3.987 - Human Origins and Evolution **Spring 2006**

List of FYI's - e-mailed "handouts" and communications

The following items were circulated to students before or after lectures as background and/or follow-up information on questions and points raised in specific lectures.

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FYI #1 - *Oreopithecus*

Date: 3/2/06

I threatened you with some spam about *Oreopithecus*, a Miocene, possibly bipedal, ape. Well here it is.

As I mentioned one of the really interesting recent discoveries is that there may have been another genus of now extinct apes which independently developed bipedalism. The candidate is *Oreopithecus* a 9 to 7 million year old genus of European ape, however, your textbook authors don't provide any real discussion of this evidence or this possibility. The genus *Oreopithecus* has been recognized for over 130 years, it being one of the first fossil apes to be discovered and described. Below are several references and abstracts of relatively recent papers which have reanalyzed the *Oreopithecus* remains and have somewhat controversially proposed that *Oreopithecus* was a habitual biped. It is clear that even if *Oreopithecus* turns out to be a biped, other physical features strongly suggest that it wasn't in the ancestral lineage leading to humans.

Köhler, Meike and Salvador Moyà-Solà

1997 Ape-like or hominid-like? The positional behavior of *Oreopithecus bambolii* reconsidered. *Proc. Natl. Acad. Sci. USA* Vol. 94, pp. 11747-11750, October 1997.

Abstract: Comparative morphological and functional analyses of the skeletal remains of *Oreopithecus bambolii*, a hominoid from the Miocene Mediterranean island of Tuscany-Sardinia (Italy), provides evidence that bipedal activities made up a significant part of the positional behavior of this primate. The mosaic pattern of its postcranial morphology is to some degree convergent with that of *Australopithecus* and functionally intermediate between apes and early hominids. Some unique traits could have been selected only under insular conditions where the absence of predators and the limitation of trophic resources play a crucial role in mammalian evolution.

Rook, Lorenzo, Luca Bondioli, Meike Köhler, Salvador Moyà-Solà and Roberto Macchiarelli

1999 *Oreopithecus* was a bipedal ape after all: evidence from the iliac cancellous architecture. *Proc. Natl. Acad. Sci. USA* Vol. 96, Issue 15, 8795-8799, July 20, 1999.

Abstract: Textural properties and functional morphology of the hip bone cancellous network of *Oreopithecus bambolii*, a 9- to 7-million-year-old Late Miocene hominoid from Italy, provide insights into the postural and locomotor behavior of this fossil ape. Digital image processing of calibrated hip bone radiographs reveals the occurrence of trabecular features, which, in humans and fossil hominids, are related to vertical support of the body weight, i.e., to bipedality.

Moyà-Solà, Salvador, Meike Köhler and Lorenzo Rook

1999 Evidence of hominid-like precision grip capability in the hand of the Miocene ape *Oreopithecus*. *Proc. Natl. Acad. Sci. USA* Vol. 96, Issue 1, 313-317, January 5, 1999.

Abstract: Functional and allometric analyses of the hand of the late Miocene ape *Oreopithecus bambolii* (Tuscany, Italy) reveal a series of features that reflect an improved grasping capability including firm pad-to-pad precision gripping that apes are unable to perform. Related features such as hand length, relative thumb length, a deep and large insertion area for the tendon of the long thumb flexor, and the form of the metacarpal 2/capitate articulation are not present in extant or fossil apes. In these features, the *Oreopithecus* hand closely matches the pattern of early hominids, presumably as a response to similar functional demands.

FYI #2 - more about hominid tooth formation than you probably wanted to know

Date: 3/8/06

I think an important part of your education in 3.987 should be for you to be aware of some of the amazing "high tech" studies that have been undertaken recently in palaeoanthropology, even if we don't manage to discuss them in detail in lecture and your text barely mentions them.

Remember on Monday I mentioned the age of the Taung australopithecine child at death and it's dental developmental sequence, the following article and abstract is a follow up. - The paper referenced below has a good general description of the technique of analyzing daily enamel formation increments, although it deals specifically with determining the ages of two more recent *Homo erectus* individuals.

The paper dealing directly with the Taung child is by Bromage, T.G. and Dean, M.C. 1985, Re-evaluation of the age at death of immature fossil hominids. *Nature* 317:525-527.

The following is an elegant analytical study.

Dean, C., M.G. Leakey, D. Reid, F. Schrenk, G.T. Schwartz, C. Stringer & A. Walker.
2001 Growth processes in teeth distinguish modern humans from *Homo erectus* and earlier hominins. *Nature* 414:628-631.

Abstract: A modern human-like sequence of dental development, as a proxy for the pace of life history, is regarded as one of the diagnostic hallmarks of our own genus *Homo*. Brain size, age at first reproduction, lifespan and other life-history traits correlate tightly with dental development . Here we report differences in enamel growth that show the earliest fossils attributed to *Homo* do not resemble modern humans in their development. We used daily incremental markings in enamel to calculate rates of enamel formation in 13 fossil hominins and identified differences in this key determinant of tooth formation time. Neither australopiths nor fossils currently attributed to early *Homo* shared the slow trajectory of enamel growth typical of modern humans; rather, both resembled modern and fossil African apes. We then reconstructed tooth formation times in australopiths, in the,1.5-Myr old *Homo erectus* skeleton from Nariokotome, Kenya, and in another *Homo erectus* specimen, Sangiran S7-37 from Java. These times were shorter than those in modern humans. It therefore seems likely that truly modern dental development emerged relatively late in human evolution.

FYI #4 - The gluteus maximus

Date: 3/20/06

This is a definite read! There's a news commentary , 'Faster Than a Hyena? Running May Make Humans Special' by Carl Zimmer in *Science* 306:1283 (19 Nov. 2004) that deals with recent research on the possible connections between the emergence of striding gait bipedalism, long distance endurance running and hunting. But more to your next assignment - when you get around to evaluating Bingham's view of the role of the gluteus maximus muscle in human evolution, you might want to consider other possible functions for it, as reported herein. In fairness to Bingham, he wrote in 2000 relying on older research, and this more detailed study came out in 2004.

The original article by Bramble and Lieberman which deals with their view of early hominid locomotion is:

Bramble, D.M. & D.E. Lieberman
2004 Endurance running and the evolution of *Homo*. *Nature* 432:345-352.

Abstract: Striding bipedalism is a key derived behaviour of hominids that possibly originated soon after the divergence of the chimpanzee and human lineages. Although bipedal gaits include walking and running, running is generally considered to have played no major role in human evolution because humans, like apes, are poor sprinters compared to most quadrupeds. Here we assess how well humans perform at sustained long-distance running, and review the physiological and anatomical bases of endurance running capabilities in humans and other mammals. Judged by several criteria, humans perform remarkably well at endurance running, thanks to a diverse array of features, many of which leave traces in the skeleton. The fossil evidence of these features suggests that endurance running is a derived capability of the genus *Homo*, originating about 2 million years ago, and may have been instrumental in the evolution of the human body form.

FYI #5 - On the diet of australopithecines

Date: 3/2006

More palaeoanthropological spam. We got into a discussion of the possibility of using isotopes to investigate diet similarity and food sharing in Isaac's Lower Pleistocene sites. While practically that would be a very long shot due to a lack of skeletal material, I mentioned it has been possible to look at diet of the australopithecines and paranthropines in southern Africa.

In recent years it has sometimes become possible to study the isotopic ratios of carbon, nitrogen and strontium in ancient bone and teeth. This allows researchers to determine the types of plants and animals that may have been eaten by these creatures. References to three such studies of South African australopithecines and their diets are below. - Obviously all of the australopithecines seem to have had fairly nutritious, widely variable, and potentially omnivorous diets.

Sponheimer, Matt and Julia A. Lee-Thorp
1999 Isotopic evidence for the diet of an early hominid, *Australopithecus africanus*. *Science* 283:368-70

Abstract: Current consensus holds that the 3-million-year-old hominid *Australopithecus africanus* subsisted on fruits and leaves, much as the modern chimpanzee does. Stable carbon isotope analysis of *A. africanus* from Makapansgat Limeworks, South Africa, demonstrates that this early hominid ate not only fruits and leaves but also large quantities of carbon-13- enriched foods such as grasses and sedges or animals that ate these plants, or both. The results suggest that early hominids regularly exploited relatively open environments such as woodlands or grasslands for food. They may also suggest that hominids consumed high-quality animal foods before the development of stone tools and the origin of the genus *Homo*.

van der Merwe, N.J., J. F. Thackeray, J. A. Lee-Thorp and J. Luyt
2003 The carbon isotope ecology and diet of *Australopithecus africanus* at Sterkfontein, South Africa. *Journal of Human Evolution* 44 :581-597.

Abstract: The stable carbon isotope ratio of fossil tooth enamel carbonate is determined by the photosynthetic systems of plants at the base of the animal's foodweb. In subtropical Africa, grasses and many sedges have C4 photosynthesis and transmit their characteristically enriched 13C/12C ratios (more positive 13C values) along the foodchain to consumers. We report here a carbon isotope study of ten specimens of *Australopithecus africanus* from Member 4, Sterkfontein (ca. 2.5 to 2.0 Ma), compared with other fossil mammals from the same deposit. This is the most extensive isotopic study of an early hominin species that has been achieved so far. The results show that this hominin was intensively engaged with the savanna foodweb and that the dietary variation between individuals was more pronounced than for any other early hominin or non-human primate species on record. Suggestions that more than one species have been included in this taxon are not supported by the isotopic evidence. We conclude that *Australopithecus africanus* was highly opportunistic and adaptable in its feeding habits.

Lee-Thorp, Julia A., van der Merwe, N.J. and C.K. Brain
1994 Diet of *Australopithecus robustus* at Swartkrans from stable carbon isotopic analysis. *Journal of Human Evolution* 27:361-372.

Abstract: Dietary adaptations of early hominids are generally understood to have played a crucial role in hominid evolution. The dietary habits of *Australopithecus robustus* are of special interest because the robust masticatory apparatus and characteristic dental features point to a distinctive dietary niche. Suggestions have ranged anywhere between carnivory and specialist herbivory, but current consensus has focused mainly on small hard items within the contest of a vegetarian diet, and more particularly, frugivory. Few studies have challenged this perspective, although the results of a recent Sr/Ca study of *A. robustus* ar Swartkrans were found to be inconsistent with herbivory. ----- Results for *A. robustus*, compared with other fauna from Swartkrans, show a mixed diet including both C3 and C4 foods. Since the C4 contribution must derive from consumption of grass or grazing animals, the data do not support either a specialist frugivorous or graminivorous niche for *A. robustus*, rather, they suggest a more generalized or omnivorous diet.

FYI #6 - on early stone tool use

Date: 3/ 22 /06

Like you didn't have enough to read or do. More palaeoanthropological spam. Following up on the issue of visibility of early stone tool use, you might want to refer to the paper below for a discussion of possible behavioral changes that might have triggered the appearance of discernible "archaeological sites" around 2.6 myr.

Panger, M.A., A.S. Brooks, B.G. Richmond and B. Wood
2002 Older than the Oldowan? rethinking the emergence of hominin tool use.
Evolutionary Anthropology 11:235-245.

Abstract: Intentionally modified stone tools first appear in the hominin archeological record about 2.5 mya. Their appearance has been variously interpreted as marking the onset of tool use by hominins or, less restrictively, the origin of hominin lithic technology. Although the 2.5 mya date has persisted for two decades, several related but distinct questions about the origin and evolution of hominin tool use remain to be answered: Did hominins use tools before 2.5 mya? Did hominins use unmodified stones as tools before 2.5 mya? Does the earliest appearance of stone tools in the archeological record represent the earliest use of intentionally modified stones as tools?

FYI #7 - headstrong hominids

Date: 4/12/06

Try this URL for an interesting discussion of skull thickness and *Homo erectus* behavior. If this is all about male competition, why are female skulls so thick too?

http://www.naturalhistorymag.com/0204/0204_feature.html

FYI #9 - Tan-Tan Acheulian figurine

Date: 4/25/06

I threatened you with some palaeoanthropological spam yesterday. Here are illustrations of the only other known possible figurine of Acheulian age . It comes from the Tan-Tan Acheulian site in Morocco. The original article which describes this find and its setting is:

Bednarik, R.G.
2003 A figurine from the African Acheulian. *Current Anthropology* 44(3):405-413.

Photos of a specimen from the front and back views removed due to copyright restrictions.

FYI #10 - Schoningen spear

Date: 4/25/06

Yet more palaeoanthropological spam. Here's an image and close-up of the point of one of the three spruce spears from the Schoningen site in Germany. According to the textbook this may be a product of *H. heidelbergensis*. The original article is:

Thieme, H.
1997 Lower Palaeolithic hunting spears from Germany. *Nature* 385:807-810.

Image removed due to copyright restrictions.
The photograph showed spear II, which is 2.30m long. The spear was shown at the left of an incomplete horse pelvis, with the base broken off.

FYI #11 - The role of cooking in human evolution

Date: 4/26/06

Yet more cooked (?) spam. There is an extremely interesting article by Wrangham and Conklin-Brittain on the role of cooking in human evolution, that argues, given the human gut length,dentition and the nutritional value of raw food, that cooking has to have been an important evolutionary factor from the time of the emergence of *Homo erectus/ergaster*. They basically argue that there wasn't time enough in a day to chew and digest enough food to support the large body size of *erectus* without cooking. The abstract of the article is below.

Wrangham, R. and N.L. Conklin-Brittain
2003 'Cooking as a biological trait'.
Comparative Biochemistry and Physiology Part A 136 (2003) 35-46.

Abstract: No human foragers have been recorded as living without cooking, and people who choose a 'raw-foodist' life-style experience low energy and impaired reproductive function. This suggests that cooking may be obligatory for humans. The possibility that cooking is obligatory is supported by calculations suggesting that a diet of raw food could not supply sufficient calories for a normal hunter-gatherer lifestyle. In particular, many plant foods are too fiber-rich when raw, while most raw meat appears too tough to allow easy chewing. If cooking is indeed obligatory for humans but not for other apes, this means that human biology must have adapted to the ingestion of cooked food (i.e. food that is tender and low in fiber) in ways that no longer allow efficient processing of raw foods. Cooking has been practiced for ample time to allow the evolution of such adaptations. Digestive adaptations have not been investigated in detail but may include small teeth, small hind-guts, large small intestines, a fast gut passage rate, and possibly reduced ability to detoxify. The adoption of cooking can also be expected to have had far-reaching effects on such aspects of human biology as life-history, social behavior, and evolutionary psychology. Since dietary adaptations are central to understanding species evolution, cooking appears to have been a key feature of the environment of human evolutionary adaptedness. Further investigation is therefore needed of the ways in which human digestive physiology is constrained by the need for food of relatively high caloric density compared to other great apes

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FYI #12 - Early *sapiens* mtDNA in Australia

Date: 5/1/06

The paper below reports the occurrence of an archaic mtDNA pattern among early Australians. The implication being perhaps that early *H.s.s* populations may have had a more complex geographic origin than that suggested by the 'out of Africa' scenario.

Adcock, G.J., E.S. Dennis, S. Easteal, G.A. Huttley, L.S. Jermiin, W.J. Peacock and A. Thorne.
2001 Mitochondrial DNA sequences in ancient Australians: Implications for modern human origins.
Proceedings of the National Academy of Sciences USA 98(2):537-542.

Abstract: DNA from ancient human remains provides perspectives on the origin of our species and the relationship between molecular and morphological variation. We report analysis of mtDNA from the remains of 10 ancient Australians. These include the morphologically *gracile* Lake Mungo 3 ['60 thousand years (ka) before present] and three other *gracile* individuals from Holocene deposits at Willandra Lakes (<10 ka), all within the skeletal range of living Australians, and six Pleistocene/early Holocene individuals (15 to <8 ka) from Kow Swamp with *robust* morphologies outside the skeletal range of contemporary indigenous Australians. Lake Mungo 3 is the oldest (Pleistocene) "anatomically modern" human from whom DNA has been recovered. His mtDNA belonged to a lineage that only survives as a segment inserted into chromosome 11 of the nuclear genome, which is now widespread among human populations. This lineage probably diverged before the most recent common ancestor of contemporary human mitochondrial genomes. This timing of divergence implies that the deepest known mtDNA lineage from an anatomically modern human occurred in Australia; analysis restricted to living humans places the deepest branches in East Africa. The other ancient Australian individuals we examined have mtDNA sequences descended from the most recent common ancestor of living humans. Our results indicate that anatomically modern humans were present in Australia before the complete fixation of the mtDNA lineage now found in all living people. Sequences from additional ancient humans may further challenge current concepts of modern human origins.

FYI #13 - possible Neandertal/*sapiens* hybrid?

Date: 5/1/06

I mentioned the Abrigo do Lagar Velho skeleton today. Here's the abstract and an illustration of the burial. At 24,500 bp, it is one of the earlier burials of *H. s. s.* known in westernmost Europe. It's attribution as a result of long term genetic admixture between Neandertals and *H.s.s.* controversial.

Duarte, C., J. Maurice, P.B. Petite, P. Soot, E. Trunks, H. Van Deer Plight, and J. Zilhao

1999 The early Upper Paleolithic human skeleton from the Abrigo do Lagar Velho (Portugal) and modern human emergence in Iberia.
Proceeding of the National Academy of Sciences USA 96:7604-7609.

Abstract: The discovery of an early Upper Paleolithic human burial at the Abrigo do Lagar Velho, Portugal, has provided evidence of early modern humans from southern Iberia. The remains, the largely complete skeleton of a '4-year-old child buried with pierced shell and red ochre, is dated to *ca.* 24,500 years B.B. The cranium, mandible, dentition, and post crania present a mosaic of European early modern human and Neandertal features. The temporal bone has an intermediate-sized juxtamastoid eminence. The mandibular mentum osseum and the dental size and proportions, supported by mandibular ramal features, radial tuberosity orientation, and diaphyseal curvature, as well as the pubic proportions align the skeleton with early modern humans. Body proportions, reflected in femorotibial lengths and diaphyseal robusticity plus tibial condylar displacement, as well as mandibular symphyseal retreat and thoracohumeral muscle insertions, align the skeleton with the Neandertals. This morphological mosaic indicates admixture between regional Neandertals and early modern humans dispersing into southern Iberia. It establishes the complexities of the Late Pleistocene emergence of modern humans and refutes strict replacement models of modern human origins

The photograph showed Lagar Velho 1 in situ, with damaged skull and left forearm elements already removed.

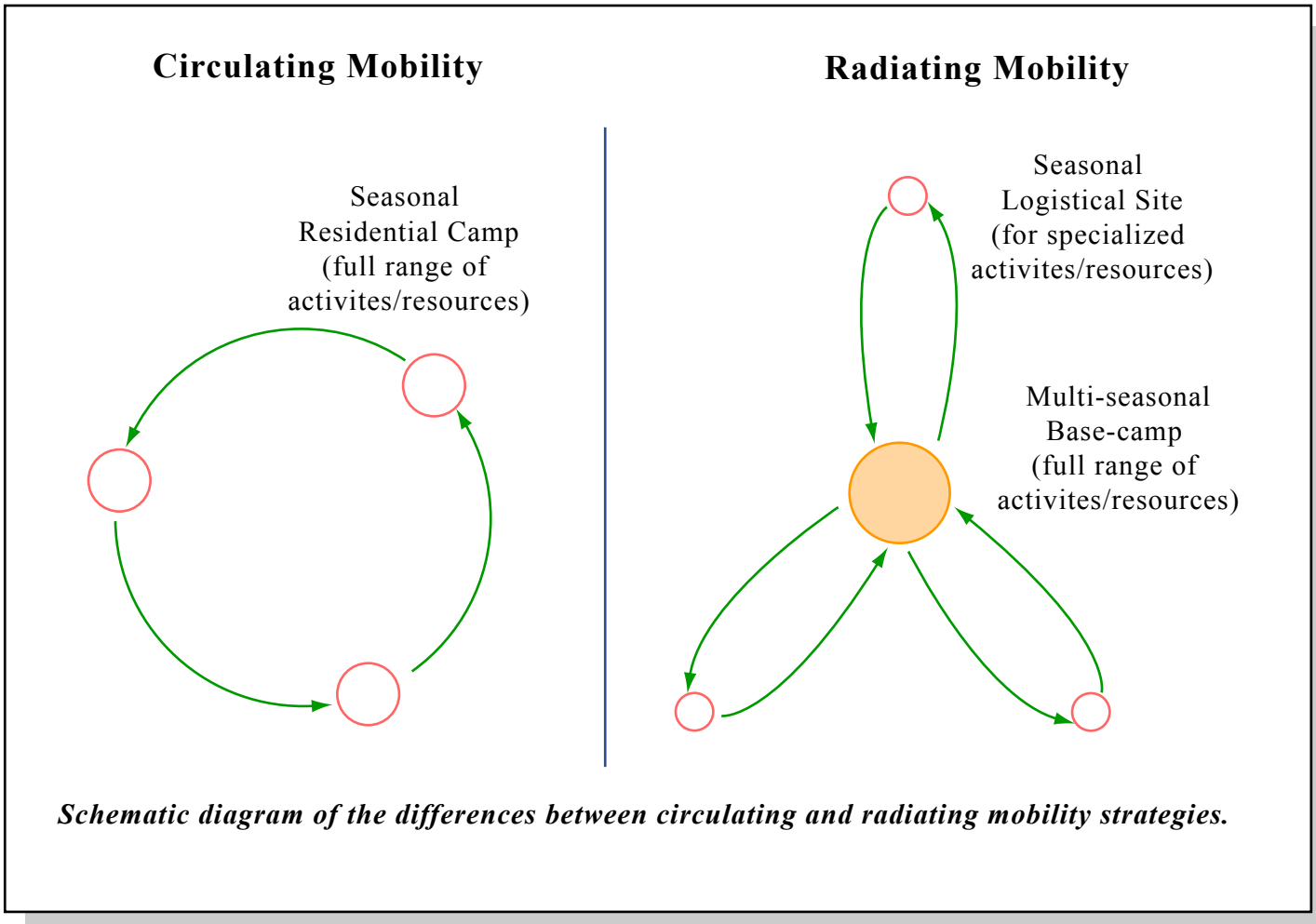
FYI #14 - Neandertal mobility patterns

Date: 5/1/06

On the issue of Neandertal mobility patterns. There is a really elegant piece of research by Lieberman and Shea (abstract below) that examines the problem. It used a really novel technique of studying cementum increments on gazelle tooth roots to determine the season of death of the animals found in the sites. The abstract of the paper presenting this research is below, as is an illustration of the two basic residential mobility patterns for hunter/gatherers. - The Neandertals are thought to practice the one on the right, radiating, while our ancestors are thought to have practiced the circulating pattern on the left.

Lieberman, D. and Shea, J.J.
1994 Behavioral differences between archaic and modern humans in the Levantine Mousterian. *American Anthropologist* 96(2):300-332.

Abstract: Early modern and archaic humans are associated with similar lithic industries in the Middle Paleolithic of the southern Levant, but new data suggest that they used the environment in different ways. Evidence from analyses of seasonally deposited increments of the teeth of the animals they hunted suggests that modern humans primarily practiced a strategy of circulating seasonal mobility, while archaic humans in the same region 30,000 years later were more residentially mobile. Analyses of their lithic hunting technology further suggest that archaic humans hunted more frequently than did modern humans. We argue that this greater hunting intensity may have been a strategy for coping with the consequences of resource biodepletion resulting from long-term multiseasonal occupation of sites. These behavioral contrasts may be related to some of the morphological differences between early modern and archaic humans.



Schematic diagram of the differences between circulating and radiating mobility strategies.

Figure by MIT OCW.

FYI #17 - one last mystery at Dolni Vestonice

Date: 5/8/06

As if exploded ceramic figurines associated with an elaborate burial of an older woman with congenital facial deformities weren't enough. Then there was the triple burial and the wooden stake. Was this a truly dysfunctional family?

Alt, K.W., S. Pichler, W. Vach, B. Klima, E. Vlcek and J. Sedlmeier.
1997 Twenty-Five Thousand-Year-Old Triple Burial From Dolni Vestonice: An Ice-Age Family? *American Journal of Physical Anthropology* 102:123-131.

Abstract: In 1986 a palaeolithic triple burial was discovered near Dolnı Vestonice (Czech Republic). The occurrence of anatomic variants in all three skeletons gave rise to speculations that the buried individuals may have been closely related. To test this hypothesis the skeletons were submitted to a systematic kinship analysis based on odontologic and other non-metric traits. Statistical tests showed that the coincident occurrence of several rare traits in the individuals is highly unlikely to occur at random. This and further data included in the analysis therefore suggest that the three individuals buried together were genetically related and actually belonged to one family.

Image removed due to copyright restrictions.

The photograph showed the upper palaeolithic triple burial that was discovered in the Pavlov hills above the village of Dolni Vestonice, Moravia, Czech Republic. The bodies were partially covered with red ochre. Grave goods included silex knives, ornamental shells of Tertiary snails, and pierced animal teeth (*Alopex lagopus, Canis lupus*), as well as pendants of mammoth ivory formerly attached to headbands.

Individuals from left to right: DV 13, DV 15, DV 14.