratios indicate a 1 km2 area near HWK and FLK in the eastern paleolake Olduvai margin supported a riparian forest to grassy woodland ~ 1·74 Myr ago. Stone artifacts and hammerstone-fractured bones are abundant across the waxy claystone paleosol, which corresponds to level 1 at HWK-E. Isotopic evidence from this preliminary study (including FLK Zinjanthropus) suggests Plio-Pleistocene hominids in East Africa may have preferred relatively closed woodland habitats that may have offered food, shade, and predator and sleeping refuge.” (Sikes, N.E. 1994).

SENSES

The acute vision of primates would not have been as useful for detecting predators on the open savanna. A developed sense of smell, present among most other savanna dwelling mammals, would have been more helpful. “About ten million years ago, the forests in Africa began to recede with climate change, forcing many species of apes and monkeys to adapt to open grasslands where predators abounded (to a much greater extent than is the case today). The savanna was, and still is, a dangerous place for a primate for a number of reasons. First, primates are not built for speed but for moving about in the trees; hence, they can easily be run down by predators. Second, primates’ sense of smell is attenuated and without a powerful olfactory bulb, they cannot detect predators as can all other mammals that have been able to survive on the savanna. Indeed, primates with their visual dominance will have trouble seeing danger lurking behind tall grasses or other obstructions; and so, the acute vision of primates is much less useful than a strong sense of smell that can pick up airborne chemical emissions from hiding predators.” (Turner, J.H. 2010).

“Now, if we imagine the first hominins that sought to adapt to a parkland or savanna environment…What challenges did they face? One drawback was a dominant visual system that evolved for life in the trees, whereas most ground-living mammals are olfactory dominant because it is automatically self-alerting and superior for detecting predators and prey at long distances by their enduring scents. In contrast, vision is inadequate for long distance perception in open terrain as it is not automatically alerting (as smell is) and often preoccupied with routine tasks, and it is useless after dark for detecting night predators, such as large prowling cats or snakes hiding in the grass. Yet it would take an act of evolutionary gymnastics at this late stage of hominin evolution to change a visually dominant primate into an olfactory dominant one.” (Franks & Turner 2013).

LOCOMOTION & MORPHOLOGY

Early Homo—Habilis, Rudolfensis—Morphology & Locomotion:

In many ways Habilis was quite similar to the Australopithecus and the Chimps--that is, he was about the same size with similar dimension in his arms and legs. So while he was bipedal, he was probably equally as good at climbing in the trees as the Australopithecus; and therefore still dependent upon the tree for his survival; for this reason, we do not have any reason to believe that Habilis was anymore efficient or faster at traveling over the earth.

Many scientists tend to believe that Rudolfensis was similar to Habilis. They both lived in Eastern Africa in grasslands at about the same time though and likely maintained a morphology that made him adept in the trees and also bipedal for moving over the land. As we shall see later, we have reason to believe that they likely inhabited different, environmental niches.

However, while Habilis is predicted to be about the same size as Australopithecus, we do not have ample fossils to predict the size of Rudolfensis, though we have some reasons to believe that he may have been larger.

But even if they were inhabiting the trees, we still need to wonder how they were using them. With Australopithecus we saw all sorts of arrangements, where some versions were both sleeping and eating in the trees while others, such as the Bosei, were likely still sleeping in the trees but gathering their food from other sources. With Hablis and Rudolfensis, they were most likely still sleeping in the trees because despite their greater intelligence and the possession of sharp rocks and maybe some other weapons, they were still vulnerable too sleep on the ground amidst the giant predators that roamed through Africa during that time.

Meanwhile, too, I would imagine that early Homo, given his more challenging environment and his larger brain, was more migratory if needed, switching from one terrain or geography to another, depending upon the availability of foods--a pattern that we see even with Paleolithic Homo Sapien.

"The earliest fossils assigned to the genus Homo are harder to assess, largely because the record of post-cranial anatomy is poor; there are few examples in toto, fewer still that can be reliably assigned to an individual, and few complete examples of individual bones, requiring that measures of relative limb proportions be made from estimated lengths (Haeusler & McHenry 2004; McHenry & Coffing 2000). Nevertheless, studies of early Homo indicate that its post-cranial anatomy was much like that of an Australopithecus. It, too, retained features of a climbing anatomy, though it may have been more human-like than the australopithecines (Haeusler & McHenry 2004). Complicating the picture is the likelihood that there were two species of early Homo in Africa between 2.5 and 1.8 Ma. One, Homo rudolfensis, may have had a more modern post-cranial anatomy, if an isolated and fragmentary humerus is a reliable indication (McHenry & Coffing 2000). Both forms continued to live in the wooded environments favoured by earlier hominids, though they may have occupied a wider range of specific habitats (Reed 1997)…There is, however, no reason to conclude that Homo habilis and rudolfensis had given up sleeping in trees." (Coolidge & Wynn 2006).

CAPTURE

PLANT FOODS

"Nevertheless, craniodental remains of Homo habilis, H. rudolfensis, and H. erectus offer some clues. For example, there appears to be no simple transition from an australopith to a Homo grade of dietary adaptation, or from closed forest plant diets to reliance on more open-country plants or animals. Early Homo species more likely had adaptations for flexible, versatile subsistence strategies that would have served them well in the variable paleoenvironments of the African Plio-Pleistocene." (Ungar, Grine, & Teaford 2006).

VARIED DIET

But despite the trend we see with Australopithecus towards greater reliance upon C4 foods as time progresses, early Homo does not appear to support that trend. Based on all the various forms of analysis, it seems likely they were eating both from the trees and the ground and otherwise exploiting as many different foods as possible during times of increasing change, stress and competition. Indeed most researchers believe that when we transitioned from Australopithecus into early Homo, we did not so much switch from one type of food to another, or start to specialize on any particular food; instead we just became better at diversifying out diet through greater intelligence and perhaps locomotion--which allowed us to survive changing environments by including greater variety of foods--which increases the amount of nutrition available overall. As we have seen, too, many species chose varied diets in part to avoid consuming too much of any one particular plant toxin and otherwise to balance their needs for nutrients, such as sugars and the variety of fatty acids and amino acids needed to sustain them.

But we also need to ask the question: if that is indeed the case, if we basically maintained the same foodways and even lifestyle as Australopithecus, why did we just not stay Australopithecus: Why did we evolve the larger brain. Since this is the first time perhaps in the history of the earth that some creature became more encephalized than the Chimpanzee, it is indeed one of the greatest questions of all time: what started the chain towards our greater intelligence. As we have seen, evolution in many ways is not particularly kind; in fact, quite cruel in many cases and we can assume that something happened in the environment that started to kill off the Australopithecus and the only way that at least one of them could evolve was by becoming smarter.

The analysis on the microwear on the teeth suggests that these Hominids did not specialize on any particular foods or plants--but ate a varied diet. But microwear studies could be misleading due to the possibility that Habilis was using tools to process plants before he put them into their mouth--which could affect the way the food wears the teeth. Overall the humble opinion of the researches at the moment, which we all acknowledge as based on limited evidence, is that the diet of Hominids did not radically change, during the transition from Australopithecus to early Homo, but stayed approximately the same with equal reliance upon the trees as some Australopithecus and even more than some others.

AUTHOR NOTE because have different teeth and all, Habilis & Rudolfensis definitely inhabited different ecosystems:

Its teeth appear to be different from Habilis--and thus suggestive of another diet, which, perhaps, explains why scientists tend to define him as a separate species. He had teeth that were more similar to the Australopithecus--that is, the molars were still quite large, probably still used for grinding; however, its muscles for chewing were not as developed and the molars had more contour on them--all of which suggests some dietary adaptation from any one of the Australopithecus. Further analysis reveals that while Habilis teeth were less flat, with more contour and ridges, that Rudolfensis had teeth that were smoother and flatter and worn more horizontally just like Australopithecus. Limited studies have suggested that he ate both plants and small amounts of animals. In the end, for our purposes and based on the limited evidence, we can just think of the Rudolfensis as being like the Habilis, except that his teeth and perhaps his face were more like Australopithecus--which is why he is sometimes referred to as the Australopithecus with the larger brain.

We would all, of course, love to have some access to the analysis of c3 and c4 analysis on Habilis or Rudolfensis for that matter, to help us further explore the quandary of their diet. But unfortunately, as of now, we have little evidence due to the scarcity of the fossils and many of them not being suited for this sort of analysis, due, perhaps, to the lack of enamel still in good shape. At the same time, while some fossils have been tested that date to the time of these two Hominoids, we cannot identify the species of the fossil to say that it was indeed Habilis; it may have been some sort of Hominoid. However, the limited evidence available suggests that Habilis was still dependent upon C3 or tree foods, while clearly eating some C4 foods as well. As we shall see, however, the early Homos, starting with Erectus, gradually transitioned to more c4 foods.

HABILIS 23 TO 49 PERCENT C4—GRASSES AND SEDGES
HUGELY IMPORTANT…(van der Merwe, Masao, & Bamford 2008).
"By 2 million to 1.7 million years ago in Turkana, early humans, Homo, ate a 35 percent grass-and-sedge diet – some possibly from meat of grazing animals – while another hominin, Paranthropus boisei, was eating 75 percent grass – more than any hominin, according to a 2011 study by Cerling. Paranthropus likely was vegetarian. Homo had a mixed diet that likely included meat or insects that had eaten grasses. Wynn says a drier climate may have made Homo and Paranthropus more reliant on C4 grasses.

By 1.4 million years ago in Turkana, Homo had increased the proportion of grass-based food to 55 percent. Some 10,000 years ago in Turkana, Homo sapiens' teeth reveal a diet split 50-50 between C3 trees and shrubs and C4 plants and likely meat – almost identical to the ratio in modern North Americans, Cerling says." (University of Utah 2013 & Cerling et al. 2013).

**NOTE: More on specific C3 & C4 plant and animal foods that may have been available to early hominids and Homo Erectus—>Plant Foods.

ANIMAL FOODS

Early hominin diet included diverse terrestrial and aquatic animals 1.95 Ma in East Turkana, Kenya:
"The manufacture of stone tools and their use to access animal tissues by Pliocene hominins marks the origin of a key adaptation in human evolutionary history. Here we report an in situ archaeological assemblage from the Koobi Fora Formation in northern Kenya that provides a

unique combination of faunal remains, some with direct evidence of butchery, and Oldowan artifacts, which are well dated to 1.95 Ma. This site provides the oldest in situ evidence that hominins, predating Homo erectus, enjoyed access to carcasses of terrestrial and aquatic animals that they butchered in a well-watered habitat. It also provides the earliest definitive evidence of the incorporation into the hominin diet of various aquatic animals including turtles, crocodiles, and fish, which are rich sources of specific nutrients needed in human brain growth. The evidence here shows that these critical brain-growth compounds were part of the diets of hominins before the appearance of Homo ergaster/erectus and could have played an important role in the evolution of larger brains in the early history of our lineage." (Braun et al. 2010).

"The large accumulations (Table 1) from the late Pliocene at FwJj20 presented here provides the oldest evidence that the hominin diet included a broad array of high-quality food items, including numerous aquatic resources…Excavations yielded 740 identifiable fossil bones of which 506 were suitable for the investigation of bone surface modifications [i.e., fracture patterns, surface preservation (20, 21)]…The high frequency of epiphyseal elements (36%; 98 epiphyses: 172 shaft fragments), especially of size class 1–2 animals (30 epiphyses: 29 shaft fragments, including examples of avifauna) suggest that the assemblage is markedly different from the patterns of bone accumulation documented for carnivores that crush and digest bone (22). Moreover, the percentage of carnivore tooth marks on limb bone fragments at FwJj20 (1.9%) is well below experimentally determined thresholds (~67%) associated with carnivore-only accumulations (22) and even lower than the frequency expected for assemblages ravaged by carnivores after hominin processing of carcasses (~20%) (23)…Examples of percussion-fractured shaft fragments and bones with cut marks indicate that hominins at this site exploited terrestrial and aquatic mammals for meat and marrow, as well as the flesh of reptiles and fish (Fig. 3). The animals that these early tool users were accessing range from size class 2 (e.g., impala, suids) to size class 5 (e.g., hippopotamus, rhinoceros) animals (13) and also include crocodiles, turtles, and catfish (Tables 2 and 3). Evidence of marrow extraction is present but lower than experimental expectations (FwJj20: percussion damage = 13% of all modifications). This is partially attributable to the prevalence of reptiles, which do not have marrow cavities that are appropriate for marrow extraction. Yet excluding reptile and fish bones does not increase this percentage to within experimental frequencies [1% of mammalian number of identifiable specimens (NISP)]. Evidence for hominin modifications at FwJj20 indicates that at least 10 separate animals were butchered at that site. Cut-mark locations are consistent with the disarticulation of large animals (e.g., cut marks on the astragalus of a hippopotamus and the glenoid of a bovid scapula). In addition, cut marks suggest evisceration (e.g., ventral surface of the costal shield of a turtle (24) as well as the medial side of the rib of a rhinoceros) and flesh removal (e.g., cut marks on the palmar surface of a phalanx of a crocodile severing the tendons of the muscle mass on the palmar surface of the manus)." (Braun et al. 2010).

"Experimental and archaeological evidence suggests that butchery of smaller animals (i.e., fish, reptiles) is less likely to leave characteristic evidence of butchery (25, 26). Therefore, the location and frequency of modifications at FwJj20 is not sufficient to address whether or not this collection represents the result of passive or confrontational scavenging from large carnivores.

Hominins may have collected these elements from carcasses of natural death accumulations. However, hominins were clearly capable of accessing flesh from multiple carcasses. The percentage of hominin modifications at FwJj20 is lower than some experimental models of hominin butchery (27), indicating that hominins may not have been the only accumulating agent. However, the virtual absence of carnivore activity suggests that hominins were substantial actors of accumulation…The number and taxonomic diversity of hominin-modified bones imply that hominins used the FwJj20 locality for the acquisition of meat from several different carcasses of terrestrial and aquatic animals as well as marrow from mammalian bones. This provides strong evidence of a diverse animal component in the diets of hominins before the appearance of H. ergaster/erectus." (Braun et al. 2010).

"The butchery activities at FwJj 20 occurred in a well-watered environment. The dominant taxonomic families among the 347 excavated specimens identifiable to family level include Hippopotamidae, Bovidae, Suidae, and Equidae (Tables 2 and 3). The FwJj20 bovid assemblage is dominated by more water-dependent tribes such as reduncines and tragelaphines (42% of the bovid NISP). Of the suids, the brachydont form Kolpochoerus (cf. heseloni) is the most abundant genus. These fauna, in addition to other water-dependent genera (e.g., Hippopotamus, Hexaprotodon, and Crocodylus), indicate a well-watered environment at FwJj20." (Braun et al. 2010).

"The technological organization and artifact-mediated extraction of high-quality food resources found in the upper Burgi Mbr suggests that stone artifact manufacture was a significant part of the adaptive complex for hominins before H. erectus/ergaster. These data support inferences that suggest an increase in the diversity of dietary adaptations in Pliocene hominins (31, 32). The scale of butchery activities at FwJj20 contrasts with the isolated incidents of hominin carnivory recorded at other late Pliocene localities. The evidence from FwJj 20 indicates that hominins were very effective at securing access to a wider variety of high-quality animal tissues than has been previously documented…although animal tissues provide nutrient-rich fuel for a growing brain, aquatic resources (e.g., fish, crocodiles, turtles) are especially rich sources of the long-chain polyunsaturated fatty acids and docosahexaenoic acid that are so critical to human brain growth (2). Therefore, the incorporation of diverse animals, especially those in the lacustrine food chain, provided critical nutritional components to the diets of hominins before the appearance of H. ergaster/erectus that could have fueled the evolution of larger brains in late Pliocene hominins." (Braun et al. 2010).

"…a study by Stewart (13), who used criteria derived from analyses of Late Pleistocene fish assemblages to assess the degree of hominin involvement in accumulating the fish remains at five Olduvai Gorge sites. She examined site location, taxonomic diversity, the natural history of the species under investigation, skeletal part representation, and bone-surface modification, from which she concluded that early hominins likely played a role in accumulating fish remains at Frida Leakey Koronga (FLK) North-North Level 3, FLK-Zinjanthropus, and Bell's Korongo (BK). Between 80% and 90% of the fish present in these assemblages were catfish, which Stewart argued could be captured with little or no technology. Catfish spawn, often in great concentrations in shallow waters, can become stranded in shallow areas as seasonal pools and channels recede. They can then be gathered by hand, which means that they would have been readily accessible to early hominins (13, 14). Despite the thoroughness of Stewart's study, however, she lacked one definitive marker of hominin exploitation of catfish—cut marks on the bones…The analysis of Braun et al. (7) of the FwJj20 fauna provides the first definitive evidence that early hominins exploited catfish—through the presence of cut-marked bones. Turtle and crocodile remains, along with more commonly identified bovid, hippopotamus, and rhinoceros bones, also exhibit cut marks, indicating that, at FwJj20, hominins consumed a wide variety of terrestrial and aquatic forms. FwJj20 is located within the well-known Koobi Fora Formation along the eastern shores on Lake Turkana in northern Kenya." (Steele, T.E. 2010).

"Braun et al. (7) justifiably did not address whether the FwJj20 carcasses were obtained through hunting or scavenging. It is likely that the crocodiles, hippopotamuses, and rhinoceroses were scavenged, although soon enough after death that there was still flesh remaining. The mode of acquisition of other species, such as the catfish and turtles, is more ambiguous. They may have been scavenged or gathered live, because only minimal technology is required to catch them." (Steel, T.E. 2010).

"An important implication of the FwJj20 assemblage is that aquatic resources that require little or no technology to obtain may have been a regular component of hominin diets whenever the environmental circumstances were appropriate and that the evidence before 160,000 y ago may be sparse for reasons of geological context and preservation rather than human behavior. Alternatively, human diet may have changed significantly around 160,000 y ago when evidence for mollusk consumption begins to be more abundant (5). Routine consumption of fish other than catfish does not appear in the archaeological record until after about 40,000 y ago (1, 3) and may reflect changes in technology that allowed people to more regularly and efficiently capture fish from deeper and faster moving waters…The FwJj20 assemblage is significant for highlighting the dietary diversity of our early hominin ancestors. The challenge now is to determine if FwJj20 represents an Oldowan pattern or a unique occurrence, and if it signals a pattern, then it must be determined if the pattern persisted." (Steel, T. E. 2010).

PROCESSING/INGESTION

TOOLS

NOTES on early Homo:

—fingers intermediate between ape and man

At the same time, he had more dexterous fingers, which would provide him with more precision grip, and both of these characteristics combined together is why Jonathon Leaky gave him the designation of "handyman" when the fossils were discovered.

Habilis finger……

When Habilis was discovered decades ago, he was deemed the "handyman" by Leaky, based on the assumption that he used tools. While this is likely the case, we do not have any direct evidence of his use of tools but rather some healthy extrapolation. As we have already seen the

Capuchin Monkey, as well as many of the Great Apes, and especially the Chimpanzee, could use crude tools, such as sticks, spears, hammers and anvils to help them gather foods. Given that Australopithecus was equally as encephalized as the Chimpanzee and possibly even smarter in some ways, we somewhat safely deducted that they probably used tools as well. However, if Australopithecus did use tools, many of them may have been made of simple plant matter or stones--and, as such, evidence of their use would have faded into oblivion.
Rebecca Note: see evidence below—discovered stone tools dating to 3.8-3.0 Ma indicate that these tools could predate Homo. Australopithecines are believed to be the first to develop knapped stone technology, combining core reduction with battering.

Archaeologists have unearthed simple, stone tools that date back to around two and one half millions years ago; however, we do not have any direct evidence which Hominoid actually used these tools; it could have been Australopithecus and later Homo's. In any case, given that Habilis and Rudolfensis had much greater intelligence, combined with the more dextrous finger of Habilis, it seems safe that they used tools in the same way at least as Chimpanzees and reasonable to assume they likely used them in considerably more sophisticated ways as well. The earliest stone tools that date both to the time of Australopithecus and early Homo are defined as Odwallan; which basically means, some Hominoid had the bright idea to smash one rock against another rock creating flakes with sharp edges, which could then be used as tools and even weapons in the same way as carnivores use their sharp teeth; in some sense, an Odwallan tool is analogous to creating a sharp tooth outside of your mouth and, as such, it could be used to cut plants, kill and slaughter animals, as defend against predators and competitors from neighboring troops. Of course, given that our ancestors heretofore, were basically devoid of either sharp teeth or claws, with the possible exception of incisors, these tools provided some serious advantages and brought them higher onto the food chain--all of which we will discuss later in greater detail.

“By the time early Homo evolved, however, mechanical alteration of food likely became much more complex. Stone tools date to approximately 2.6 mya (millions of years ago) in the archeological record (Semaw et al., 1997), and may be even older (McPherron et al., 2010). Analyses of early Oldowan sites indicate that hominins used these stones extensively on meat and plant material (Keeley and Toth, 1981, Semaw et al., 2003, Dominguez-Rodrigo et al., 2005, Bunn, 2007 and Pobiner et al., 2008). Sharp edges on hand axes could have been used to slice meat and tubers into smaller, more easily ingested particles, while other Lower Paleolithic tools including spheroids, hammerstones and handaxes could have been used to pound or grind food. These different kinds of mechanical processing might have significantly reduced masticatory effort by reducing ingested particle size and tenderizing the food.” (Zink, Lieberman, & Lucas 2014).

“At first glance, it would seem that the near synchrony of appearances of Homo and the first stone tools and cut marked bones are connected, particularly in light of long-standing assumed associations between H. habilis and Oldowan artifacts (Leakey et al. 1964). However, there were at least three genera and four species of hominins in East Africa around 2.4– 2.5 Myr, and there is no way to know which one(s) was responsible for these artifacts. The earliest known cut marks, for example, are found in the same stratigraphic horizon as hominin fossils referred to “Australopithecus” garhi (Asfaw et al. 1999). Also, the earliest evidence for Paranthropus (Walker et al. 1986) dates to 2.5 Myr, and some scholars have suggested that at least P. robustus used durable, identifiable tools (Susman 1988, Backwell & d’Errico 2001). At this point, then, we cannot argue that durable tool manufacture reflects a new, unique adaptive zone that can help define and distinguish the genus Homo. Regardless of whether Australopithecus or Paranthropus left an archeological record, however, most would agree that one or more species of early Homo probably did make and use Oldowan tools.” (Ungar, Grine & Teaford 2006).

Author Note on Tool Use—Some evidence of stone tools dating to the middle Pliocene (~3.8—3.0 Ma), thus occurring before the appearance of Homo who has been traditionally associated with emergence of stone tool use. This stone assemblage has been named “Lomekwian” and predates Oldowan stone tools by 700,000 years. More on this in doc “Australopithecus & Ardipithecus Foodways” under “Intelligence”…

“Human evolutionary scholars have long supposed that the earliest stone tools were made by the genus Homo and that this technological development was directly linked to climate change and the spread of savannah grasslands. New fieldwork in West Turkana, Kenya, has identified evidence of much earlier hominin technological behaviour. We report the discovery of Lomekwi 3, a 3.3-million-year-old archaeological site where in situ stone artefacts occur in spatiotemporal association with Pliocene hominin fossils in a wooded palaeoenvironment. The Lomekwi 3 knappers, with a developing understanding of stone’s fracture properties, combined core reduction with battering activities. Given the implications of the Lomekwi 3 assemblage for models aiming to converge environmental change, hominin evolution and technological origins, we propose for it the name ‘Lomekwian’, which predates the Oldowan by 700,000 years and marks a new beginning to the known archaeological record.” (Harmand, S. et al. 2015).

“Conventional wisdom in human evolutionary studies has assumed that the origins of hominin sharp-edged stone tool production were linked to the emergence of the genus Homo1, 2 in response to climate change and the spread of savannah grasslands3, 4. In 1964, fossils looking more like later Homo than australopithecines were discovered at Olduvai Gorge (Tanzania) in association with the earliest known stone tool culture, the Oldowan, and so were assigned to the new species: Homo habilis or ‘handy man’1. The premise was that our lineage alone took the cognitive leap of hitting stones together to strike off sharp flakes and that this was the foundation of our evolutionary success. Subsequent discoveries pushed back the date for the first Oldowan stone tools to 2.6 million years ago5, 6 (Ma) and the earliest fossils attributable to early Homo to only 2.4–2.3 Ma7, 8, opening up the possibility of tool manufacture by hominins other than Homo before 2.6 Ma…Cut-marked bones from Dikika, Ethiopia20, dated at 3.39 Ma, has added to speculation on pre-2.6-Ma hominin stone tool use. It has been argued that percussive activities other than knapping, such as the pounding and/or battering of plant foods or bones, could have been critical components of an even earlier, as-yet-unrecognized, stage of hominin stone tool use21, 22, 23, 24, 25. Any such artefacts may have gone unrecognized if they do not directly resemble known Oldowan lithics, occur at very low densities or were made of perishable materials10.” (Harmand, S. 2015).

“Stone tools such as cores, flakes, and hammer stones allow paleoanthropologists to trace presumed butchery even further back in time than the examples from Olduvai Gorge. Recently archaeologists have pushed back the oldest known tools to the 3.3 million-year-old site of Lomekwi 3 in northern Kenya (Harmand et al., 2015). There was no butchered bone at Lomekwi, but the slightly older site of Dikika in Ethiopia has yielded possibly cut marked bone, but no artifacts (McPherron et al., 2010). The 2.6 million-year-old site of Gona (Semaw et al., 2003), and the 2.3 million-year-old site of Lokalalei (Roche et al., 2003; Delagnes and Roche, 2005) have yielded both stone tools and cut marked bone. It thus appears as if butchery was a component of hominin adaptations prior to the first appearance of Homo erectus 1.8 Ma (Anton and Snodgrass, 2012; Anton et al., 2014). The hominin evident at Dikika was Australopithecus afarensis, and the nearest time/space associated hominin for Lomekwi was Kenyanthropus platyops, another smaller brained form (Harmand et al., 2015). Thus, Australopithecus grade hominins were the first to develop knapped stone technology, and also the first to make a shift toward reliance on meat from scavenged carcasses.” (DeLouize, Coolidge, Wynn 2016).

“Homo erectus was not the first hominin to butcher animals for meat. 400,000 years earlier another group of hominins butchered animals at Olduvai Gorge. The site at FLK has famously yielded evidence for butchery of small to medium sized mammals, with an especially distinct focus on extracting marrow from long bones (Bunn and Kroll, 1986; Bunn et al., 2010; Dominguez-Rodrigo et al., 2011). Here the taxon of the butchers is not clear; the one fossil hominin recovered from the site was the skull of a Paranthropus, but many consider it to have been not the butcher, but one of the butchered. An early form of Homo, Homo habilis, occurs in deposits of the same age at Olduvai, and thus was the presumed butcher at FLK (Wood, 2014). Homo habilis used sharp flakes struck from lava cores to butcher meat from the scavenged carcasses, and the cores themselves to break open the long bones for marrow.” (DeLouize, Coolidge, & Wynn 2016).

Early Homo (likely Habilis or possibly Erectus) may have processed meat by pounding…pounding tools found at site dating to 1.75 million years ago…
“Earlier Homo processed meat by pounding (there is extensive evidence for pounding tools at the 1.75 Ma site of FLK (Mora and de la Torre, 2005)).” (DeLouize, Coolidge, & Wynn 2016).

There’s also evidence that Homo pounded bones to extract marrow: “Thus, bone marrow extraction activities carried out in Olduvai using percussion processes are well documented (Blumenschine, 1995; Bunn, 1989; Shipman, 1989). In fact, even the existence of bone anvils probably related to this type of bone marrow processing have been identified (Leakey, 1971; Shipman, 1989).” (Mora & De la Torre 2005).

Homo may have also used pounding tools to pound plant foods such as nuts and hard fruits, and to process other organic materials.:
“In this paper, we have speculated on a hypothesis linking percussion activities with carcass processing. However, this possibility also presents problems, because in some of the sites with more percussion objects such as TK, the bone evidence is very scarce. For this reason, it is

important to return to the discussion of chimpanzee technological activities related with nut-cracking. Thus, vegetal processing could be included as another hypothesis in order to explain percussion activities at Olduvai. In addition to the ethological analogy from the nut-cracking behaviour of chimpanzees, the archaeological example from Gesher Benot Ya'aqov—where there are nut seeds associated to anvils (Goren-Inbar et al., 2002)—are also available…Until comparative studies are carried out, it is possible to speculate that hominids at Olduvai were using the hammer-anvil technique for accessing fruits that, following some works (i.e., Peters, 1987), could be a very relevant resource in the Olduvai basin during certain times of the year (see also Blumenschine and Peters, 1998). On balance, a realistic explanation could be a combination of all these options, with hominids at Olduvai using the lithic material for breaking bones, smashing nuts and processing diverse organic elements. New comparative, experimental, residual analysis and use-wear studies are needed to give additional information about these processes. For the moment it is relevant to underline the absolute importance of percussion processes in many of the Olduvai sites." (Mora & De la Torre 2005).

"As Zihlman & Tanner (1978) noted, plants often account for 60%–70% of the human forager diet. Thus, tools may well have been used first to gather and process plants." (Ungar, Grine & Teaford 2006).

Reminder that Chimps use pounding tools—
"Remarkably, ethological studies (i.e., Boesch and Boesch-Achermann, 2000; Mercader et al., 2002, etc.) have underlined the significance of percussion processes amongst chimpanzees and the more than probable similarities with the archaeological record." (Mora & De la Torre 2005).

"Chimpanzee communities, both wild and released (ref. 7 and refs. therein), have been observed to engage in tasks whose by-products are pitted stones. In the evergreen forests of western Africa (7–9), chimpanzees were seen using hammers and anvils to crack open six species of nuts (ref. 7 and refs. therein). As those nuts vary in size, shape, and hardness, different approaches were needed to crack them open. The physical characteristics of the nuts, coupled with the type of bedrock and soil cover, were reflected in the choice of raw material—rock, wood, or root—and the size of the hammer and anvil used." (Goren-Inbar, Sharon, Melamed, & Kislev 2002).

GRINDSTONES

We should also consider the possibility that early Homo used stone or other tools that have not been discovered. For example we could hypothesize that, because early Homo was smart enough to make flakes, by crushing rocks into each other, he might be smart enough to make grindstones--that is, flat stones that you rub together for the purpose of grinding something into mush or flour--in the same way that Australopithecus used his large, flat molars. Through popular media and books, we are led to believe that grindstones were not invented and used until much later in time; from there, the media can then make the claim that foods like grains were not eaten until the Neolithic Revolution or sometime before--and therefore, we are not adapted to eat them at all. However, the claim is based on several accounts of faulty thinking. It's possible that grindstones were used much sooner, even millions of years earlier, and we just have not found the evidence yet. As someone once said, the absence of evidence is not evidence. Furthermore the evidence would be difficult to find as, in their crudest forms, grindstones are just regular, flat stones that could quickly lose evidence that they were once used for processing food.

We should also consider that these grindstones were used because, apart from being within the skill and intelligence of early Homo, they could explain, in part, the interesting correlation that begins to develop with early Homo--that is, as our brains get bigger, our teeth become smaller, likely not because we were necessarily changing our food choices--but more because we were processing our foods so much more outside of our bodies. For example, as we have seen, seeds are well-protected from predation by hard, indigestible outer shells so when animals swallow them, they start intact and are then shat out elsewhere to sprout. If any of us swallowed one wheat berry intact, we would see it in our stool many hours later. But through grinding, these outer shells would be shattered, in the same fashion as we shatter wheat grains into flour--therefore making the endosperm, the starches, proteins and fats, available to the reach of digestive enzymes. They could also apply this same process to roots, corms, nuts and beans for similar effect.

This grinding may have mimicked the process of the flat, wide and thick teeth found in the Australopithecus that then continued to some extent into early Homo, especially Rudolfensis. But its also possible that with the change in climate, these brittle and hard foods, like seeds, became increasingly harder and more encased in fibrous shells--so much so that they could not be eaten without risking tooth fracture even with huge molars; and teeth fracture, in an evolutionary environment still devoid of our human compassion, could easily result in death. It's also possible that this grinding, too, might have made other seeds, previously unavailable to even Robustus versions, now available, greatly enhancing the supply of food.

PLATES OF BOWLS

Though perhaps even though more farfetched, it's conceivable that early Homo, with his larger brain, could have used some sort of bowl or plate in the form of rocks, leaves or animal tissues, that may have allowed them to collect bits of processed, chopped and ground foods into one area for swallowing. Or they may have soaked foods in water into one vessel, such as some sort of shell or animal skin or hollowed log, which can make foods softer; even hard shelled seeds, like wheat, become softer. This process, too, can through chemistry begin the process of deactivating anti-nutrients and toxins and even germinate seeds which can make them easier to digest and more nutritious.

ADVANTAGES OF INTELLIGENCE AND TOOLS

Regardless of the specifics, the greater intelligence and tools would have helped these early Homo
in their foods in many different ways. Although Australopithecus, especially the Robustus (or Paranthropus) had really strong and wide teeth for grinding, its still nonetheless possible that

their teeth were not strong enough to access certain foods, especially considering that one cracked and damaged tooth could mean death. So if early Homo used tools more than his teeth to process his foods first, it could provide considerable advantages by allowing him to exploit certain foods, like grains, nuts, other seeds or roots, that were not accessible to Australopithecus.

FLAKES

But in addition to these tools, they had even more: namely their Odwallan tools, or sharp flakes. We do not have much evidence to know the answer to this question but we can make some reasonable hypotheses. In both the popular and scientific imagination, stone tools have been typically associated with hunting--or at least butchering, just because we have found animal bones, from various times in the past, that prove that Hominids used them for butchering animals. But, if they were using them on plants just as much, if not more, it would be difficult for us to know that, as plants do not survive the ravages of time. So, realistically, we need to be skeptical of the association between stone tools and animals. In fact, its hard to imagine early Homo using these flakes to hunt: its unlikely that they possessed the complicated technology to attach these flakes to shafts and, as such, it would be difficult to use them as projectile weapons. Also throwing these flakes, as you would rocks, probably would not make them meaningful weapons either. Furthermore, since early Homo could likely not run any faster or longer than Australapithicus, its unlikely that they could run down or otherwise capture other animals, at least consistently, and then kill them with these flakes. Furthermore primates like Chimps and Baboons seem plenty capable of just using their strength to kill their prey anyway, so these flakes would just prove redundant. So in short I cannot imagine a scenario in which these flakes make hunting all that more effective and reliable, though it may have provided some meaningful advantages.

Once animals were actually captured and killed, early Homo could have easily used these flakes to help them butcher and process the meat--which may have provided some advantages. But in the case of early Homo, I am not sure that using flakes to slaughter animals provided all that much advantage; as we have seen chimpanzees can eat their Colobus monkeys, and baboons their small antelope, without the use of flakes. I imagine that we humans, with our even smaller teeth and mouth, could somehow manage well-enough if you can tolerate the thought. Animal foods, too, are already softer and easier to chew than nearly all plants, which makes stone tools all the less essential. If the prey was larger, say about the size of a deer, these tools may have provided meaningful advantages for slaughtering--but it's hard to imagine early Homo as being able to hunt these animals with any regularity. And, as we have seen, I do not accept the argument that scavenging contributed significantly to the Hominoid diet, because we have never shown a particular adaptation to consume putrid meat.

So it's possible that flakes did not emerge principally for the purpose of hunting and slaughtering animals; maybe they were more useful for plants and even protection from predation. When scientist conducted some chemical analysis on the stone tools of Homo Erectus, the hominoid that came immediately after early Homo, they found that they were using their tools perhaps more for plants than for animals, so that is possibly the case with early Homo. Stone tools could prove more effective than sticks at digging into the earth to disinter roots and tubers or used to cut the stalks of grass to help in the collection of seeds in the same way as we use the sickle. They could also be used to cut or even mash any kind of plant foods, including roots, tubers, fruits, vegetables and other foods into smaller pieces or even into near mush.

DENTAL ADAPTATIONS

“Multiple lines of evidence indicate that the australopith ancestors of Homo consumed lots of mechanically demanding plant foods and probably resembled great apes in spending a substantial proportion of the day feeding and chewing, approximately an order of magnitude more than non-industrial humans. Maximum bite force capabilities in early Homo were less than half that of australopiths, and while H. habilis retained many primitive masticatory features, including large, thick post-canine teeth, H. erectus had considerably smaller post-canines, along with smaller faces. These derived masticatory features suggest that the genus Homo consumed foods that were easier to eat, requiring fewer, less forceful chews and reducing the need for high maximum bite forces.” (Zink & Lieberman 2016).

“The fossil, archeological, and paleoenvironmental evidence taken together suggest a model of increasing dietary versatility with the appearance and early evolution of Homo. The concurrence of stone tools, cut marked bones, and early Homo by ~2.4 Myr suggests that regardless of what other hominins were doing, H. rudolfensis and H. habilis probably used durable and perishable tools to increase the range of foods to which they would have had access. Technological innovation likely played a relatively minor role in the dietary adaptations of these taxa, though, because H. rudolfensis and H. habilis show little evidence of the changing selective pressures expected if tools replaced jaws and teeth in initial food processing. These hominins retain fairly thick molar enamel and broad mandibular corpora perhaps for processing hard foods or those foods requiring repetitive loading, yet they show more molar cusp relief than at least Praeanthropus afarensis, suggesting an improved ability to fracture tough foods such as pliable plant parts and meat. Tools would have allowed for more dietary flexibility, but increased dietary versatility still may have been driven more by biological (i.e., dental) than by cultural evolution.” (Ungar, Grine & Teaford 2006).

“What about underground storage organs? Thick tooth enamel, flat occlusal surfaces, and broad mandibular corpora of Homo rudolfensis and H. habilis are consistent with crushing hard and brittle foods, such as USOs (assuming that these are, in fact, hard and brittle). However, the fact that early Homo had more occlusal relief than did their hominin predecessors suggests they were not adapted to hard and brittle roots and tubers. Furthermore, cheek tooth microwear data suggest lower pit percentages than expected of a hard object specialist (Ungar et al. 2006)…In sum, there is little evidence that H. rudolfensis and H. habilis would have specialized on these foods.” (Ungar, Grine & Teaford 2006).

“Additionally, Eng et al. (2013) have shown that early Homo produced maximum masticatory muscle forces that were on average 66% lower than in gracile australopiths. These morphological changes are hypothesized to signal reduced masticatory effort within the genus, and are assumed to have been made possible by a change in diet to softer foods and/or higher quality, energetically dense foods that require fewer chews per calorie consumed." (Zink, Lieberman, & Lucas 2014).

Dental adaptations observed in Homo would not have been well suited for chewing raw meat in spite of the evidence indicating increased meat consumption with early Homo.:

"One often discussed dietary shift is the increased consumption of meat by early Homo, which is supported by archaeological evidence such as bone cut marks and stone tool remains (Bunn, 1981, Bunn, 1994, Bunn, 2007, Bunn and Kroll, 1986, Dominguez-Rodrigo et al., 2002, Plummer, 2004 and Dominguez-Rodrigo and Barba, 2006). Meat is a high quality food source that is calorically dense, highly digestible, and an important source of protein and fat. From a masticatory perspective, however, consumption of raw meat may be a challenge. Muscle tissue comprises elastic contractile fibers hierarchically bound by connective tissue. Under compressive, limited-space environments like the area between occluding teeth, meat fractures do not effectively propagate. The low-crested bunodont molars of apes and hominins appear to be especially poor at fracturing meat, and according to some accounts it takes chimpanzees 4.0–11.5 h to chew small (~4 kg) animal carcasses (Goodall, 1986 and Wrangham and Conklin-Brittain, 2003). These observations suggest that increased raw meat consumption by hominins may have required substantially more chewing effort, which is inconsistent with the relatively smaller, less robust masticatory apparatus of Homo species." (Zink, Lieberman, & Lucas 2014).

NOTES on early Homo:
--teeth in more rounded arc, closer to humans, jaw smaller

With the Australopithecus we see that as their environment produced increasingly tough and hard foods, they evolved larger and stronger teeth better at grinding. Certainly during the Pleistocene when Habilis and Rudolfensis were emerging, plants foods certainly became even more difficult to chew. But instead of their teeth becoming even larger or harder or sharper, the early Homo chose two different strategies: Rudolfensis's teeth and jaw stayed about the same, with the larger molars, thickly enameled molars good for grinding foods. However, Habilis chose another, more surprising strategy that reversed the trend: his teeth and jaw and supporting muscles of Habilis shrank in size overall. More specifically, their molar teeth actually become more human-like--that is, slightly smaller with more rounded cusps, making them perhaps better for tearing food but still good at grinding as well. However, its front teeth, its incisors in particular, actually became slightly larger, making them better at puncturing and tearing foods while they put them into their mouth.

There are several possibilities or combination of possibilities to explain this adaptation to Habilis teeth; one is that they may have started eating more animal foods, which of course are softer; another is that they found some sort of niche foods such as some kind of soft tuber although nobody seems to believe this possibility at the moment. But another possibility, to which I am partial, is that they were using their larger brains to create basic tools to help them process foods into smaller and softer pieces before they put them into their mouth. From hereonout, we will see another trend emerging regarding teeth--that is, as our brains became larger, our teeth became smaller, which suggests that as we became smarter, we increasingly learned to process foods outside of our mouth, through cutting, grinding, soaking, fermenting or cooking, before putting them into our mouth; or in other words, we learned to predigest foods outside of our bodies--which would have provided us great and powerful advantages to our physiology.

Furthermore analysis of the enamel of early Homo and later Homo reveals that most of the line of our Evolution maintained relatively thick enamel on their teeth, with the exception of the Neanderthals. At the same time, it does appear that from early Homo to later Homo, such as with Erectus, that we see some decline in the thickness of the enamel. The thick enamel is likely an adaptation to prevent teeth from cracking while feeding on hard and brittle objects like seeds--which suggests that early and late Homo continued to eat these sorts of foods but that these foods gradually became softer over time. But again, this evidence is hard to interpret, since we do not know the extent to which foods were processed with tools or other mechanisms before they were placed in the mouth.

Thickness of Enamel among Homo: Thick enamel is present among later Homo including modern humans in spite of advances in food processing, suggesting that thick enamel may not be as strongly linked to hard object feeding as is typically thought.—
“Early Homo postcanine teeth from Africa and Asia show highly variable average and relative enamel thickness (AET and RET) values. Three molars from South Africa exceed Homo AET and RET ranges, resembling the hyper thick Paranthropus condition. Most later Homo groups (archaic European and north African Homo, and fossil and recent Homo sapiens) possess absolutely and relatively thick enamel across the entire dentition. In contrast, Neanderthals show relatively thin enamel in their incisors, canines, premolars, and molars, although incisor AET values are similar to H. sapiens. Comparisons of recent and fossil H. sapiens reveal that dental size reduction has led to a disproportionate decrease in coronal dentine compared with enamel (although both are reduced), leading to relatively thicker enamel in recent humans. General characterizations of hominins as having ‘thick enamel’ thus oversimplify a surprisingly variable craniodental trait with limited taxonomic utility within a genus. Moreover, estimates of dental attrition rates employed in paleogeographic reconstruction may be biased when this variation is not considered. Additional research is necessary to reconstruct hominin dietary ecology since thick enamel is not a prerequisite for hard-object feeding, and it is present in most later Homo species despite advances in technology and food processing.” (Smith, T.M. et al. 2012).

DIGESTION
Also based on the structure of his pelvis, we do not have any reason to believe that Habilis's digestive system was any different, at least in size, than Australopithecus in any substantial way. Or in all these regards, he stayed about the same as the Australopithecus.

METABOLISM
NOTE: EXPENSIVE TISSUE HYPOTHESIS? WRONGFUL assumptions about meat and even fat--and therefore Hunting--or save until Homo Erectus.

"Or in other words, they were looking for good sources of sugars, first of all; since fruit was undoubtedly in decline, they were probably seeking the double strategy of eating fruit, with its combination of glucose and fructose, as well as starches like tubers and seeds, which are all glucose--and accordingly, like his predecessor Australopithecus, we probably possessed greater ability to digest starch as compared to his common ancestor. Like his predecessors, too, he probably needed good sources of fats, though I doubt his needs for fats increased over what is needed for Chimpanzees--but given reasons why: just not that much fat available in the tropics.)…"

--superior energetics: fatty acids as source of fuel, as well as the usual carbs from fruits, tubers and grains or corms, and then good amount of key fats, including cholesterol, to build the brain--allowing for the superior energetics to build the brain and maintain the energy for the brain

When we combine all the limited information we know about these two species, each of us can perhaps generate our own guesses, or even conclusions, about their foodways. For now I will offer my own opinion. Since more information suggests or even proves that these early Homo were about the same size as Chimpanzee, we can assume that they had that same middling metabolism--but with a twist: they had significantly larger brains. And as we know, all brains are energetically expensive--which means that, per mass, brains require considerably more ATP than most other organs to run, with the exception of our liver, heart and kidneys, which require about the same amount of energy. In other words, its likely that they may have needed an even more refined diet than their predecessors to keep their brains powered.

MORE ON REFINED DIET, EXPENSIVE TISSUE HYPOTHESIS, METABOLISM & BRAIN EXPANSION UNDER ERECTUS NUTRITION PHYSIOLOGY & METABOLISM

ENCEPHALIZATION & INTELLIGENCE
HABILIS encephalization

However from these fossils of craniums, jaws and scattered limbs, we can draw some dramatic conclusions: that these were really the first of our people, the first primate to begin to encephalized well-beyond the norms of all the others and lead us down the path to ourselves… However, he (Habilis) did change in some meaningful ways; his brain was about fifty percent larger than the Australopithecus (which equates to about half the size of our own brain).

RUDOLFENSIS encephalization
Its brain was either about the same size or perhaps even slightly larger than that of Habilis, at about 750 cc, while its face was likely more apelike than the Habilis.

When we compare these two Hominoids, with our limited information, we can conclude that they were still quite similar to Australopithecus in morphology--but with brains that were about fifty percent larger, with most of that development, it has been theorized, happening in the frontal lobe--the area responsible for abstract thought.

Author note: "Brain expansion is the primary anatomical criterion that distinguishes the genus Homo from earlier hominids such as Australopithecus, yet the picture of when and where early Homo evolved is far from clear. Fossil evidence indicates that there were at least three different varieties of early Pleistocene Homo living in East Africa between 2.5 and 1.5 Ma. The two seemingly earlier varieties, assigned by some to Homo habilis and Homo rudolfensis, had brain sizes that were on average 30% greater than pene-contemporaneous Australopithecus and Paranthropus." (DeLouize, Coolidge, Wynn 2016).

"Explanations for Homo's increase in relative brain size and abilities have focused on the energetic costs of large brains (Pontzer, 2012). There is a direct relationship between number of neurons and caloric requirements (Fonseco-Azevedo and Herculano-Houzel, 2012), a link that could possibly be related to protein calorie nutrition, as a lack of dietary protein has been shown to lead to a decrease in brain weight and in the protein content of the brain (Lucas and Campbell, 2000). Thus, an evolutionary increase in brain size must have been accompanied by an increase in accessible calories, either by a change in dietary quality, an increase in time spent foraging, or a change in the way calories are stored.In 1995 Aiello and Wheeler (1995) made a strong case for the "expensive tissue hypothesis," arguing that early Homo 'paid for' the increase in neurons via a dietary shift to meat, which is a higher quality food (more concentrated calories) than the plant foods that form the majority of the diet for most apes, including early hominins. They further argued that the dietary shift would have been accompanied by a decrease in the length of the gut; because the gut is also an "expensive tissue," it would be difficult for hominin physiology to support both. Digesting meat requires shorter guts than digesting plants, and thus a reduction in gut length would naturally accompany the dietary shift or, a stronger version of the argument, require the dietary shift…What seems clear is that the 30% increase in brain size over Australopithecus required some kind of dietary/adaptive shift. The contemporaneous archaeological evidence for butchery makes a strong circumstantial case that this dietary shift included meat." (DeLouize, Coolidge, & Wynn 2016).

INTELLIGENCE
GREATER INTELLIGENCE
When most species encounter this level of change, they either become extinct or adapt their morphology in some way: for example, as antelopes encounter greater predation, they may have just adapted to sprint faster.

Or if the physicality of their food changes, they just change their teeth. And of course we have seen those morphological changes in the previous Hominoids but when you think of this awkward ape, who is perhaps bit slow on the trees and the ground as compared to his competition, and even fairly defenseless as well, it's hard to imagine how he could morphologically adapt and survive. Naturally there are plenty of options for adaptation but if you work through the list, none of them really seem to be feasible. And for that reason, it seems that their best and perhaps their only option was to evolve greater intelligence, amidst all this competition and change--a trend, too, that has already been established throughout the primate kingdom and that became even more pronounced in the future in our own line of evolution--that is, get smart or get extinct.

ADVANTAGES OF INTELLIGENCE

As we have already seen in our section on primates, intelligence can greatly help primates find food. In this particular case, most of the Australopithecus were generalized feeders as are most Great Apes, likely relying upon tree, ground and animal foods--but as our brains became even larger, early Homo could become even better at using their intelligence to find foods and even expand their territory: they could better procure foods from different environments, from trees, from grass, from bushes, from riparian and lake environments. They could better remember where those foods are, whey they became available, and how to gather them. And given that their food was probably more scattered, they would likely need to expand their territory--in the same pattern as we have seen before with other primates--and they therefore would prove better equipped to remember the qualities and dangers of that territory.

TOOLS

With this greater intelligence early Homo could develop better tools to help him procure foods. Through analogy with Chimpanzees, we can assume that they could use sticks to procure honey and insects and use hammer and anvils to crack nuts and perhaps even certain animal foods, like brains and marrow, as well as use primitive spears to impale other animals. But, while this technology seemed at the edges of Chimpanzees intelligence, as some individuals and certain cultures could not even learn these skills, they were probably used with greater skill and regularity with early Homo.

In the end, according to my own reconstruction,
--more intelligence, better tools, greater nutrition,
allowing for shrinking of mouth and at least lays the ground for the shrinking of the digestive system, allowing for greater growth of the brain.
--allowing for superior energetics compared to chimps: whole idea can primate grow bigger brain to support the brain

SOCIAL DYNAMICS

SEXUAL DIMORPHISM

NOTES on early Homo:

cannot draw any conclusions on dimorphism...Yes, early Homo's sexual dimorphism unknown due to small sample size and sex assignments that are uncertain.

"The marked size differences exhibited by fossils of H. habilis have led to speculation that it might have been sexually dimorphic. However, it is unknown in many cases whether individual fossils belong to males or females, or even whether they represent members of different species. With so little evidence, speculation concerning the mating system of H. habilis is of little value."(Dixson 2009 p. 11).

GROUP SIZE & DEMOGRAPHIC

"Although the height of Homo habilis did not differ dramatically from Australo- pithecus africanus, body weight was larger as their skeletons were more robust, and cranial capacity averaged about 550 cc (Stringer 1992)—a 20 percent increase associated with an expansion of group size to 70 or 80 individuals (Dunbar 2001). The increase in group size was accompanied by a greater cognitive capacity to monitor the increased number of interpersonal dyads (2,775 at N = 75)…" (Massey 2002).

PREDATION WARNING & TERRITORY PROTECTION

NOTES on early Homo:

—use tools to fight predators--no fight in predators--even monkeys do this

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