

# CRO-MAGNON AND QAFZEH — VIVE LA DIFFERENCE

C. LORING BRACE

*Museum of Anthropology, University Museums Building, Ann Arbor, Michigan 48109 U.S.A.*

**ABSTRACT** The obligatory use of cooking by the Mousterian occupants of the north temperate zone relaxed the forces of selection maintaining archaic tooth size and led to the reductions that shaped modern human face form from the Middle East to the Atlantic coast. The delay in the spread of cooking techniques accounts for the later onset of dental reduction to the south. The development and use of projectiles in the African Middle Stone Age led to gracilization and the earlier appearance of "modern" post-cranial and reflected cranial form in Africa. The subsequent adoption of the use of projectiles elsewhere was followed by gracilization and the appearance of "modern" post-cranial morphology. The craniofacial form of Cro-Magnon allies it with the living populations of northwestern Europe, specifically with the fringes in Scandinavia and England, but not with the European continent. Qafzeh represents the pattern still found in sub-Saharan Africa, particularly West Africa. Although the craniofacial configuration in both is "modern," the dentition of Qafzeh is archaic in size and form. Qafzeh is a logical representative of the ancestral form for sub-Saharan Africans but not for Cro-Magnon and subsequent Europeans.

## INTRODUCTION

Over the past decade or so, much attention has been paid to the question of the emergence of "modern" human form. The approach generally taken has been a plunge into the fossil record to consider nuances in the form and matters concerning the dating of this, that, or the other specimen in order to suggest its relevance or irrelevance for contributing to our understanding of the origins of "modern" morphology. One of the things that has been curiously neglected in this approach is any systematic attempt to come to grips with just what constitutes that "modern" condition so taken for granted by the majority of the profession that focuses on the course of human evolution as its particular subject for study. Instead, there is a wondrously Eurocentric set of assumptions that is based more on the course of post-Renaissance political history than on anything remotely like actual morphological analysis. This has been linked together with the traditions of rejecting the principles of evolutionary biology by those who purport to be students of human evolution. For a critical assessment of these traditions, see Brace, 1981, 1982, 1988, 1992, and 1995b.

For more than a century, the archetype of early modern human form has been assumed to be embodied in the specimens found in 1868 at Cro-Magnon in southwestern France (Broca, 1868). According to the accepted folklore of the field, Cro-Magnon illustrated the earliest manifestation of modern human appearance. This dated from the Aurignacian maybe more than 30,000 years ago in western Europe (Mellars et al., 1987; White, 1989), although new techniques have pushed that date back another ten-thousand years in Bulgaria and northern Spain (Bischoff et al., 1989; Cabrera Valdez and Bischoff, 1989). Starting at that time, human evolution presumably came to a halt and there has been no further change in human form. In the words of Stephen Jay Gould, "The Cro-Magnons, why they are us!" No predecessors are contemplated, and all subsequent change is assumed to have been in the realm of culture (Gould, public presentation in Ann Arbor, Michigan, October 30, 1982; Gleick, 1983; Diamond, 1989, 1990; Klein, 1992).

The claim that there has been no subsequent anatomical change is manifestly untrue. A quick look at the most abundant evidence available, the teeth, shows that gross dimensions alone in the early Upper Paleolithic were closer to "classic" Neanderthal figures

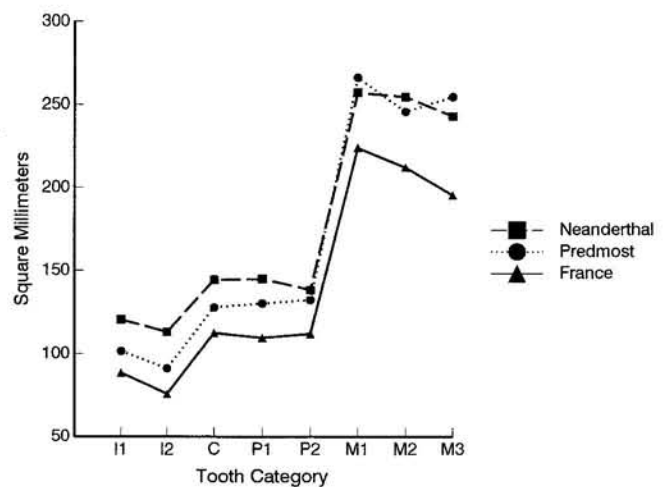


Fig. 1. Profiles of cross-sectional areas of the summed maxillary and mandibular tooth categories of European Neanderthal, Early Upper Paleolithic, and living French samples. Data are given in Table 2.

than to living Europeans (Brace et al., 1987; Brace, 1995b,c) (Fig. 1). The stance represented in the words of Gould can be taken for the feelings of the vast majority of those who write about the emergence of "modern" human form, and it is rooted more in transcendental faith than in anything approaching science. Rarely if ever is it supported by anything approaching statistically testable collections of data. And, who is this "us" that the Cro-Magnon specimens presumably exemplify?

### PROTO-CRO-MAGNON?

We have been told that Qafzeh is a proto-Cro-Magnon specimen (Howell, 1959; Valladas et al., 1988; Vandermeersch, 1989). Clearly Qafzeh does not display archaic cranial features even if it has an archaic dentition (Brace et al., 1991). At nearly 100,000 years (Valladas et al., 1988), it is one of the oldest representatives of "modern" human cranial form, but, once again, that specter of what constitutes the "modern" condition comes back to haunt us. Given the various "modern" manifestations present in the half-dozen or more regional clusters that can be identified (Brace and Hunt, 1990; Brace, 1996a), which "us" does Qafzeh represent? And can it really stand for the ancestors of the population to which Cro-Magnon belonged?

I have collected craniofacial measurements on representative samples of all the major modern human clusters, and it is an easy enough thing to use discriminant function statistics to test the placement of individual specimens such as Qafzeh and Cro-Magnon against them (Brace, 1991a) (Table 1). It is in the nature of the statistic that you cannot determine the population to which an individual specimen belongs, but it is an easy enough matter to determine the groups from which it is excluded. The pattern of features found in Qafzeh 6, for example — the only specimen with enough variables to be treated in this fashion — can be excluded from all modern human samples except those from sub-Saharan Africa, most particularly West Africa (Table 1). It would appear that the sub-Saharan craniofacial configuration has retained a statistical coherence for nearly 100,000 years.

Cro-Magnon, on its part, is clearly excluded from every "modern" human craniofacial configuration except that characteristic of Europe (Table 1). And if the European configuration is broken down into its constituents, Cro-Magnon could not occur within those groups that run from eastern Europe to the Atlantic coast, although it cannot be excluded from England, the Faeroe Islands and Norway. It is a curious little irony to contemplate the thought that the most famous fossil "modern" in France could not be ancestral to the "modern" French, but cannot be excluded from the ancestry of the recent English.

There is another curious irony in all of this. In 1839, it was the American anatomist and anthropologist, Samuel George Morton, who realized that the difference between the craniofacial configurations of Africans and Europeans was so marked that it could not have come about by natural means in the time he assumed was available, a time calculated since Noah's ark was presumed to have landed on Mount Ararat in the western Caucasus — Turkish Armenia — at the end of the Biblical flood. Morton's views were subsequently adopted by

Paul Broca as the basis for an outlook that still prevails in French anthropology (Brace, 1982). The irony now is that the French point of view, which has never been comfortable with the perspective of Darwinian mechanism, evidently feels that 100,000 years is quite enough time to convert an African into a European, while the constituency that I represent — thoroughly Darwinian in its outlook, is quite happy in seeing a European "classic" Neanderthal become transformed by gradual means into a modern European but yet has trouble seeing how the transformation of an African craniofacial pattern into a European one could take place within the same period of time.

TABLE 1. Probability levels by Fisher's linear discriminant function that Qafzeh 6 and Cro-Magnon 1 can be excluded from membership in the group named in the row heading.

	Number	Qafzeh 6	Cro-Magnon
Africa	118	0.986	0.000
Amerind	487	0.009	0.002
Asia	763	0.004	0.000
Austro-Melanesia	237	0.007	0.000
European Continent	142	0.000	0.041
Europe NW Edge	98	0.000	0.955
Eskimo	155	0.000	0.000
South Asia	96	0.000	0.002
Jomon-Pacific	448	0.000	0.002

Data were extracted from Table 2 of Brace (1996b).

PREMOLAR NUMBERING AND AGENESIS IN PRIMATES

TABLE 1. Dental Agenesis in Old World Primates

	Number of Individuals	Incisors	Premolars	Molars	Total
<i>Cercopithecoidea</i>					
<i>Colobus</i>	140	---	5(3.6)	6(4.3)	11(7.9)
<i>Presbytis</i>	100	1(1.0)	---	---	1(1.0)
<i>Cercopithecus</i>	350	---	1(0.3)	3(0.9)	4(1.0)
<i>Macaca</i>	350	---	---	---	---
<i>Papio</i>	38	2(5.3)	---	---	2(5.3)
Total	978	3(0.3)	6(0.6)	9(0.9)	18(1.8)
<i>Ponginae</i>					
<i>Gorilla</i>	190	---	1(0.5)	---	1(0.5)
<i>Pan</i>	100	---	1(1.0)	2(2.0)	3(3.0)
<i>Pongo</i>	100	---	---	---	---
Total	390	---	2(0.5)	2(0.5)	4(1.0)
<i>Hominidae</i>					
Europeans	4000	12(0.3)	5(0.1)	259(6.5)	276(6.9)
Africans	1000	25(2.5)	10(1.0)	247(24.7)	282(28.2)
Total	5000	37(0.7)	15(0.3)	506(10.1)	558(11.1)

Values = number with percentage incidence in brackets. No agensis was found in the canines. (After Lavelle and Moore, 1973)

premolar region (Lavelle and Moore, 1973). Premolar agensis is generally more common in the mandibular region for all three groups although Brekhus et al. (1944) found the frequencies to be slightly higher in the maxillary region for humans.

Dental agensis in modern humans is commonly correlated with the reduction of the maxillomandibular region due to the high incidence of agensis of M3 at the distal end of the dental arch and I<sup>2</sup> at the mesial aspect (Schultz, 1932; Butler, 1963; Lavelle and Moore, 1973). However, this does not adequately explain the absence of P4 (Brekhus et al., 1944).

In a comparison of the cercopithecoid, pongid, and human data cited in Lavelle and Moore's study on dental agensis, large-sample z-tests of the population proportion exhibiting tooth agensis were calculated both for molar and premolar frequencies

between the primate groups (no comparison could be made for incisor agensis due to a lack of comparative data for the great apes). A significant difference was not found between the monkeys and apes in the frequencies of molar agensis, but significant differences were detected between both the monkeys and humans and the apes and humans ( $p < .001$ ). No significant differences were found between any of the groups in regards to premolar agensis frequencies, suggesting that while molar agensis may be related to a reduction in the jaw, premolar agensis is not.

The suggestion that agensis is related to dental arch reduction in modern humans is not borne out by other lines of evidence. Eskimo populations with large dental arches (Pedersen, 1949) and more prognathous African populations (Lavelle and Moore, 1973) often exhibit a reduction in the third molar region. Brekhus et al. (1944) found little correlation between dental arch size and the number of teeth, citing evidence of agensis and the retention of large spaces between the teeth in small jaws, agensis and crowded teeth in small jaws, and crowded teeth in large jaws in individuals within the same families. Reduction in M3 was observed to be accompanied by a reduction in other teeth in 94.7% of the cases of molar agensis that Brekhus et al. examined, and multiple deficiencies were seen in nearly half of all cases of agensis.

Suggestions that tooth size reduction and agensis are correlated (Butler, 1939; Garn et al., 1963) are not supported by a study that revealed a lack of correlation between the mesiodistal and buccolingual diameters of teeth (Baum and Cohen, 1971). Calcagno and Gibson (1988) suggest that if the maxillomandibular region is undergoing reduction or fewer teeth are needed in modern humans, then positive selection for a reduction in tooth number would be more economical than a reduction in tooth size whereby teeth would wear more quickly. In a clinical study by Brekhus et al. (1944), observed frequencies of various combinations of I<sup>2</sup>, P4, and M3 agensis far exceeded the expected frequencies, and it was suggested that directional evolution is indeed occurring and reduction in tooth size is merely coexistent.

### CONCLUSIONS

The present system of numbering teeth in mammals based on their position, relation to other teeth, and mode of succession in the paleontological literature dates back to the mid-nineteenth century (Owen, 1840-45). Premolars are counted from the molar region forwards in most veterinary literature due to the stability of the fourth premolar in most mammals (Peyer, 1968). It would appear logical to number the premolars in sequence from the most posterior premolar forwards based on the typical order of their development in mammals. However, this system would present problems with the reversed developmental sequences seen in the tree shrew and extant primates.



processes have never been convincingly associated with different functional capabilities. Even the size of the area of neck muscle attachments has no clear relationship with the size and strength of those muscles themselves. The total surface area to which the neck muscles of a cow or a horse are attached is no greater than that allotted to the neck muscles of a human being. Yet, in the bovine and equine examples, the vastly heavier head is not balanced on top of the spinal column but held throughout life thrust forward in a nearly horizontal position by the continuous tension of a muscle mass that absolutely dwarfs the human condition.

On the other hand, in the course of 50,000 years of human evolution, occipital morphology has undergone far less alteration. Everything from the details of mastoid process form and nuchal muscle attachments to fully "bun-shaped" occiputs demonstrates a continuity from Neanderthal morphology to that visible in the inhabitants of the fringes of western Europe today in Norway, the Faeroe Islands, and England (Brace, 1991a, 1995a, 1996b). Given those aspects of occipital morphology in living northwest Europeans, one would have to predict fossil ancestors with a similar configuration. Fossil predecessors exist with the right occipital characteristics (Hublin, 1978), and they are called Neanderthals.

There are only three non-dental aspects of craniofacial form that are clearly associated with the forces of selection: relative size of the brain box itself, the thickness of its walls, and the size of the nasal skeleton. The first of these, the relative size of the portion of the cranium devoted to enclosing the brain, does not differ between representatives of contemporary hominids over the span of the last one-and-one-half million years. The same thing is also true for the second of those three key cranial features, the thickness of the skull bones themselves (Kennedy, 1991). However, both relative brain size and the thickness of the cranial vault walls have changed significantly over time, but they have never displayed significant regional differences at any given point. For more than 80% of the time that the genus *Homo* has been in existence, there is also no evidence for discernible differences in the size of the nasal skeleton between contemporary hominids.

In a manner similar to the emergence of tooth size distinctions, regionally recognizable differences in nasal size have only arisen within the last 200,000 years (Franciscus and Trinkaus, 1988; Franciscus and Long, 1991). The contrast in the manifestation of that feature is vividly displayed when Qafzeh is compared with the "classic" Neanderthals. That degree of adaptively related nasal difference, however, is scarcely sufficient reason to warrant separate specific recognition. When matters are considered using this perspective, there is no more reason to separate Qafzeh and the "classic" Neanderthals at the specific level than there is to grant specific distinction to the difference in nasofacial features displayed when living sub-Saharan Africans are compared with northwest Europeans — or at least some northwest Europeans.

From the perspective of evolutionary biology, this simply portrays the same stance as the one articulated by Franz Weidenreich nearly half a century ago, namely, that, since the beginning of the genus *Homo*, there has been only one human species in existence at any one time (Weidenreich, 1943a,b, 1946, 1947, 1949). However, it was the addition of an adaptive perspective to Weidenreich's conception of gene flow that suggested how the mechanics could work that would both maintain specific unity at any given point in time and also produce the kind of coordinated change by which "modern" form emerged simultaneously over the whole range inhabited by the genus *Homo* (Brace, 1964, 1967, 1979, 1991b, 1992, 1995b, 1996a,b).

The mechanics of the model I offered nearly thirty years ago have been alluded to piecemeal (e.g. Brose and Wolpoff, 1971; Wolpoff, 1980; Wolpoff et al., 1984), but the model as a whole has never been given any consideration at all. The measure of the extent to which it has been overlooked can be seen in the off-hand claim that simultaneous evolutionary change towards a modern configuration from various regional Neanderthal

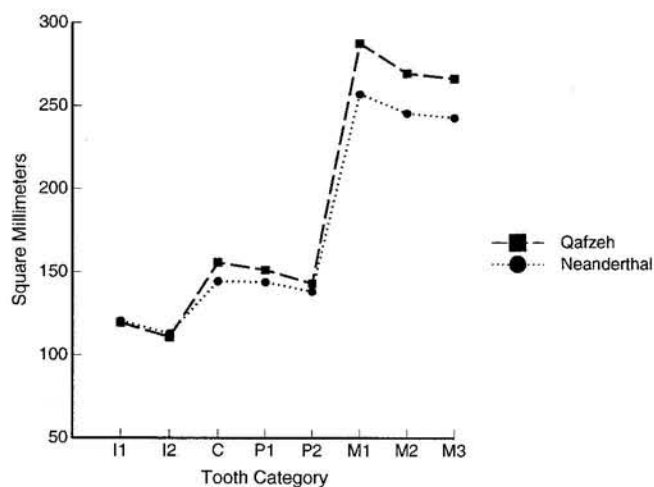


Fig. 3. Tooth-size profiles comparing dental dimensions of Qafzeh and European "classic" Neanderthals. Data are given in Table 2.

manifestations "can hardly be considered likely" (Bräuer, 1984). Even the recent formulations most obviously derived from it, the so-called "multiregional" continuity model — said to have been "first outlined in a broad theoretical context by Wolpoff et al. in 1984" (Smith et al., 1989) — only added the two syllable "multi" to the original version of regional continuity and removed a consideration of the mechanism by which the whole process is driven (Brace, 1992, 1995a,b). This being the case, it is time that the essential parts of that model were recapitulated in summary form.

## CONCLUSIONS

"Modern" human form is a typological abstraction uneasily grafted onto the fact that all living human beings belong to the same species despite manifest differences in appearance. The emergence of "modern" human morphology would appear to have been produced in somewhat different fashion in different parts of the world. The essential precursor was the world-wide achievement of the intellectual and linguistic capacities that we now recognize as being uniquely human. This was the consequence of responding to the selective pressures engendered by survival within the milieu of the Cultural Ecological Niche (Brace, 1995b, Chapter 9). The only anatomical evidence we have for this is the achievement of proportionately modern levels of brain size somewhere between 200,000 and 100,000 years ago in people who otherwise had the skeletal and dental robustness of Middle Pleistocene *Homo erectus*.

What led to the appearance of "modern" form was the reduction in that *erectus* level of robustness that followed when those sapient intellectual capabilities interposed barriers between the forces of selection and specific aspects of the human physique. These barriers were developed at different times in different places, and the result was that "modern" human form emerged in mosaic fashion. The early appearance of obligatory cooking in the north led to the beginnings of dental reduction and the subsequent shrinking of the associated parts of the face. To this day, the people in the north temperate zone have the smallest teeth in the world.

At the same time, the use of projectiles for hunting purposes in Africa (Yellen et al., 1995) relaxed the selective pressures that elsewhere had maintained those aspects of robustness characteristic of post-cranial human form throughout the Middle Pleistocene. The consequence was that the gracilization which we think of as being "modern" developed first in the south long before there was any hint of the "modern" state of dental reduction (Shea 1988). Eventually, projectiles spread out of Africa via Israel and were adopted elsewhere (Shea, 1992), and the process of gracilization was the predictable consequence (Brace, 1995b). In similar fashion, cooking eventually spread south (Brace, 1995a, 1996b). It was not needed to thaw food, but it was eventually discovered that cooking could retard spoilage and thus prolong the period over which food-stuffs could be used. Again, the subsequent reduction in tooth size was the predictable result (Brace, 1995b).

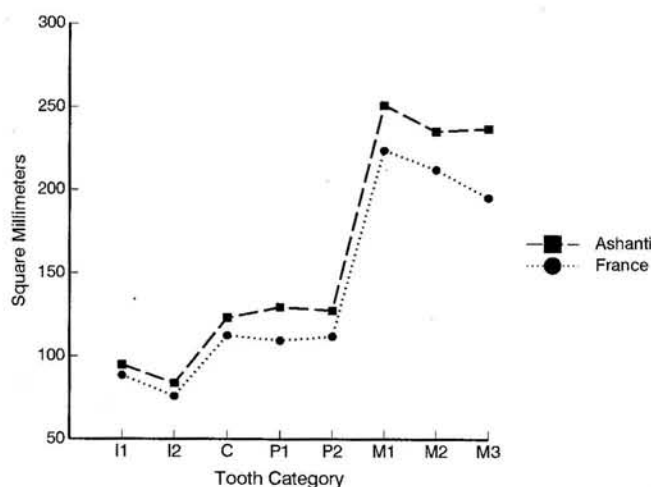


Fig. 4. Tooth size profiles comparing recent French dental dimensions with those of recent West Africans (Ashanti). Data are given in Table 2.

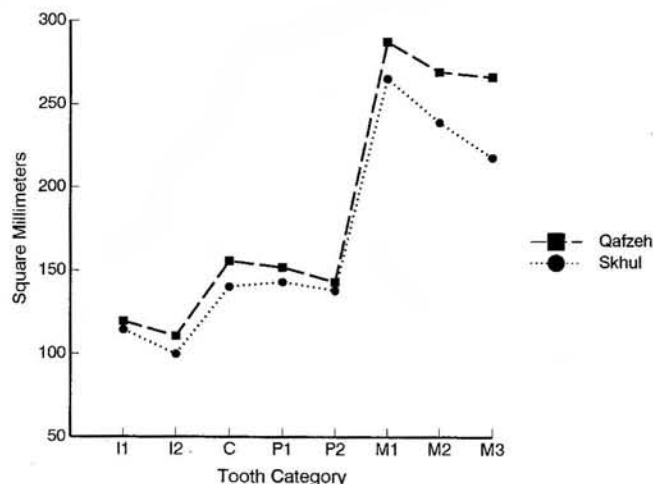


Fig. 5. Tooth size profiles comparing Qafzeh and Skhul. The pattern is exactly the same as that shown when West Africans and French are compared — just shifted a bit. Data are given in Table 2.

CRO-MAGNON AND QAFZEH — VIVE LA DIFFERENCE

Reduction in tooth size between Qafzeh and modern West Africans is 17% which is exactly the same as the percentage reduction between "classic" Neanderthal tooth size and the Late Upper Paleolithic in Europe (Brace, 1995c). Furthermore, the pattern of larger molar-to-incisor proportions of Qafzeh vis-A-vis Neanderthal (Fig. 4) is preserved when modern sub-Saharan Africans are compared with modern Europeans (Fig. 4). A striking similarity to the African-European comparison emerges when Qafzeh and Skhul are plotted on the same graph (Fig. 5). When the pattern of dental reduction is shown from Qafzeh to the modern Africans from whom they cannot be distinguished on craniometric features, the profiles of cross-sectional areas reduce in perfectly parallel fashion (Fig. 6), just as the tooth-size profiles of the Neanderthals and the modern French show a comparably parallel pattern (Fig. 7). This is treated in greater detail elsewhere (Brace, 1995c).

In both the details of its dental and craniofacial size and form, Qafzeh is an unlikely proto-Cro-Magnon, but it makes a fine model for the ancestors of modern sub-Saharan Africans. Along with the microfauna at the Qafzeh site (Tchernov, 1988, 1991, 1992), the human remains are best regarded as evidence for a temporary intrusion of African elements into the Middle East that had no direct long-term consequences. Indirectly, however, the adoption of projectiles by their Neanderthal contemporaries — whether at that time, or earlier — led to those selective force changes that produced the transformation of Neanderthal to "modern" post-cranial form. After another 50,000 years, Cro-Magnon was just what one would expect to see, but as the result of a transformation from a Neanderthal ancestor and not one that looked like Qafzeh.

Qafzeh and Cro-Magnon, then, represent earlier manifestations of African and European configurations respectively. Those patterns are alive and well in Europe and Africa today. Neither one is better nor worse than the other, they are simply different. On this note, we can celebrate that fact with the words, 'vive la difference'!

TABLE 2. Cross-sectional tooth size figures for the summed maxillary and mandibular teeth in the named categories for each of the populations indicated.

Population	Number	I1	I2	C	P1	P2	M1	M2	M3
Neanderthal	13(5-20)	120.5	113.0	144.3	144.9	138.2	257.0	254.5	242.8
Qafzeh	5(3-9)	119.5	110.6	155.5	151.0	142.9	287.5	269.5	266.4
Skhul	4(3-7)	114.6	99.9	140.3	143.1	137.9	265.4	239.2	217.9
Předmost	7(4-10)	101.6	91.2	127.7	130.1	132.2	266.2	245.7	254.5
Ashanti	20(10-31)	94.8	83.7	123.0	129.5	124.4	251.0	235.2	236.9
France	45(14-81)	88.5	75.8	112.5	109.5	111.9	223.9	212.2	195.3

Data are abstracted from Table 1 in Brace (1995c). Neanderthal data are from Wolpoff (1971:171-185), Qafzeh from Vandermeersch (1981:176-177), Skhul from McCown and Keith (1939:212-213), and Předmost from Matiegka (1934:142-143). Ashanti were studied at the American Museum of Natural History in New York. Specimens labeled "France" are from Brittany and Nièvre and curated at the Musée de l'Homme, Paris. Cross-sectional tooth size figures are the sum of the mesio-distal times the bucco lingual measurements for the means of the right and left maxillary and mandibular I1...M3.

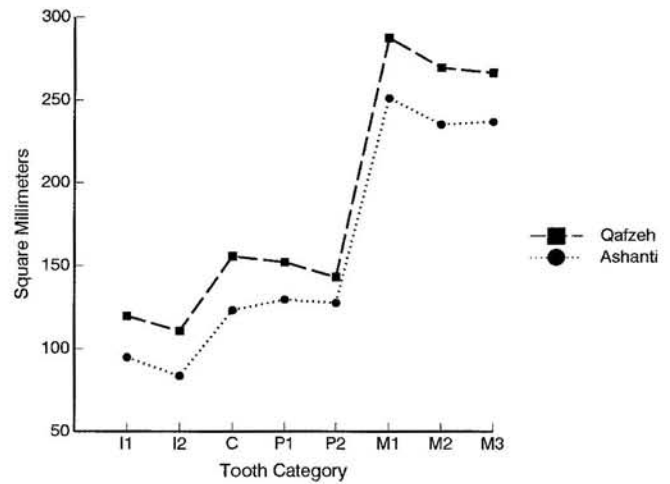


Fig. 6. Tooth size profiles comparing the dental dimensions of Qafzeh and a recent West Africa sample (Ashanti). Data are given in Table 2.

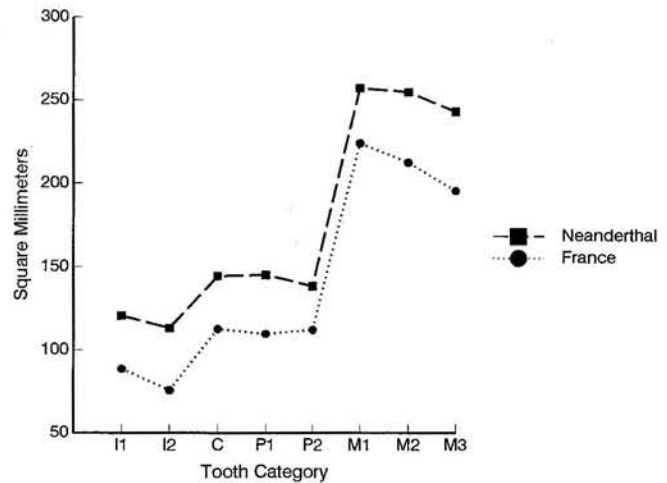


Fig. 7. Tooth size profiles comparing European "classic" Neanderthals with recent French. Data are given in Table 2.



## ACKNOWLEDGMENTS

This manuscript is based in part on the presentation given at the 3rd International Congress on Human Paleontology, Jerusalem, Israel, August 25, 1992. Attendance was made possible in part by the Irene Levi Sala CARE Archaeological Foundation. Qafzeh 6 was measured at the Institut de Paléontologie Humaine in Paris, courtesy of Professor H. de Lumley. Cro-Magnon 1 and the recent French samples were measured at the Musée de l'Homme in Paris, courtesy of Dr. J-L. Heim. The Ashanti sample was measured at the American Museum of Natural History, courtesy of Dr. I. Tattersall.

## LITERATURE CITED

- Bischoff JL, Soler N, Maroto J, and Juliá R (1989) Abrupt Mousterian/Aurignacian boundary at c. 40 ka bp: Accelerator <sup>14</sup>C dates from L'Abreda Cave (Catalunya, Spain). *J. Archaeol. Sci.* 16(6):563-576.
- Brace CL (1964) The fate of the "classic" Neanderthals: A consideration of hominid catastrophism. *Curr. Anthropol.* 5(1):3-43.
- Brace CL (1967) *The Stages of Human Evolution*. Englewood-Cliffs New Jersey: Prentice-Hall.
- Brace CL (1979) Krapina, "classic" Neanderthals, and the evolution of the European face. *J. Hum. Evol.* 8(5):527-550.
- Brace CL (1981) Tales of the phylogenetic woods: The evolution and significance of evolutionary trees. *Am. J. Phys. Anthropol.* 56(4):411-429.
- Brace CL (1982) The roots of the race concept in American physical anthropology. In F Spencer (ed.): *A History of American Physical Anthropology 1930-1980*. New York: Academic Press, pp. 11-29.
- Brace CL (1988) Punctuationalism, cladistics and the legacy of Medieval Neoplatonism. *Hum. Evol.* 3(3):121-138.
- Brace CL (1991a) Monte Circeo, Neanderthals, and continuity in European cranial morphology, a rear end view. In M Piperno and G Scichilone (eds.): *The Circeo I Neandertal Skull: Studies and Documentation*. Istituto Poligrafico e Zecca Dello Stato, Libreria Dello Stato, Rome, pp. 175-195.
- Brace CL (1991b) *The Stages of Human Evolution*. 4th ed. Englewood-Cliffs, New Jersey: Prentice Hall.
- Brace CL (1992) Modern human origins: narrow focus or broad spectrum? The David Skomp Lecture. Department of Anthropology, Indiana University, Bloomington.
- Brace CL (1995a) Bio-cultural interaction and the mechanism of mosaic evolution. *Am. Anthropol.* 97(4):1-11.
- Brace CL (1995b) *The Stages of Human Evolution*. 5th ed. Prentice-Hall, Englewood-Cliffs, New Jersey.
- Brace CL (1995c) Trends in the evolution of human tooth size. In J Moggi-Cecchi (ed.) *Aspects of Dental Biology: Paleontology, Anthropology and Evolution*. Ninth International Symposium on Dental Morphology, Florence, Italy. Florence: Institute for the Study of Man, pp. 437-446.
- Brace CL (1996a) A four-letter word called "race." In LJ Reynolds and L Lieberman (eds.): *Race and Other Misadventures: Papers in Honor of Ashley Montagu*. Dix Hills, New York: General Hall Publishers, pp. 106-141.
- Brace CL (1996b) Modern human origins and the dynamics of regional continuity. In T Akazawa and E Szathmary (eds.): *Prehistoric Mongoloid Dispersals. Symposium 1992*. New York: Oxford University Press, pp. 81-112.
- Brace CL, and Hunt KD (1990) A non-racial craniofacial perspective on human variation: A(ustralia) to Z(uni). *Am. J. Phys. Anthropol.* 88(3):341-360.
- Brace CL, Rosenberg KR, and Hunt KD (1987) Gradual change in human tooth size in the Late Pleistocene and post-Pleistocene. *Evolution.* 41(4):705-720.
- Brace CL, Smith SL, and Hunt KD (1991) What big teeth you had Grandma!! Human tooth size past and present. In MA Kelley and CS Larsen (eds.): *Advances in Dental Anthropology*. New York: Wiley-Liss, pp. 33-57.
- Brauer G (1984) A craniological approach to the origin of anatomically modern *Homo sapiens* in Africa and implications for the appearance of modern Europeans. In FH Smith and F Spencer (eds.): *The Origins of Modern Humans: A World Survey of the Fossil Evidence*. New York: Alan Liss, pp. 327-410.
- Broca P (1868) Sur les cranes et ossements des Eyzies. *Bulletin de la Société d'Anthropologie de Paris. série 2, Tome 111*, pp. 350-392.
- Brose DS, and Wolpoff MH (1971) Early Upper Paleolithic man and Late Middle Paleolithic tools. *Am. Anthropol.* 73(5):1156-1194.
- Cabrera Valdes V, and Bischoff JL. (1989) Accelerator <sup>14</sup>C dates for Early Upper Paleolithic (Basal Aurignacian) at El Castillo Cave (Spain). *J. Archaeol. Sci.* 16(6):577-584.
- Clark GA (1992) Continuity or replacement? Putting modern human origins in an evolutionary context. In H. Dibble, and P Mellars (eds.) *The Middle Paleolithic: Adaptation and Variability*. Philadelphia: University of Pennsylvania Museum, pp. 183-205.
- Diamond J (1989) The great leap forward. *Discover* 10(5):50-60.
- Diamond J (1990) A pox upon our genes. *Natural History* 99(2):26-30.
- Franciscus RG, and Long JC (1991) Variation in human nasal height and breadth. *Amer. J. Phys. Anthropol.* 85(4):419-427.
- Franciscus RG, and Trinkaus E (1988) Nasal morphology and the emergence of *Homo erectus*. *Am. J. Phys. Anthropol.* 75(4):517-527.
- Gingerich PD (1974) Size variability of the teeth in living mammals and the diagnoses of closely related sympatric fossil specimens. *J. Paleontol.* 48(5):895-903.

- Gingerich PD (1980) Dental and cranial adaptations in Eocene Adapidae. *Zeitschrift für Morphologie und Anthropologie*. Volume 71, No.2, pp. 135-142.
- Gingerich PD (1983) Rates of evolution: effects of time and temporal scaling. *Science* 222:159-161.
- Gleick J (1983) Stephen Jay Gould: Breaking tradition with Darwin. *New York Times Magazine*. November 20. pp. 48-64.
- Howell FC (1959) Upper Pleistocene stratigraphy and early man in the Levant. *Proceedings of the American Philosophical Society* 103(1):1-65.
- Hublin J-J (1978) Quelques caractères apomorphes du crâne néandertalien et leur interprétation phylogénique. *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences de Paris. série D, tome 287*, pp. 923-926.
- Kennedy GE (1991) On the autapomorphic traits of *Homo erectus*. *J. Hum. Evol.* 20(5):375-412.
- Klein RG (1992) The archeology of modern human origins. *Evol. Anthropol.* 1(1):5-14.
- Kurtén B (1954) Observations on allometry in mammalian dentitions: Its interpretation and evolutionary significance. *Acta Zoologica Fennica* 85:1-13.
- Kurtén B (1959) Rates of evolution in fossil mammals. *Cold Spring Harbor Symposia on Quantitative Biology*. Vol. 24, pp. 205-214.
- Kurtén B (1967) Some quantitative approaches to dental microevolution. *J. Dent. Res.* 46(5) (Supplement):817-828.
- McCown TD, and Keith A (1939) *The Stone Age of Mount Carmel. Volume 2: The Fossil Remains from the Levallois-Mousterian*. Oxford: Clarendon Press.
- Mategka J (1934) *Homo Pledmostensis: Fossilní Clovek z Předmostí na Morave. Nákladem České Akademie Věd a Umění, V Praze – Prague. L'homme fossile de Předmostí en Moravie (Tchécoslovaquie)*. 1. Les Crânes, pp. 105-145.
- Mellars PA, Bricker HM, Gowlett JAJ, and Hedges REM (1987) Radiocarbon accelerator dating of French Upper Palaeolithic sites. *Curr. Anthropol.* 28(1):128-133.
- Morton SG (1839) *Crania Americana*. Philadelphia: J. Dobson.
- Russell MD (1985) The supraorbital torus: "a most interesting peculiarity." *Curr. Anthropol.* 26(3):337-360.
- Shea JJ (1988) Spear points from the Middle Paleolithic of the Levant. *J. Field Archaeol.* 15(4):441-450.
- Shea, JJ (1992) Lithic microwear analysis. *Evol. Anthropol.* 1(4):143-150.
- Smith FH, Falsetti AB, and Donnelly SM (1989) Modern human origins. *Yearbook of Physical Anthropology*. Volume 32, pp. 35-68.
- Stringer CB, Grün R, Schwarcz HP, and Goldberg P (1989) ESR dates for the hominid burial site of Es Skhul in Israel. *Nature* 338:756-758.
- Tchernov E (1988) The biogeographical history of the southern Levant. In Y Yom-Tov and E Tchernov (eds.): *The Zoogeography of Israel*. Dordrecht: Dr. W. Junk, pp. 159-249.
- Tchernov E (1991) The Middle Paleolithic mammalian sequence and its bearing on the origin of *Homo sapiens* in the southern Levant. In O Bar-Yosef and B Vandermeersch (eds.): *Le Squelette Moustérien de Kebara 2*. Cahiers, de Paléoanthropologie. Editions du CNRS, Paris. pp. 77-87.
- Tchernov E (1992) Biochronology, paleoecology, and dispersal events of hominids in the southern Levant. In T Akazawa, K Aoki, and T Kimura (eds.): *The Evolution and Dispersal of Modern Humans in Asia*. Hokusen-Sha, Tokyo, pp. 149-188.
- Valladas H, Reyss J, Joron, JL, Valladas G, Bar-Yosef O, and Vandermeersch B (1988) Thermoluminescence dating of Mousterian 'Proto-Cro-Magnon' remains from Israel and the origin of modern man. *Nature* 331:614-616.
- Vandermeersch B (1981) *Les Hommes Fossiles de Qafzeh (Israël)*. Paris: Centre National de la Recherche Scientifique.
- Vandermeersch B (1989) The evolution of modern humans: Recent evidence from southwest Asia. In P Mellars and C Stringer (eds.): *The Human Revolution: Behavioural and Biological Perspectives on the Origins of Modern Humans*. Edinburgh: Edinburgh University Press, pp. 155-164.
- Weidenreich F (1943a) The "Neanderthal Man" and the ancestors of "Homo Sapiens." *Am. Anthropol.* 45(1):39-48.
- Weidenreich F (1943b) The Skull of *Sinanthropus pekinensis*: A Comparative Study On A Primitive Hominid Skull. *Palaeontologia Sinica*. New Series D, n°10, pp. 1-484.
- Weidenreich F (1946) *Apes Giants and Man*. Chicago: University of Chicago Press.
- Weidenreich F (1947) Facts and speculations concerning the origin of *Homo sapiens*. *Amer. Anthropol.* 49(2):187-203.
- Weidenreich F (1949) Interpretations of the fossil material. In WW Howells (ed.): *Early Man in the Far East: Studies in Physical Anthropology*, No 1. The American Association of Physical Anthropologists, Detroit, pp. 149-157.
- White R (1989) Production complexity and standardization in early Aurignacian bead and pendant manufacture: Evolutionary implications. In P Mellars and C Stringer (eds.): *The Human Revolution: Behavioural and Biological Perspectives on the Origins of Modern Humans*. Edinburgh: Edinburgh University Press, pp. 366-390.
- Wolpoff MH (1971) *Metric Trends in Hominid Dental Evolution*. The Press of Case Western Reserve University, Cleveland. Case Western Reserve Studies in Anthropology, no 2.
- Wolpoff MH (1980) *Paleoanthropology*. New York: Alfred A. Knopf.
- Wolpoff MH, Wu XZ, and Thorne AG (1984) Modern *Homo sapiens* origins: A general theory of hominid evolution involving the fossil evidence from East Asia. In FH Smith and F Spencer (eds.): *The Origins of Modern Humans: A World Survey of the Fossil Evidence*. New York: Alan Liss, pp. 411-483.
- Yellen JE, Brooks AS, Cornelissen E, Mehlman MJ, and Stewart K (1995) A Middle Stone Age worked bone industry from Katanda, Upper Semliki Valley, Zaire. *Science* 268:553-556.