Chapter 10

AURIGNACIAN FEMALE CRANIA AND TEETH FROM THE MLADEČ CAVES, MORAVIA, CZECH REPUBLIC

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Introduction

The two female crania from Mladeč were both found in the Main Cave by Szombathy in 1881. This paper presents their description and comparisons, and the descriptions of several much more fragmentary crania. There is no reason to assume their chronological age differs from the other surviving Mladeč cranial material from the Main Cave or the remains from the Quarry Cave (Svoboda, 2000). Consequently, we do not repeat the geological and archaeological discussion in Frayer et al. (this volume).

Mladeč 1 is the most complete of all the cranial remains from Mladeč. When first discovered it was regarded as male, but with the subsequent recovery of the Quarry Cave specimens (Mladeč 5 and 6), it became apparent that Mladeč 1 was female. While certainly not identical to Mladeč 1, the more incomplete calotte Mladeč 2 and the fragmentary face which articulates with it (Mladeč 7) constitute the second female. Both specimens are young adults based on dental criteria. The other specimens we very briefly describe in this chapter are fragments now destroyed (Mladeč 38 and 42) and the very fragmentary vault piece found by Knies (Mladeč 41) in the Main Cave. The latter, in the Moravské zemské muzeum Brno collections, is a small vault fragment that is unidentifiable (and unsexable). Based on the inventory provided by Szombathy (1925) and our revisions of it, certainly more female remains existed in the Main Cave, but these are the only survivors with useful information preserved. As with the Mladeč males, the tragedy at Mikulov castle robbed us all of a rich collection of early Upper Paleolithic female remains. Compared to the males, Mladeč 1 and 2 are considerably more gracile and differ between each other in various aspects of their preserved anatomy. These two contrast with Neandertal females much more than the Mladeč males contrast with Neandertal males. These two facts pose the main questions beyond the comparative descriptions that we consider here: the nature of sexual dimorphism at Mladeč, and the contrasting patterns of male and female evolution. Mladeč 1 and 2 are currently housed in the Naturhistorisches Museum Wien where they were studied by the authors at various times between 1974 and 2001.

Comparisons

For the most part, the rationale and details of the comparisons we made are discussed in the paper on the male remains from Mladeč by Frayer and colleagues (this volume). The comparisons are made by sex: the Mladeč females are compared with females from other samples, and only compared with the Mladeč males in the discussion of sexual dimorphism. Our comparisons involve means and ranges, as an alternative measure of variation, and we caution the reader to remember that these are observed ranges that may dramatically underestimate the expected ranges of variation for the prehistoric samples.

Adult comparative sample compositions

The European Neandertal sample

The specimens included in the sample of European Neandertals are, unless specifically noted, limited to those representing the period of the Würm glaciation, as indicated by stratigraphic, archaeological, and in a limited number of cases radiometric data. The female Neandertal sample consists of the following crania: Gibraltar (Forbes Quarry) 1; La Ferrassie 2; Marillac C10-41; La Quina 5[1], 8, 10, and 27; Saccopastore 1; Šala; Salzgitter-Lebenstedt; Spy 1[2]; and Vindija 202, 205, 224, 225, 252, 259, 260, 262, 279, and 284. For a variety of reasons, sex determinations for some of the females are somewhat more problematic. The list of females we use here represents our best determinations at this time.

The fact is that there are few female European Neandertals, and to expand our comparisons, in some cases we have also used Krapina C and E maxilla. The similarities of Saccopastore 1 and Gibraltar to the pre-Würm Krapina C (cranium 3) are often noted, and seem to be at least part of the basis for attributing an early date to the later two females (for instance, Stringer et al., 1984). However, we regard these similarities as due to sex and not to geological age, and therefore do not believe they can be used to infer geological age through a morphological date (for instance, as Payá and Walker, 1980; do). Clearly, a full understanding of Neandertal female morphology can only be resolved through the recovery of a well-dated Western European female late Neandertal, but this may be an expectation that is unlikely to be fulfilled because of the burial customs of the Neandertal folk themselves.

In addition to the above, the European female Neandertal dental sample includes Châteauneuf-sur-Charente 2 and Hortus 8.

The Skhul/Qafzeh sample

The Levant sites are clearly from the later part of the Middle Paleolithic, and by every date estimate they precede the Mladeč remains in age. While their ages are surely not identical, we believe that they sample similar and probably related populations and because they are potentially ancestral, they can be validly combined for comparisons, under the assumption that the ancestors of the Mladeč folk arrived in Europe by migration from the southeast. This is an idea that springs to the minds of many who continue to read the persistent descriptions of these folk as "proto Cro-Magnoids". We include this sample in our comparisons to allow an examination of the morphological basis that could provide evidence to support or reject the contention of this migratory origin for the Mladeč population from southwest Asia.

The female Skhul/Qafzeh cranial sample we have used consists of Qafzeh 3 and 5, and Skhul 2 and 7. The bases for considering Qafzeh 9 and Skhul 9 males are presented in Frayer et al. (this volume). The female sample from Skhul/Qafzeh is very small, and all of the specimens comprising it are incomplete. Comparisons with these females are often of limited value because of their fragmentary nature, and in a number of cases we do not make them at all. When our comparisons are limited to a single individual, we identify it.

The European early Upper Paleolithic female sample

The third comparative cranial sample is from the earliest European Upper Paleolithic of Central Europe, the sample of specimens closest to Mladeč in age. Because many were collected so long ago,

1 While La Quina 5 is often considered to be female, the dentition is among the largest of the Würm European specimens.

2 Spy 1 is problematic because in some respects it resembles the Feldhofer Cave male calotte.

convincing absolute dates are virtually unknown for this sample and in most cases the dating is by archaeological association. We have been conservative in the determination of this sample, not wishing to confuse the comparisons by including specimens that may actually be much younger. The sample is comprised of individuals that have the highest probability of actually representing European populations during the earliest phases of the Upper Paleolithic[3]: Zlatý Kůň, which may be later than the Aurignacian (Svoboda, 2000); Dolní Věstonice 1–3; Cioclovina (Păunescu, 2001); Předmostí 4, 10, and the older subadult 5. For the most part we do not make systematic comparisons with this sample, but discuss individual anatomical comparisons, or occasionally the comparison of mean values for measurements, when they inform the discussion. The specimens and their stratigraphic and archaeological context are reviewed in Churchill and Smith (2000).

Dates and associations from the literature on this sample are not always authoritative, because of the dates and in some cases the circumstances of discovery for the specimens. Female, or possibly female, specimens that have been thought to date to the earliest Central European Upper Paleolithic, but that either lack convincing confirmatory archaeological and/or geological evidence, or are now known simply to be later in time, include the following: Brno 3, Hahnöfersand, Svitávka; Velika Pećina, and Kelsterbach (Otte, 1979; Smith et al., 1999; Valoch, 1982; Svoboda et al. 2002; Vlček, 1971; Stringer et al., 1984 whose skepticism [pp. 68–69] we share). We believe it is very unlikely that we have included specimens in our sample significantly younger than 26,000 years B. P., and if we have erred it is on the side of caution.

Data collected

In almost all cases the observations and measurements reported here are based on studies of the original specimens in Vienna by the authors. Details of the measurements and measurement techniques and of the data sources are reported in Frayer et al. (this volume). For our Předmostí data, we have relied on the primary cast of cranium 4 located at the Moravské muzeum in Brno, the publications of Matiegka (1934), and additional details mentioned by Kříž (1903), Maška (1895), Wankel (1884), Skutil (1940), Absolon (1929), Hrdlička (1930), Szombathy (1925), and Morant (1930). The other specimens that could only be studied as casts were Cioclovina, and Dolní Věstonice 1 and 2. In all cases when the use of reproductions was necessary, accuracy of the casts was ascertained and if necessary the cast measurements were scaled by comparison with published measurements of the originals.

As much as possible, the morphological features we discuss are named following Weidenreich (1951). We almost always used standard measuring points, as defined by Martin (1928) and White (2000). In those cases where we found it necessary to define a position for measurement, it is discussed in the text. Our abbreviations for these and other landmarks and directions, especially as used in the tables, are given in Table 1.

We calculated indexes, angles at the parietal corners, and various projections into the sagittal plane at the midline. The only other calculated variable was cranial capacity. Direct determinations of the Mladeč hominids cranial capacities were never made. Szombathy ascertained a capacity for cranium 1 by taking the average of calculations made from the Manouvrier, Lee-Wackler, and Froriep formulae and the Welcker tables. This was approximately 1620 cc. Billy (1972) reports a capacity of 1550 cc. for this specimen. Szombathy estimated the cranium 2 capacity by taking proportions of cranial measurements with cranium 1, arriving at a range of 1470–1480 cc. Frayer (1986) reports a 1370 cc. determination, which he calculated from the Poissoinnet et al. (1978) regression.

3 This means the Szeletian, Aurignacian, and early Gravettian.

Table 1. Definitions of abbreviations found in the tables. The descriptions of the terms defined are in Martin (1928)

Abbreviation	Definition	Abbreviation	Definition
alv	alveolare	k	krotaphion
ant	anterior	L	length
ast	asterion	l	lambda
au	auricular point	mf	maxillofrontale
ba	basion	mm	millimeters
Br	breadth	ms	mastoidale
br	bregma	na	nasion
btwn	between	o	opisthion
C	canine	occ	occipital
cc	cubic centimeters	op	opistocranion
co	coronale	pr	prosthion
FH	Frankfort Horizontal	proj	projection
fmo	frontomalarorbitale	pt	point
fmt	frontomalartemporale	st	stephanion
gl	glabella	sup	superior
ht	height	UFH	upper facial height (na-alv)
i	inion	zm	zygomaxillare
iob	innerorbital breadth	zpm	zygomatic process of the maxilla
ju	jugale	zt	zygotemporale

We have calculated two regressions to determine the cranial capacities of these specimens, as well as several others from the Central European early Upper Paleolithic sample, using those individuals with actual endocast determinations. These are Dolní Věstonice 3 (1322 cc from Jelínek, 1954), Pavlov (1472 cc, from Vlček, 1991), and Předmostí adult crania 3 (1608 cc), 4 (1518 cc), 9 (1555 cc), and 10 (1452 cc, all from Matiegka, 1934). There is also an endocast capacity for the Předmostí juvenile cranium 22 (1335 cc), but this was not used in the derivation of the regression formulae.

These 5 crania formed the basis for developing two regressions for cranial capacity estimation, a least mean squares linear determination, and a power curve based on a least mean squares fit of logs. In both cases we used a volume estimation for the independent variable. The volume was estimated two different ways, using measurements that avoided including cranial superstructures. Nasion-opistocranion provides a length measure that does not include the superciliary area, and nasion-lambda is the most complete length possible on Mladeč 2. Biparietal breadth avoids the basal pneumatization, and the vertical height from the auricular point to bregma is the only comparable height measure for Mladeč 1 and 2. The two formulae are based on the following variables:

$$V_1 = \text{(nasion-opistocranion)*(biparietal breadth)*(auricular height)*}10^{-4},$$

$$V_2 = \text{(nasion-lambda)*(biparietal breadth)*(auricular height)*}10^{-4},$$

where in both cases the volume estimate variables were calculated from the products of the measurements in millimeters. Formula determined from the first could be used to estimate cranial capacity for Mladeč 1 and Cioclovina (1475 cc). Formula determined for the second could be used for these, and Mladeč 2. Linear and power curve regressions were determined for both volume variables from the sample of endocast capacities.

$cc = 3.21 * V_1 + 562.36$ (average error of 35 cc), $cc = 36.29 * V_1^{.656}$ (average error of 34 cc),

$cc = 3.51 * V_2 + 510.57$ (average error of 33 cc), $cc = 31.49 * V_2^{.685}$ (average error of 33 cc).

Four cranial capacities could be estimated for Mladeč, only the last two formulae could be used for Mladeč 2. The multiple estimates were averaged and the resulting capacities rounded to the nearest 5 cc. These estimates are given in Table 2. Our Mladeč 1 determinations are quite close to those published by Billy (1972), and the Mladeč 2 determination is close to Frayer's (1986). In all, we believe these capacities are probably as accurate as could be ascertained without direct volume determinations since they are based on regressions developed within the (biological) sample to which they are applied.

The female vaults

Mladeč 1

Mladeč 1, a virtually complete cranium, was found at locus "a" in Chamber D of the Main Cave at Mladeč by J. Szombathy in 1881 (Figs. 1, 2 and 5). Near it was recovered a femur diaphysis Mladeč 27. The vault was reconstructed from a number of pieces. The observations below are based on our study of the original specimen in the Anthropological Division of the Naturhistorisches Museum Wien (see this volume, chap. 8, Plate I).

We believe that an accurate age at death can be ascertained for Mladeč 1. Third molar crypts are present, and open to the alveolar margin on both sides, but neither tooth remains. According to Skinner and Sperber (1982, 298) these crypts are "poorly preserved and indefinite", with the left crypt "preserving in its roof a trace of alveolar radicular crest formation for root bifurcation." Their radiographs show fused roots for the second molars. Apical closure for the second molar roots is at about 14 years in populations that average a 12 year occlusal eruption for this tooth. If an 18-year occlusal eruption is assumed for the third molar, root development for this tooth would begin at about 15 years. Following this assumption, the suggestion of bifurcation in the root of one of the third molars indicates an age-at-death of 16–17 years.

The question, of course, is whether an 18-year-old age for M^3 occlusal eruption can be assumed. Root development of the third molar relative to the crown wear on the M^2 indicates that this may be an overestimate of the age at death, and certainly shows that the third molar eruption is not likely to have been significantly later than 18 years. Skinner and Sperber estimate an age of 14.9 [13.5–17.0 (90% confidence interval range)] for the specimen (assuming it is female, see below), which would indicate that the M^3 was erupting younger than 18 – a condition common for all hominids earlier than Mladeč. For an independent confirmation of the age at death, we examined the tooth wear on the anterior molars. M^2 shows little wear, with most of the ori-

Fig. 1. Lateral view of Mladeč 1

ginal cusp heights remaining. Szombathy reports that when the specimen was discovered the external cranial and facial sutures were open. To verify his observations with an estimate of the dental age, we compared Mladeč 1 to the Krapina E maxilla (aged at 16 years according to criteria developed by Wolpoff (1979), but with erupted third molars) and to several late Upper Paleolithic specimens in the Naturhistorisches Museum Wien with unerupted third molars but some wear on the second molars. The Mladeč 1 molars are equally or slightly more worn than any of these, suggesting that at death the specimen was not far from third molar eruption. A cast of the molar dentition was compared with other Upper Paleolithic specimens aged by Skinner and Sperber (1982). Mladeč 1 shows slightly more molar wear than the Lachaud adolescent (15–16), La Pique 62.1 (14–17), and the Roc de Cave juvenile (14–16). A comparison was also made with the maxilla of Mladeč 2. Here, the first and second molars of Mladeč 1 are slightly less worn, and Mladeč 2, as described below, has an erupted third molar. In sum, our experience with tooth wear in Upper Pleistocene hominids from Europe suggests that 16 and 17 years are reasonable approximations for the ages at death for these two Mladeč specimens. For these reasons, we estimate the age of death of Mladeč 1 to have been 16±1 years. The specimen was clearly an older subadult.

Mladeč 1 has often been regarded as a male (Szombathy, 1901, 1904, 1925; Morant, 1930; Matiegka, 1934; Riquet, 1970; Henke, 1987). We believe this perception comes from the size and robustness of this young specimen (especially compared with modern European females), and its purported similarities to the Cro-Magnon I male (Szombathy, 1901, 1904). On the other hand, other studies of the specimen have suggested the skull is a female (Jelínek, 1983; Frayer, 1978,

Fig. 2. The Mladeč 1 cranial base

1980, 1986; Wolpoff, 1982, 1999; Smith, 1982, 1984, 1997). The reason for this different interpretation lies in the basis of comparison. The "male" characters seem pronounced when comparisons are made with some of the later males from Western Europe, but the female characteristics are most evident when comparisons are made with the Mladeč males (e.g., Fig. 23 and other comparisons below).

We offer the following considerations to help accurately determine the sex of this specimen. Compared with Mladeč crania 4, 5, and 6 (see Figs. 19 and 23 for the comparison with Mladeč 5), the Mladeč 1 superior orbital margins are sharp and the superciliary arches are vertically tall, but only slightly projecting. Visually, compared with adult women from the early Upper Paleolithic of Europe, the expression of supraorbital projection is much less than Cioclovina, somewhat less than in Předmostí 4 females, but only slightly less than Zlatý Kůň. The frontal squama is high and rounded, and the nuchal region is much more gracile than those of Cioclovina and Předmostí 4. There is an elevated nuchal line at the midline, but no evidence of a nuchal ridge or torus. Although the mastoid process projects more below the cranial base than do the mastoids of the Mladeč males, its overall dimensions are smaller. The mastoid is considerably smaller and less projecting than the mastoids of the later Předmostí females.

Fig. 3. Lateral view of Předmostí 5, after Matiegka (1934)

Some of these comparisons may be influenced by the fact that the specimen is not a mature adult. While the final size of the palate, face, and vault had been attained, some of the cranial superstructures and muscle attachment areas might have developed further had the specimen lived longer. Moreover, in the Mladeč 4 male, a specimen clearly not very much older than Mladeč 1, but younger than Mladeč 5 and 6 on the basis of suture closure, the cranial superstructures and muscle markings are much better developed than in the Mladeč 1 female. However, as a 16-year-old female, we do not believe that the age related changes could have substantially altered the overall morphological features of the specimen. Therefore, comparison with the Předmostí 5 female is relevant to the problem of the Mladeč 1 age (Figs. 3 and 4). This Předmostí specimen died at a very similar age to Mladeč 1, Matiegka (1934) suggests an age of 15–16 years according to its dentition. We concur that she was slightly younger than Mladeč 1 at death, based on the superior position of the third molar, still in its crypt (in so far as it can be judged from the photographs published by Matiegka (1934)). Předmostí 5 is not unusually small; she has total cranial vault measurements almost invariably between those of the two adult Předmostí females (no. 4 and no. 10). Like Mladeč 1, her superciliary arches are distinct; vertically tall, but with little projection. The mastoids are very well-developed and projecting. There is lambdoidal flattening and the occipital has a very short vertical face. The nuchal plane shows distinct rugosity. This combination of "masculine" and even Neandertal-like features is expressed in a cranium that is diagnosably female. Similarly, the "masculine" supraorbital region of Mladeč 1 is less well developed than the Předmostí 4 supraorbitals, an older aged female (Fig. 8).

Fig. 4. Facial view of Předmostí 5, after Matiegka (1934)

We recognize that further growth and/or bone remodeling might affect the development of the supraorbital region, the nuchal region, and the expression of muscle markings on the vault. However, we do not believe it possible that these features could change to the extent that they would come to resemble the Mladeč males. Instead, we believe that if they had changed with increasing age, they would more closely resemble the Předmostí 4 (Fig. 8) or Zlatý Kůň (Fig. 24) females.

Thus, while Mladeč 1 might be considered as male if it had been found in a much later context, its association with the Mladeč 4, 5 and 6 crania and its general similarities to the Předmostí and Zlatý Kůň females leads us to sex it as a female. Indeed, its confusion with later males gives some insight into the mode of variation and the direction of evolutionary change in these early Europeans (Frayer, 1980).

Preservation

The skull is virtually complete, although it is missing the following portions: a small posterior section of the left zygomatic arch, the lateral and inferior portions of the right mastoid, a good portion of the lateral vault wall on the right (described below), a large triangular piece from the right portion of the lambdoidal suture laterally and inferiorly (mostly involving the occipital side of the suture), and all of the maxillary dentition except for the first and second molars. The missing portion of the lateral vault wall on the right side extends from about 17 mm posterior to the orbital corner to the mid-parietal, superiorly to 50 mm from the sagittal suture, and inferiorly to the border of the parietal except at its most posterior corner where temporal squama is also missing. This entire area has been reconstructed symmetrically with the left side and we consider this reconstruction to be quite accurate. The missing area around the lambdoidal suture has also been reconstructed.

Matrix has been left over much of the vault's surface, and staligmatic material even further obscures details of the *pars basilaris* and some of the sphenoid anterior to it, especially covering details at the occipitosphenoidal synchrondrosis. Apart from this area, the heaviest concentration is on the face, and covering the nuchal plane. However, except for the parts of the cranial base the matrix

Fig. 5. Mladeč 1 in an angled view

is very thin and most underlying details can be easily discerned. There is also a considerable amount of matrix on the interior part of the skull, making direct measurements of most cranial thicknesses and cranial capacity impossible, which is why we took a regression approach.

Dr. Hermann Prossinger (see Prossinger and Teschler-Nicola, this volume) of the Institute for Anthropology, University of Vienna, has interpreted a CT-scan of the vault for us. He notes the "whole cranium is covered with some sort of shellac or varnish." He writes further that there is a

> *"tell-tale x-ray signature of gypsum (primarily the smoothness of its attenuation) on the right side, where the gypsum is "embedded" in the fossilized bone (most likely so that the curator could keep the gypsum in place during the attempted reconstruction of the parietal). [Moreover, the base of the vault] is encrusted with some material that has a very large attenuation coefficient. It appears inordinately bright in the CT-images. Finding the border between this encrustation and the bases is no simple task. [...] There are many stones and similarly strongly attenuating materials in many places of the endocranium (plugging many foramina, for example). [...] The region of the frontal sinus is filled with a filament-like structure, which I think is some kind of deposited material. There are other sediments inside the cranium, as well as (in patches) all over the exterior surface."*

Despite these limitations, the overall preservation of the skull is good, so that it is possible to determine most standard landmarks and details of the external surface with accuracy. However, some areas of the external table have been flaked away, leaving small regions where the most external portion of the vault is missing. According to Szombathy, much of this flaking occurred during the original excavation of the skull and was associated with removing the adhering staligmatic pieces and reindeer ribs.

The vault as a whole

The cranium is very large, well rounded, and fairly robust in some features, especially considering its age at death. The cranial capacity we have determined for it (Table 2) is the largest of any female in the Central European early Upper Paleolithic. Its maximum length of 198.5 mm is also the largest value for any earlier Central European Upper Paleolithic woman, and exceeds the means of both the Neandertal and the Qafzeh female samples. Other measures of sagittal length reflect this marked size. Comparison of lengths taken from nasion and glabella show that the glabellar prominence of the specimen contributes significantly to this length. Interestingly, even with the larger supraorbitals of the Neandertal and Skhul / Qafzeh females, Mladeč 1 is longer than most of these more archaic specimens. Length measures including the face, such as prosthion-inion, also show Mladeč 1 to be longer than Neandertal females, as do direct measures from basion to glabella and to lambda. The one length measure that does not differ significantly between Mladeč 1 and the Neandertal females is the prosthion-mastoidale distance. The Neandertals are very large, compared with the earlier Central European Upper Paleolithic females, well outside their range in that the earlier Central European Upper Paleolithic and Neandertal female ranges do not even overlap.

The maximum cranial breadth occurs on the parietal bones, as it does on nearly all of the female specimens in the comparative samples. The breadth value, of 141.5 mm is below the Neandertal mean. Qafzeh 3 is considerably larger. Mladeč 1 narrows considerably at its base, although not as much as Neandertals. For instance, biauricular breadth is about 13 mm smaller than the maximum breadth of the vault, slightly less than the mean difference in Neandertal females. The bimandibular fossa breadth, across the outsides of the glenoid cavities (bi-*gp*), exceeds biauricular breadth, unlike every Neandertal female vault. The mastoids are more vertically oriented in the Mladeč 1 vault, and therefore the distance between their tips is toward the top of the Neandertal

Table 2. Female cranial vault dimensions

	Mladeč females 1	Mladeč females 2	Mladeč male 5	Qafzeh 3	Neandertal Mean (n)	Neandertal Range
Capacity (cc)	1540.0	1390.0	1650.0		1297.0 (4)	1245.0–1367.0
Lengths (mm)						
gl-op	198.5		205.6	182.5	193.6 (3)	179.0–201.0
gl-l	185.0	175.0	194.0	175.5	178.0 (3)	166.0–185.5
na-op	193.0		196.0	176.9	188.6 (4)	176.0–199.5
na-i	179.0		186.5	174.0	183.2 (4)	170.5–196.9
na-l	182.0	173.0	188.2	170.5	177.0 (4)	165.5–186.6
br-i	160.5		160.2	151.0	144.5 (5)	139.8–152.3
pr-i	192.0				184.3 (2)	177.0–191.5
pr-ms	129.5	124.0			128.4 (2)	125.9–130.9
ba-gl	113.4				109.0 (1)[2]	
ba-i	86.0				77.3 (2)	74.1–79.4
Breadths (mm)						
Cranial	141.5	141.0	156.0	156.0	142.7 (4)	138.3–146.0
Biparietal	141.5	140.0	154.0	156.0	142.7 (4)	138.3–146.0
Auricular	128.8	132.4	150.0		126.5 (4)	119.9–130.1
Bimastoid	108.0	113.0	136.0		101.3 (4)	96.2–110.4
Bimandibular fossa	129.0	132.3			124.1 (4)	119.2–126.0
Heights (mm)						
ba-br	138.0				113.3 (2)	110.5–116.0
op-br	155.0				133.2 (2)	132.5–133.9
Arcs (mm)						
na-op	306.0		318.0		278.5 (2)	270.0–287.0
na-i	345.0		342.5	317.0	287.2 (3)	282.0–297.5
na-o	395.0			378.0	331.0 (1)[1]	
gl-l	248.0	241.0	256.0	254.0	219.2 (3)	214.0–225.5
br-i	210.0		202.5	194.0	176.6 (4)	170.0–186.5
au-br	154.0	147.0	159.0		147.5 (4)	140.0–152.0
*Indices (*100)*						
MaxB/Max L	71.3		75.9	85.5	74.1 (3)	68.9–81.6
MaxB/na-l	77.8	81.5		91.5	80.8 (4)	76.6–88.2
Parietal B/Max L	71.3		74.9	85.5	74.1 (3)	68.9–81.6
au ht/na-l	61.8	59.9	59.1		59.8 (4)	54.6–66.3
au ht/na-op	58.2		56.7		56.0 (4)	52.5–62.3
gl-l arc/chord	134.1	137.7	132.0	144.7	123.3 (3)	119.3–128.9
br-i arc/chord	130.8		126.4	128.5	122.3 (4)	118.4–127.3
au-br arch/chord	117.1	119.5	118.6		119.6 (4)	116.9–121.2

[1] Gibraltar1

range in spite of the generally broader dimensions of the Neandertal female crania. Like the Mladeč males, the bimastoid distance is large relative to the Neandertal and the earlier Central European Upper Paleolithic means, suggesting that a broad distance across the mastoids characterizes the entire Mladeč sample.

Cranial height as measured from bregma (vertex is coincident with bregma), greatly exceeds the Neandertal maximum. From the auricular point (Table 3), height also exceeds the Neandertal range (although to a lesser extent). The difference in cranial height characterizes the general relation between the Neandertal and the earlier Central European Upper Paleolithic female samples, although in the male comparisons (Frayer and colleagues, this volume), cranial height for Mladeč 5 is almost the same as the Neandertal mean. Expressed as a ratio to nasion-opistocranion or nasion-lambda lengths (Table 2), the relative auricular height is almost the same as in Neandertal females. In fact, of all these specimens, the vault with the *greatest* relative height is Gibraltar 1. The difference in cranial height, then, reflects the larger size of Mladeč 1 and not the appearance of a different cranial proportion.

As seen in lateral view (Fig. 1), the Mladeč 1 face appears quite vertical, except for its alveolar prognathism which results in an index of prognathism (gnathic index) of 104.2 (118.3 from the auricular point, see Table 11). The gnathic index is slightly less than in the Neandertals, while the auricular gnathic index is slightly greater. We take this to mean that the degree of prognathism is essentially the same. The middle and upper facial regions are quite flat transversely, but the region of the maxilla surrounding the nasal aperture is very prominent and the angle of the nasal bones is high. This nasal angulation conforms to the Neandertal and the early Central European Upper Paleolithic pattern in which the angulation begins at nasion, and is distinct from the flat vertical orientation of the superior portion of the nasals preserved in the Qafzeh 3 female.

A significant contrast in lateral view comes with the relative height of the face. Although the Mladeč 1 facial height is the largest of all Central European Upper Paleolithic women, compared with the nasion-lambda dimension,[4] it is a relatively low face in relation to the Neandertal females (Table 11). This ratio (38.5) is much below the Neandertal mean and range.

Table 3. Distances from the auricular point to midline landmarks, in sagittal projection (mm) for female crania

au projection to:	Mladeč females 1	Mladeč females 2	Mladeč male 5	Neandertal Mean (n)	Neandertal Range
prosthion	110.0	110.8		116.3 (2)	112.6–120.0
nasospinale	103.2			107.5 (2)	107.3–107.6
nasion	93.0	87.8	103.5	103.9 (4)	95.0–111.2
glabella	100.1	96.0	114.5	112.4 (3)	107.9–116.0
bregma	112.4	103.7	111.2	105.4 (4)	96.2–109.7
lambda	109.5	98.9	103.0	97.9 (4)	91.7–104.1
opistocranion	105.1		99.2	83.9 (4)	77.9–92.1
inion	86.6		84.8	83.9 (4)	77.9–92.1
opisthion	42.4			41.1 (2)	35.3–46.9

4 So that Mladeč 2 can be compared, the length to opistocranion was not used.

Table 4. The cranial base and the position of basion for female crania

	Mladeč 1	Neandertal	
		Mean (n)	Range
ba-hormion	30.1	24.2 (2)	22.8–25.6
ba-pr	108.9	109.0 (2)	104.0–114.0
ba-na	104.5	103.0 (2)	101.9–104.0
ba-Glenoid pt	68.3	66.1 (2)	65.2–67.1
ba-ms	57.8	53.2 (2)	52.0–54.4
o-ms	60.9	60.8 (2)	58.6–63.9
ba-au projection	24.8	11.4 (2)	11.2–11.6
Front Occ Condyle-pr	104.4	111.1 (1)[1]	
Front Occ Condyle-na	104.5	104.0 (1)[1]	
Front Occ Condyle-i	88.4	81.0 (1)[1]	

[1] Saccopastore 1 only

At first glance, projection of the upper face anterior to the cranial base seems to be dramatic in this specimen. For instance, the nasion-basion diameter (Table 4) exceeds both the Neandertal and the earlier Central European Upper Paleolithic ranges. The basion-glabella distance is also large (Table 2). Thus, as measured from basion the upper face seems to project markedly, as we have observed it does in the Mladeč males (Frayer and colleagues, this volume). However, the corresponding measurements of the upper face from the auricular point are somewhat less (Table 3). In this case the Mladeč 1 values are below the Neandertal ranges. The projection from the auricular point to nasion is about 90% the Neandertal mean. Contrasting the measurements from basion with the measurements from the auricular point, the variation in estimates of facial projection from these two different regions of the cranial base indicate that there is a distinction between the relative positions of basion on the one hand, and of the biglenoid and the biauricular lines on the other.

That such a difference exists is easily observable by inspection (Fig. 6). In Neandertal females such as Gibraltar and Saccopastore 1 the biauricular line passes at or posterior to basion, while in Mladeč 1 and the other earlier Central European Upper Paleolithic females such as Předmostí 4 and Dolní Věstonice 3 this line passes *anterior* to basion.

We examine the possibility that in the more recent sample the auricular position is the same and it is the front of the foramen magnum that is further from it than in the Neandertals. This would account for the contradictory comparisons of facial projections discussed above. In measurements of the distance between basion and hormion (because of the adhering staligmatic material the occipitosphenoidal synchrondrosis cannot be found in Mladeč 1), two Neandertal females average 24.2 mm (Table 4), but the Mladeč 1 value is 30.1 mm. Although Mladeč 1 cannot be directly compared, the length of *pars basilaris* averages 17.9 mm for these two Neandertal females, and 25.7 mm for two earlier Central European Upper Paleolithic females, reflecting the same difference. The males reveal a similar pattern, four Neandertals averaging 21.7 mm and two earlier Central European Upper Paleolithic specimens averaging 24.7 mm for the *pars basilaris* length. Moreover, in the males of the early Central European Upper Paleolithic sample the biauricular line also passes anterior to basion while in the Neandertal males the line is posterior to basion. In sum, whether directly measured from the foot of the vomer or from the sphenoid, the front of the foramen magnum is further from these points in the Central European early Upper Paleolithic sample of both sexes.

The same does not hold for the position of the posterior foramen magnum. In the Neandertal females the biauricular line averages 41.1 mm anterior to opisthion and Mladeč 1 is virtually identical, 42.4 mm. The fact that the foramen magnum length is considerably greater in Mladeč 1 (Table 8) accounts for this difference.

What of the distance from basion to the dentition? A measure from the front of the occipital condyle to the second molar position (Table 13) is much shorter in Mladeč 1 than in Saccopastore 1. The distance from basion to the M^3 posterior border varies similarly, with the mean for two Neandertal females at 65.8 mm while we estimate Mladeč 1 at about 55 mm. The Neandertal dentition is further from the cranial base, and this distance is reduced in Mladeč, presumably as an aspect of facial reduction but this does act to shorten the leverage of molar forces around the fulcrum of the occipital condyles.

A similar effect is the closer positioning of the Mladeč tooth row to the glenoid fossa and the mandibular condyle than is the case for the Neandertal females (Table 4). The more flattened Mladeč 1 face results in essentially the same distances from the auricular point or the glenoid point to *zygomaxillare* (direct measurements) as the Neandertal females have, in spite of the fact that projection of the lower face is reduced in Mladeč. Thus, the Mladeč posterior teeth have moved even further behind *zygomaxillare* and thereby away from the most anterior masseter attachment, and toward the cranial articulation of the mandible. Put another way, more of the posterior tooth row is directly covered by temporalis and masseter musculature, and the anterior teeth have moved closer to the most anterior masseter attachment. It is because of this facial flattening that in spite of the changes described above, the facial length measure *(au-fmo)* of Mladeč 1 is virtually identical to the Neandertal female mean.

In a different analysis of the cranial base, the basion position orthogonally projected onto the nasion-lambda line was determined. The position of basion was calculated as a ratio of the distance between the position of the basion projection to nasion, with the full nasion-lambda distance. This ratio is 49.0 for Saccopastore 1 and 53.1 for Gibraltar. Mladeč 1 is less, 43.3 mm.[5] The Mladeč basion position is more posterior relative to the nasion-lambda line.

We believe there are two differences between Mladeč and the Neandertal sample that in combination resolve these contradictory observations. The evolution of Mladeč, and subsequently of the rest of the earlier Central European Upper Paleolithic sample, has involved a more posterior positioning for *both* the full face and basion, and a deepening of the vault lowering the basion position. As Lieberman (1975) and Laitman et al. (1979) have pointed out, the reduction in anterior positioning of the Neandertal face had consequences that could potentially affect the form of the supralaryngeal vocal tract, trachea, and esophagus in the submandibular region. We believe the more posterior position of the foramen magnum in the earlier European Upper Paleolithic is a response to the parallel reduction in facial size and projection. Together, these posterior shifts in the positions of the face and the cranial base *helped maintain a consistent form and unchanging function* for the structures in the submandibular region, during a period of marked evolutionary changes in the structure of the face. In this respect, our interpretation of the evolutionary changes in all the elements of this region differs from Lieberman (1975) and Laitman et al. (1979). They regard the developments in this region as corresponding to a functional *change* in the supralaryngeal area, while we interpret the differences between the Neandertal and the earlier Central European Upper Paleolithic samples as maintaining the same functional relationship while the anterior projection of the face reduced.

5 The three other females in the earlier Central European Upper Paleolithic sample are just about the same, averaging 45.5 (43–48.3). The same relation holds for the males: four Neandertals average 51.0 (48.4–53.2), while two earlier Central European Upper Paleolithic males average less, 46.9 (43.5–50.3).

Fig. 6. Comparison of the Neandertal female from Saccopastore (left) and Mladeč 1. This comparison addresses many things, but perhaps the most important is the logic behind comparing specimens of the same sex. A surprising number of contrasts said to distinguish Neandertals are not seen here. Saccopastore does not have a less projecting mastoid process, the vertical face of her occiput is not sorter, she does not have a better expressed occipital bun, and her cranial height as would be seen in life – the cranial height above the top of the orbit – is not markedly less. Of course Saccopastore is a Neandertal and Mladeč 1 is not, but this issue is not about the taxonomic identity of the specimens, it is over how and why they differ. Holding sex constant is an important way to address it

We conclude that the position of the auricular point has been more conservative than the position of the foramen magnum, and that both the face and the front of the foramen magnum change their positions in concert relative to the biauricular line. Consequently, because the region is more stable, the measurements from the auricular point are the more relevant for understanding the changes in basal and facial morphology. For this reason, we regard the reduced projections of the Mladeč 1 face relative to auricular point as best describing the actual morphological change (Table 3).

However, understanding the comparisons of these projections for the Mladeč 1 prognathism index as calculated from the auricular point (Table 11) is limited by the fact that there are no faces allowing this calculation in the Skhul/Qafzeh female sample, and confused by the fact that more specimens contribute to the mean distances to the upper part of Neandertal faces than to the mean distances to the lower part. Comparing mean values, it appears that while projections to the upper part of the face (nasion and glabella) are markedly reduced, the reductions to the lower part are somewhat less reduced. However, this is not actually the case. The two Neandertal females that are complete have the same index that Mladeč 1 has (117 for the Neandertals, 118 for Mladeč 1, and for that matter four Neandertal males have a mean index of 117). The difference between the ratio of the Neandertal means and the mean of the Neandertal ratios comes from the fact that more specimens contribute to the mean values for the upper part of the face than contribute to the mean values for the less often preserved lower part of the face. We contend that the mean of the ratios gives the more accurate comparison.

Other observations of the vault in lateral view show it to be evenly rounded from glabella to a position about 78 mm posterior to bregma. Beginning here the bone is flattened for a distance of 37 mm, to the position of lambda. Below this there is a distinct occipital bun. The anterior aspect is more curved than the Neandertals, the glabella-lambda arc/chord index, for instance, is above the Neandertal range, but this curvature is dramatically less than Qafzeh 3. The more posterior portion contrasts and is less curved. The arc/chord index for bregma-inion, while still above the Neandertal range, is closer to the mean and very similar to the index for Qafzeh 3. We attribute this difference in curvature to the Mladeč 1 bunning, which is very Neandertal-like. In a comparative context, the

Fig. 7. Mladeč 1 compared with the Qafzeh females 3 (left) and 7 (right), Mladeč 1 drawn by Karen Harvey and the Levant women after Vandermeersch (1981). These Levant females are potential ancestors for Mladeč 1 under both the replacement and Multiregional hypotheses

degree of occipital bunning within the Neandertal female sample varies considerably. In some, such as Spy 1 and Gibraltar the parietal flattening associated with this morphology extends well onto the occiput. In others such as La Quina 5 this flattening involves only the posterior of the parietal bones; the superior surface of the occiput is evenly curved. Bunning in the earlier European Upper Paleolithic females, including Mladeč 1, conforms to the latter pattern. In contrast Qafzeh 3 lacks bunning of any kind (Fig. 7), while Qafzeh 5, has a very elongated flattened area involving the parietal bones and occiput.

The posterior aspect of the vault is quite projecting. Indeed, this is characteristic of the entire earlier Central European Upper Paleolithic sample, but in this regard the Mladeč 1 specimen is at the top of the range or above, so the posterior projection of this specimen is greater than most (Fig. 8).

Our final observations from the lateral view concern the orientation of several aspects of the cranial base. Posterior to the foramen magnum, the nuchal plane of Mladeč 1 is much more angled than the nuchal planes of the Neandertal females, which range from somewhat less angled to nearly horizontal. In contrast, the Skhul/Qafzeh females appear to have an even higher angulation of the nuchal plane.

Anterior to the foramen magnum, the *pars basilaris* is also more angled superiorly in the anterior direction, compared with the Neandertal females. These data combine to suggest that the foramen magnum itself, and the occiput surrounding it, is in a more inferior position in Mladeč 1, and the vertical separation of the auricular point from the cranial base is also greater. This seems to represent an inferior expansion of the posterior portion of the braincase, and is characteristic of the comparative earlier Central European Upper Paleolithic sample, in some cases to an even greater degree. This observation is compatible with the increased Mladeč distances of the front of the foramen magnum from the biauricular line, described above. This increase is not as much *posterior* as it is *inferior*. These comparisons are quite evident in Fig. 6.

In sum, we have described three changes in Mladeč 1 that together account for the increased flexure of her cranial base when compared with the Neandertal females. These are (1) the more inferior position of the foramen magnum reflecting the expansion of the inferioposterior cranial base, and (2) the more posterior positions of the face, so that the same functional relationships in the submandibular region are maintained. It is in these changes, rather than in the changing flexure of the cranial base resulting from them, that the sources of evolutionary change can be found. However, to fully understand the influence of these changes, the expanded braincase must also be taken into account. Mladeč 1, like the other early Upper Paleolithic females of Europe, has significant brain size expansion compared with the Neandertal males. In this change, the females are not similar to the

Fig. 8. Mladeč 1 (right) compared with Předmostí 4 (left, after Matiegka, 1934). These early Upper Paleolithic females share many features. In particular, they both have "masculine" details such as supraorbital development. Nasal angulation (including the high position of the base of the nasal angle), the size of facial foramina such as the zygomatic foramen, visible in this view, and the angle and prominence of the lambdoidal flattening are more Neandertal-like in the earlier Mladeč specimen

comparison of males, and the amount of sexual dimorphism in brain size is reduced in Europe (Frayer, 1986).

The increased basal flexure of the earlier Central European Upper Paleolithic females, clearly seen in Mladeč 1, is associated with some reduction in the basal length of the vaults (Weidenreich, 1943; Howell, 1951). Thus, the nasion-inion distance (Table 2) reduces from 183.2 mm in the Neandertals to 179 mm in Mladeč 1, a consequence, we believe, of the vaults' reduced anterior projection. The Skhul/Qafzeh females are even more reduced. However, as discussed in Frayer and colleagues, this volume, the Mladeč males do not show a corresponding reduction in basal length. Since the crania of the earlier Central European Upper Paleolithic males are like the females in that they are more flexed than those of their Neandertal male counterparts, and we assume the Mladeč males are similar to these others, the changes in flexure and in basal length do not appear to be functionally related.

From the vertical aspect, postorbital constriction is slight. The vault bulges strongly behind the anterior border of the temporal fossa, and then continues to broaden slightly to the parietal bosses. The bosses are positioned directly over the mastoids, anterior and superior to the position observed in most of the comparative specimens. Behind the bosses the skull narrows sharply to the sides of the occipital bun, which is thereby pronounced in appearance. This general configuration of the parietal bosses and the area posterior to them is characteristic of some Neandertal females (for instance, La Quina 5). The whole contour is not much like Qafzeh 3, the Skhul/Qafzeh female best preserving these details.

Also from the superior view, there is marked glabellar prominence anterior to the otherwise flat, superior facial region. Glabellar projection does not obscure the even more projecting superior nasal region or the prognathism in the alveolar region. On the right (undistorted) side, the zygomatic arch can be observed. The comparison with Gibraltar is illustrative. Glabellar prominence is similar in this Neandertal female, although the width of the projecting area is narrower. Lateral to it, the superior orbital rim is more strongly angled posterolaterally. The view of the nose is equally projecting in this view, but below it the less prognathic maxilla cannot be seen.

As seen from the rear the parietal walls are vertical, with their greatest breadth at the parietal bosses. Szombathy describes this shape as pentagonal. The contour of the superior surface is slightly domed (Fig. 9). This condition is common for the earlier European Upper Paleolithic females, and not unlike the left contour of the Spy 1 vault, which, however, has lower and more posterior parietal bosses and the parietal wall turns more markedly medially at its base. In the Levant females, the Qafzeh 3 morphology is quite similar to that of Mladeč 1 except for the more posterior position of the boss. The mastoids of Mladeč 1 are vertically aligned, parallel with the parietal sides, differing in this respect from both Neandertal and Skhul/Qafzeh females and some of the other earlier European Upper Paleolithic sample (for instance, Předmostí 4) in which the processes show a definite medial orientation. In other earlier European Upper Paleolithic females such as Předmostí 10 however, the mastoids are more vertical and resemble the orientation of Mladeč 1.

There is a large irregular ossicle at the lambda position (about 14 mm in breadth and 15 mm in height), and a second much smaller one between the large ossicle and the right parietal. Szombathy located lambda within the large ossicle, evidently by extending the sutures to the point where they would have met had there been no ossicle. This ossicle extends along the right portion of the lamb-

Fig. 9. Posterior view of Mladeč 1

doidal suture, almost to the broken area. There are at least four additional very small ossicles along the left portion of the lambdoidal suture.

The basal view of Mladeč 1 (Fig. 2) shows the changes in foramen magnum position discussed above. Besides the features associated with a more posterior foramen magnum position (elongated *pars basilaris,* etc.), a number of other differences may be noted that align the Mladeč specimen with the earlier Central European Upper Paleolithic sample. The orientation of the long axes of the glenoid fossae in the Neandertals is almost exactly transverse to the long axis of the skull, while in Mladeč 1 and other earlier European Upper Paleolithic female specimens the long axes of the fossae have a distinct anteromedial orientation. The temporal fossa is in a more anterior position for all of the earlier Central European Upper Paleolithic females, including Mladeč 1.

The Mladeč 1 temporal fossa length, 44 mm, is almost as large as the 44.5 mm Neandertal mean (Table 9). Breadth of the fossa seems to differ markedly, with the Neandertal fossa much narrower. However, this may be an artifact of small sample size. Area enclosed by the fossa can only be compared for Mladeč 1 and the Gibraltar female. The Neandertal area is only 74% that of the Mladeč female. Perhaps this is attributable to the small sample size, but we suggest it might also indicate that the Neandertal females have smaller temporal musculature (see discussion of most posterior extension of temporal line).

In facial view, the Mladeč 1 face is shorter, flatter, and more strikingly overshadowed by a much higher forehead than any of the Neandertal females (Fig. 10). Some of the most dramatic differences are in the reduced heights of the face (Table 11). In contrast, upper facial breadths (biorbital, bizygomatic, and bijugal) are inconsistently different. Bijugal breadth is above the Neandertal female mean, reflecting the greater facial flatness of Mladeč 1, while the other breadths are reduced compared with the Neandertal females. There are greater differences in facial heights than in breadths, decreases in orbital and nasal heights result in a relatively low nose and low orbits. For instance, the nasal index for Mladeč 1 is much less than the female Neandertal mean (and below the range). Other associated central midfacial reductions include narrowing of the upper maxillary breadth and the bi-infraorbital foramen breadth compared with the Neandertals. However, as noted above the lateral aspects of the midface expand, so that midfacial and bijugal breadths increase. The facial height reductions are most dramatic of these changes, with Mladeč 1 much smaller than and well below the range of the 2 Neandertal females.

Another consequence of these changes is the complete lack of overlap in the orbital indices. Mladeč has significantly lower orbits; the heights are less and the orbital index reflects this. No orbital heights are known for the Skhul/Qafzeh females, but the orbit breadth of Qafzeh 3 is smaller than Mladeč or any Neandertal female. Another difference in orbital shape stems from the orbital margins. The Mladeč 1 orbits are rectangular with orbital margins that are approximately straight and at right angles to each other. Most of the other earlier European Upper Paleolithic females conform to this pattern; the rectangular form of the orbits is expressed equally or even more strongly in some of the other individuals such as Předmostí 10. However, in Mladeč 2 the orbital contours are rounded and thereby more like the Neandertals. In the Neandertal females the four orbital borders are rounded. Moreover, the juncture of the inferior margin with the lateral margins is not angular. Instead both medial and lateral margins slope significantly from the base (inferior margin), to the vertical midpoint of the orbit and this entire surface can be described as a junction. In sum, the Neandertal female orbits are not only absolutely taller, but have an orbital shape that is markedly rounded, when compared with most of the early Upper Paleolithic females from Central Europe.

The last difference in the orbits is observed in their lateral orientation. The outer and inner orbital margins in Mladeč 1 both lie in the same paracoronal plane, and thus the orbital angulation can be described as flat. This configuration is characteristic of the other earlier European Upper Paleolithic females, and to the extend it can be discerned, of Qafzeh 3. In the Neandertal females, the

Fig. 10. Mladeč 1 face

orbital pillars are posterior to the nasal borders, and thus the orbits are angled to the paracoronal plane. This distinction reflects the difference in facial orientation, and the fact that the Neandertal females are characterized by both a marked anterior projection of the nose and the maxilla surrounding it, and a posterior displacement and lateral orientation of the orbital pillars.

However, a distinct similarity is found in the development of the frontofacial paranasal sinus system. Europeans, including Neandertals, often have large frontal and large maxillary sinuses, and in this regard differ on average from the normal condition in many other populations (Szilvássy et al., 1987). For instance, Africans have relatively small maxillary sinuses. Mladeč 1 has the European condition of large paranasal sinuses (Fig. 11). Only the frontal sinuses can be observed in the Qafzeh females, these are quite large. The maxillary sinus Szilvássy and colleagues report for a Qafzeh male, cranium 6 are also quite large.

Lower on the face, the Neandertal midface is puffed outwards in the region surrounding the nose, and between the nasal aperture and the orbits, resulting in a weakly expressed canine fossa. Below the nose, however, the anterior of the maxilla is flat and vertical, with no specific alveolar prog-

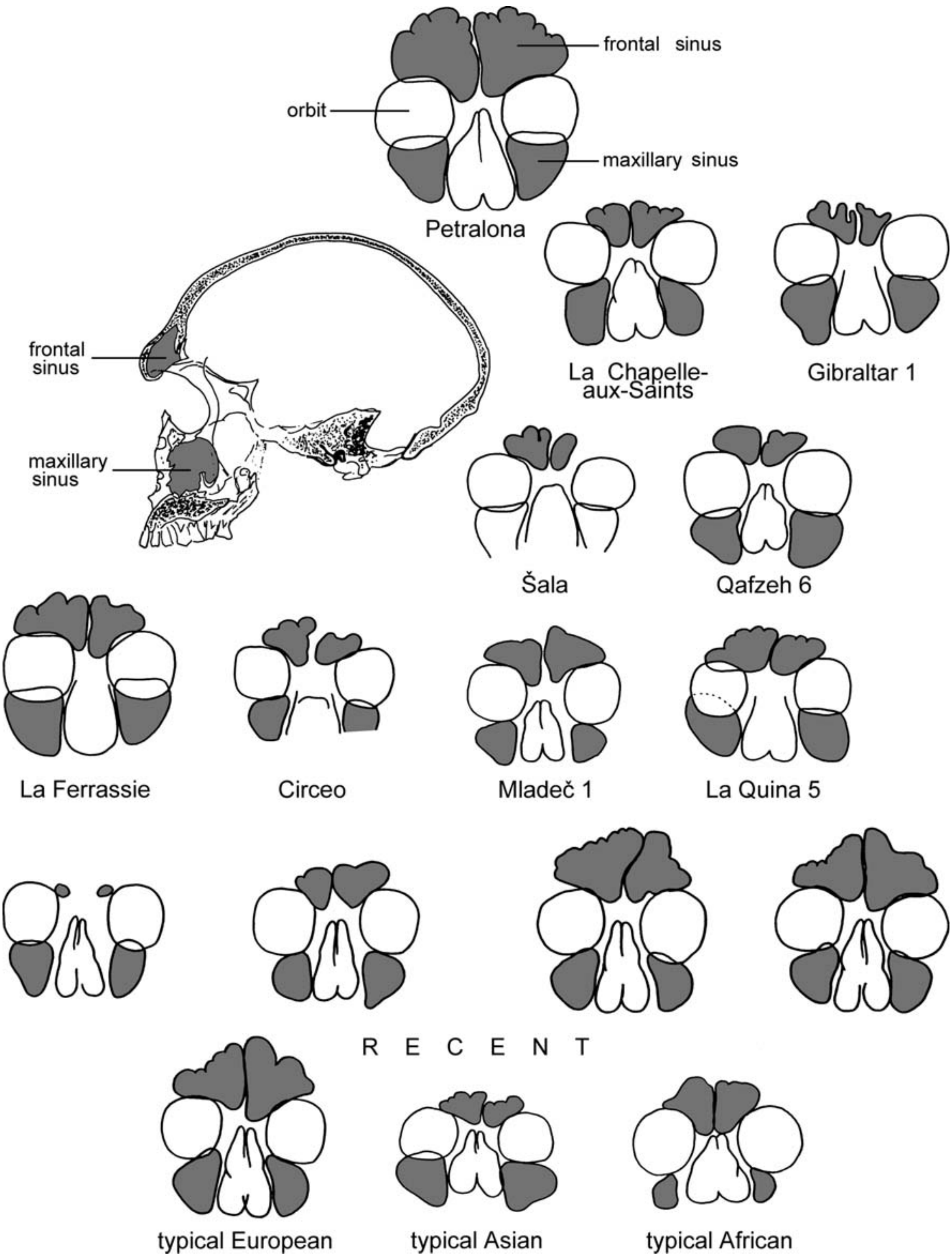

Fig. 11. Geographic distribution of paranasal sinuses (frontal and maxillary) in fossil and recent crania, shown here with a cross-section of La Ferrassie indicating the sinus positions. In the European pattern, these sinuses are about equal in size; frontal sinuses predominate in Africans and maxillary sinuses in Asians according to these authors. From Szilvássy, Kritscher and Vlček (1987), and Heim (1976, Fig. 49)

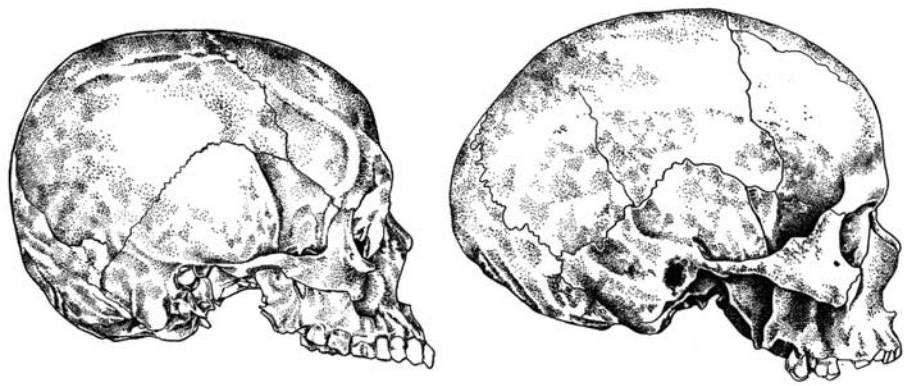

Fig. 12. Comparison of a Masai woman (left) and Mladeč 1, both drawings by Karen Harvey. This comparison contrasts the different morphologies of alveolar prognathism, and fails to reveal any special similarities that might suggest that Mladeč has an especially close relationship with Africans

nathism. The Mladeč 1 condition is quite the opposite. The midface is more deeply excavated lateral to the nose below the orbits, a canine fossa is present, and the inferior maxilla shows distinct alveolar prognathism, although nothing to the extent of prognathism characteristic of Africans (Fig. 12). In the lower border of the zygomatic process of the maxilla, however, the Mladeč 1 specimen is more intermediate. Most of the earlier Central European Upper Paleolithic female faces (Cro-Magnon 2, Fig. 16), Předmostí 10 and 22, for instance) show distinct maxillary notches between the lower border of the process and the external wall of the palate. In the Neandertals, and to a great extent Mladeč 1, the lower border flows evenly onto the wall, producing what Howell (1957) once described as shelving of the malar onto the maxilla.

In sum, we would say that while some similarities exist, the Mladeč 1 cranium is less like the Neandertal females than the Mladeč males are like the Neandertal males. To some extent this is because the Mladeč female preserves the face while the males do not (except for the Mladeč 8 maxilla), but the fact remains that Mladeč 1 evinces only a few features that can be considered transitional.

This contrasts with the comparisons that can be made for the Levant females. These show many fewer specific similarities to the females of the early Upper Paleolithic of Central Europe. Qafzeh 3, for instance, is a rounder and more compact but much more robust vault. It lacks the occipital extension and bunning of Mladeč 1, the nuchal plane is higher and more vertically oriented, and the forehead is higher and more rounded, with a more pronounced frontal boss just above glabella. On the other hand, the supraorbitals are continuous, and much thicker and more projecting on the Qafzeh female (as they are in the other Skhul/Qafzeh females). At nasion, the nasal bones are flat across and extremely broad, in contrast to the narrow and "pinched" appearance of Mladeč 1. The nuchal plane is longer and more robust, and the cranial base is broader. In many respects the Qafzeh female retains many more archaic features. As we concluded with the males (Frayer et al., this volume), we find difficulty in applying the appellation "proto-Cro-Magnoid" to this Levant sample.

Frontal

The Mladeč 1 frontal is large, particularly high, and well rounded. Sagittal lengths (Table 5) are above the Neandertal ranges (by a small amount) even earlier Central European Upper Paleolithic means. Maximum frontal breadth varies similarly, with Mladeč above the Neandertal mean. However, breadths at the anterior of the frontal, the minimum frontal breadth and inner and outer biorbital breadths are smaller than the Neandertal means. The anterior of the Mladeč frontal is relatively narrow, as reflected in the minimal/maximum frontal breadth index. For most of these dimensions and indices the Skhul/Qafzeh sample is intermediate between the Neandertal females and Mladeč 1. The strongest exception is the minimum frontal breadth, which is very large in this sample.

Sagittal rounding of the squama is reflected in the high glabella/bregma arc/chord index, 112.6. This is above the Neandertal range. The squama is also high and evenly rounded transversely, moderately contrasting with the Neandertals in this regard. There is no frontal boss and the frontal lacks a sagittal keel. However, in the area of metopion there is a distinct but very small bump, measuring no more than 30 mm sagittally and 14 mm transversely. There are similar structures in a somewhat higher position on the Předmostí 4 frontal, but none in the other early Central European Upper Paleolithic females.

Squama thickness can be determined at the approximate position of the lateral eminence (Table 6). This is not a particularly diagnostic measurement; the means of the samples do not differ markedly. Mladeč 1 is slightly below the mean values, but within the ranges of all samples.

The temporal line borders the superior surface of the squama where it is preserved on the left. Unlike most early Central European Upper Paleolithic females, the line on Mladeč 1 does not form a distinct ridge. This is almost certainly a consequence of the specimen's young age; for instance, in Předmostí 5 (Fig. 3), the temporal ridge only extends a short distance posterior to the temporal notch. The line is discernable in Mladeč 1, where it is superior to the angulation between the squama's top and its sides. The markedly upward arching of the temporal line at the supraorbital notch is a feature shared with some of the other early Central European Upper Paleolithic females as well as with the Skhul/Qafzeh females. In the Neandertal females, however, the temporal line barely arches, usually traveling in a straight-line posterior to the temporal notch. Spy 1 is most similar to the Mladeč condition. The Mladeč 1 bistephanion breadth of 108 mm, measured between the temporal lines, is considerably less than the maximum frontal breadth, reflecting the high position of the these lines. The distance is in the low portion of the Neandertal range. However, the Neandertal females lack an equivalent angulation of the frontal squama at the temporal line. We note (Frayer and colleagues, this volume) that the same contrasts concerning the temporal line characterize the Mladeč males compared with the Neandertal males, and in a parallel manner, the Spy 2 male comes closest to matching the Mladeč male condition. Unlike Mladeč 5, the anterior face of the temporal fossa in Mladeč 1 is more vertical; a condition shared with the comparative females.

The supraorbital area is separated from the frontal squama by a shallow but distinct supratoral sulcus. This sulcus is positioned superiorly to the superciliary arches, which thereby form more of a bulge on the frontal squama above the orbits than a projecting bar anterior to this squama. The sulcus expression is weaker than in any other early Upper Paleolithic adult female. This could be a consequence of age at death in Mladeč 1. At the extreme, the supratoral sulcus in this early Upper Paleolithic adult female sample can be markedly well expressed (Fig. 8).

The supraorbital region is clearly divided into a superciliary arch and a weakly developed lateral toral structure, which is mainly expressed as a lateral thickening of the superior orbital border. The projection of the superciliary arches is very small. As measured from the anterior face of the frontal squama (following Weidenreich), a figure of 19.0 mm was obtained, but this is misleading since most of the distance spanned is close to parallel with the frontal squama and not orthogonal to it as Weidenreich designed the measurement to express. We do not perceive that the supraorbital structures are particularly projecting, or laterally prominent in this specimen. In contrast, vertical height of the superciliary arch is quite marked. Measured medially and at the highest point on the orbit, the vertical height of the superciliary arch is above both the Neandertal and Skhul/Qafzeh ranges. The ab-

Table 5. Dimensions (mm) and indices of frontal bones in female crania

	Mladeč females 1	Mladeč females 2	Mladeč male 5	Skhul/Qafzeh Mean (n)	Skhul/Qafzeh Range	Neandertal Mean (n)	Neandertal Range
Breadths							
Min Frontal	103.5	101.1	106.2	108.0 (1)[3]		103.8 (5)	101.0–107.0
Max Frontal	126.5	118.0	126.0			117.4 (5)	108.0–127.0
Min/Max Index	81.8	85.7	84.3			88.6 (5)	82.8–93.5
fmt-fmt	109.7	113.4	120.9			114.4 (5)	106.5–121.8
fmo-fmo	103.0	107.0	109.0	104.0 (1)[4]		106.2 (6)	97.5–112.0
st-st	108.0	102.0	113.6			113.6 (5)	104.4–112.8
Bi-st/Max Br index	85.4	86.4	90.2			96.8 (5)	96.5–97.3
Orbit Angle Br	30.0	33.5	39.0	30.7 (2)	30.3–31.0	32.2 (4)	29.0–35.0
mf-mf	25.5	29.6	25.2			24.1 (4)	21.0–26.9
fmt-fmo	8.5	6.0	9.9	12.2 (2)	11.5–12.9	9.8 (11)	8.5–11.9
Lengths							
na-br	114.4	103.0	116.0	109.0 (1)[3]		104.5 (5)	100.6–111.7
gl-br	110.1	100.0	113.6			102.5 (4)	97.3–109.6
Arcs							
na-br	133.0	121.0	140.0	123.0 (1)[3]		116.1 (4)	111.0–121.0
gl-br	124.0	112.0	127.0			107.8 (4)	99.5–117.5
Arc / Chord Indices							
na-br	116.5	117.5		112.8 (1)[3]		110.1 (4)	107.9–112.1
gl-br	112.6	112.0	111.8			105.2 (4)	102.3–107.2
Supraorbitals							
na-fmt	57.7	60.0	56.0	62.0 (1)[3]		63.8 (6)	60.3–66.4
na-fmo	52.5	56.9	63.9	55.2 (2)	53.5–56.9	57.6 (6)	55.0–61.0
Medial projection		11.2	17.5	15.7 (2)	14.3–17.0	19.4 (5)	17.0–21.0
Orbit center projection[1]		7.0	14.5	17.8 (2)	16.5–19.0	19.1 (11)	11.1–27.5
Lateral projection		17.7	23.0	18.0 (1)[3]		20.9 (4)	17.5–24.0
Length from sulcus	19.0		19.0	18.2 (2)	18.0–18.4	20.6 (5)	16.9–24.5
Medial height[2]	21.0	20.5	20.5	17.5 (2)	16.1–18.9	15.8 (6)	13.4–18.0
High pt height[2]	16.8	11.6	18.0	10.8 (2)	9.2–12.3	10.5 (10)	6.5–14.1
Orbit center height1[1, 2]	6.1	4.0	16.2	11.0 (3)	7.1–14.5	10.0 (12)	4.3–14.9
Lateral height[2]	6.7	4.9	8.5	10.8 (2)	10.5–11.1	9.6 (10	6.8–12.3
Central/medial ht Index	29.0	19.5	79.0	78.7 (2)	76.7–80.7	67.5 (6)	32.1–89.8
Lateral/medial ht Index	32.1	23.9	41.0	62.0 (2)	58.7–65.2	59.4 (6)	49.4–78.3

[1] The orbit center is not the same as the midorbit position in Wolpoff et al. (1981), Smith and Ranyard (1980). Measured at the center of the orbit, it is medial to the position where midorbit measurements are taken in these publications.

[2] This is "thickness" in Wolpoff et al. (1981), Smith and Ranyard (1980)

[3] Qafzeh 3

[4] Skhul 2

Table 6. Cranial thickness (mm) in females

	Mladeč females 1	Mladeč females 2	Mladeč male 5	Skhul/Qafzeh		Neandertal	
				Mean (n)	Range	Mean (n)	Range
Frontal							
Lateral eminence	6.0	4.0	8.5	6.4 (4)	5.0–7.5	6.5 (7)	3.8–9.5
bregma		5.5		9.7 (1)[1]		6.2 (4)	5.5–7.2
Parietal							
bregma		4.0		6.0 (1)[2]		5.9 (3)	5.1–7.0
vertex		3.0		9.2 (2)	8.5–9.8	6.0 (2)	4.5–7.0
lambda		5.5	6.0	10.7 (3)	8.7–13.6	9.5 (1)[4]	
asterion	6.0	5.8	8.5	10.1 (3)	7.1–15.1	6.3 (3)	5.5–8.0
Mastoid notch	5.5	4.0	7.0	8.2 (1)[3]		5.5 (3)	5.0–6.0
Anterior eminence	3.0	6.3	6.5	8.8 (3)	7.7–9.5	7.3 (4)	4.5–11.0
Middle Eminence	4.0	4.7	6.0	10.3 (3)	7.8–12.3	8.2 (6)	5.3–11.3
Posterior eminence	6.5	5.5	6.5	8.7 (4)	7.0–9.5	7.2 (3)	5.0–10.0
Occipital							
lambda	5.0		7.5	10.4 (3)	9.2–12.0	7.6 (4)	5.5–11.0
inion	13.0		11.0	13.8 (2)	13.5–14.0	10.8 (4)	6.0–14.0

[1] Qafzeh 3
[2] Qafzeh 5
[3] Skhul 2
[4] Spy 1

sence of a lateral supratoral structure is probably age related, torus is found in both center-orbital and lateral positions. In some cases the expression of this feature is marked (for instance, Zlatý Kůň).

At the most lateral aspects of the superciliary arch, there is a well-developed supraorbital groove, separating the medial and lateral portions of the brows. At the most medial extent of this groove, distinct supraorbital foramina occur bilaterally. Both left and right foramina are positioned within the groove and well above the superior orbital margin (5.5 mm). Both are separated from the superior orbital margin by a distinct bar of bone. There is no frontal foramen. Zlatý Kůň exhibits a similar morphology in this region, although the supraorbital foramen is not as highly placed on the margin and the bar of bone separating the foramen from the superior orbital margin is much thinner. In fact, in general Mladeč 1 most closely resembles Zlatý Kůň, and we believe the similarity would have even been greater had the Mladeč female died at a somewhat older age.

The Mladeč 1 supraorbital region is modern in the European context, although among living European populations it is unlikely that any female could be found that comes close to matching it in robustness. Comparisons with the Neandertal condition are quite different. The Neandertal females generally have a shallower supratoral sulcus than the males (especially Gibraltar and La Quina 5). The region differs grossly from the modern European condition in that the frontal slope is lower and the supraorbital torus forms a continuous bar of bone (of greatly varying thickness) over the orbits. Torus heights at both the middle and the lateral aspects of the orbits are a significant proportion of the medial supraorbital height (see the supraorbital height indices). In the Mladeč specimen these heights are a much smaller proportion of the medial height. A higher frontal slope for the Neandertal females would make the supratoral sulcus much more similar to the Mladeč 1 condition, but the contrast of browridge with superciliary arch would still remain.

With regard to the Levant sample, the contrasts are somewhat different, and these females are even *less* like Mladeč than the Neandertals are. The Skhul/Qafzeh hominids generally have a continuous supraorbital torus and not superciliary arches. The supraorbital height indices show that both center-orbital and lateral heights are a very large proportion of the medial height – possibly the largest contrast. In the Skhul/Qafzeh females, the supraorbitals are positioned anterior to the frontal squama and are set off from it by supratoral sulci that are even more deeply excavated than is generally true for the European Neandertal females. Indeed within the Levant, high frequencies for a deeply excavated supratoral sulcus may be a distinctive feature. Levant Neandertal females such as Tabun and Zuttiyeh also have very deeply excavated supratoral sulci.

The morphological pattern and the size of the Skhul/Qafzeh supraorbitals vary somewhat. For instance, in Skhul 2 it is a thick, evenly developed bar of bone, thinning only at the very lateral edges. In Qafzeh 3 the torus is also thick and continuous, but it thins in the center-orbital region, lateral to the position of its large supraorbital notch. In Qafzeh 5 the torus is considerably thinner, at least in a vertical direction. However, none of these particularly resemble Mladeč 1. There is also marked variation in the slope of the frontal in this sample. Most of the frontal bones appear to be lower than Mladeč 1. The exception is Qafzeh 3, a frontal that easily matches this European female in both frontal slope and curvature. The fact is, however, that none of these females especially resemble the Mladeč 1 condition in the combined details of the supraorbital region.

At the anterior of the frontal, upper facial flatness, as measured by the nasion projection anterior to the bi-*fmt* line, is small (Table 11). The Mladeč 1upper face is considerably flatter than the Neandertals. However, the Levant females are even flatter than any of the Europeans. This is evident from an inspection of Qafzeh 3. In terms of upper facial flatness, the Skhul/Qafzeh hominids are extremely flat while the Neandertal faces are peaked along the midline accentuating the projection of the noses. Mladeč 1 is intermediate between these, although on the whole sharing the somewhat peaked upper facial morphology with the Neandertal women.

Orbital depth in Mladeč 1, 56.4 mm, is quite reduced compared with the Gibraltar female value of 64.1 mm. This is the only comparison that we can make with another female specimen.

The distance between the orbits, measured by the anterior interorbital breadth, barely differs between the samples. As measured between the interior corners of the orbits (Table 5), the distance is less than the Neandertals. For the Skhul/Qafzeh sample, while no distance between the orbits can be measured, the interorbital breadth was likely much greater in Qafzeh 3.

The roof of the Mladeč 1 orbit increases in height behind the inferior margin of the superciliary arch (both sides). It reaches its maximum height in an even arch some 15 mm posterior to this inferior margin. The morphology contrasts with the region in the Neandertal females, where the orbital plate is flat, and rises only slightly behind the inferior margin of the supraorbitals. The Skhul/Qafzeh females resemble the Neandertal sample in this feature.

Overall, then, the frontal of the Mladeč 1 female is fundamentally unlike the frontal bones of both the European Neandertal females and the Levant females from Skhul and Qafzeh, and it is unclear which of these would make a better morphological precursor since they also differ substantially from each other. Moreover, the frontal morphology is quite distinct from the male condition as represented by Mladeč crania 4, 5, and 6. We are hesitant to apply a cladistic approach and determine character states for a feature that is seen to vary between the males and females of the same sample. The more traditional approach of comparative anatomy leads to the conclusion that the Mladeč 1 morphology is distinctly European, and can be matched in any of a number of other early Upper Paleolithic crania from the region although it is far more robust than modern European females.

Parietal bones

Our description will be based on the left side because of the reconstruction involving a good portion of the right parietal. Comparing chords for the four borders of the parietal Mladeč 1 and the Neandertal females (Table 7), the Mladeč 1 parietal is expanded and more rectangular in shape. The ra-

Table 7. Parietal dimensions (mm) and indices

	Mladeč females 1	Mladeč females 2	Mladeč male 5	Skhul/Qafzeh Mean (n)	Skhul/Qafzeh Range	Neandertal Mean (n)	Neandertal Range
Chords							
br-l	117.0	112.5	119.1	117.2 (1)[1]		107.8 (4)	101.0–117.6
l-ast	90.5	80.0	94.8	87.3 (2)	87.0–87.6	85.6 (4)	80.0–89.8
k-ast	91.3	81.0	87.5			81.0 (3)	75.4–87.3
k-br	101.5	97.0	106.3			92.1 (3)	86.7–96.5
k-l	135.2	131.0	139.0			128.8 (3)	125.2–133.0
br-ast	147.0	133.3	148.0	144.3 (1)[1]		133.4 (4)	126.0–139.5
br-st	76.3	54.0	64.4	51.3		70.5 (5)	63.3–76.0
Parietal radius	71.2	66.2	72.6			64.8 (3)	64.6–65.1
Arcs							
br-l	126.0	129.0	129.0	121.0 (1)[1]		115.3 (4)	108.0–126.0
k-br	123.0		121.0			109.2 (3)	103.5–116.0
l-ast	103.0	90.0	103.0	95.0 (1)[2]		95.1 (4)	90.0–103.0
k-l	168.0	162.0	162.5			167.0 (3)	161.0–178.0
br-ast	180.0	163.0	179.0			163.3 (4)	154.0–172.0
br-st	77.0	61.0	66.0			76.2 (5)	68.0–82.0
Parietal angles (degrees)							
br-l	110.4	116.4	110.2			107.7 (3)	101.8–115.1
br-k	90.9	94.3	94.1			90.7 (3)	84.3–96.6
ast-k	79.7	75.5	74.1			77.5 (3)	71.4–84.3
l-ast	78.9	73.8	84.5			84.1 (3)	82.7–85.6
Arc / Chord indices							
br-l	107.7	114.7	108.3			106.9 (4)	104.4–108.9
k-br	121.2		113.8			118.0 (3)	116.1–120.2
l-ast	113.7	112.5	108.6			112.3 (5)	106.5–117.3
br-ast	112.4	112.3	120.9			122.5 (4)	118.6–124.8
k-l	124.3	123.7	116.9			129.7 (3)	126.6–133.8

[1] Qafzeh 5
[2] Qafzeh 3

dius of the circumscribed circle also shows the expansion of the Mladeč 1 parietal size. The parietal angles measure less difference in shape. We conclude that the Mladeč parietal is larger and slightly more rectangular, but fundamentally close to the same shape as parietal bones of the Neandertal sample. In terms of curvature, as measured by the arc / chord index of each parietal border, Mladeč 1 has essentially equally curved anterior and posterior borders. For the superior border, Mladeč 1 is the same as the Neandertal mean. The arc / chord indices for the diagonal measures show Mladeč 1 to be less curved than the Neandertal females.

The temporal lines are high on the parietal bones, considering the sex and age of the specimen. Because of the condition of the bone surface, we cannot identify an inferior line. The superior line follows a markedly medial arch posterior to the coronal suture, passing through the apex of the parietal boss. Posterior to the boss, the inferior line arcs strongly downwards and anteriorly, forming the supramastoid crest on the temporal squama. Behind the boss, the superior line arcs posteriorly to meet and parallel the middle and inferior portion of the lambdoidal suture, and then anteriorly to form the mastoid crest. In none of the Neandertal females does the superior temporal line extend as posteriorly as the lambdoidal suture, although the Spy 1 line almost reaches the suture. However, in this Neandertal the superior temporal line only reaches the lambdoidal suture at its very most inferior point, and does not bring a large portion of the nuchal musculature as far backwards as is the case in the Mladeč female. This is the same contrast that is found in the Mladeč males. As we noted above, the cross-sectional area enclosed by the temporal fossa may be smaller in the Neandertal sample, perhaps accounting in part for this difference in the most posterior extent of the temporal line.

The parietal thicknesses vary considerably from the front to the back of the bone (Table 6). However, they all are small, below the ranges of the Skhul/Qafzeh and Neandertal samples. In all of these thicknesses, and in the thicknesses at the posterior of the bone (asterionic, mastoid notch), Mladeč 1 is reduced relative to the Neandertals, while the Skhul/Qafzeh thicknesses are *greater* than the Neandertals.

Occipital

The Mladeč 1 occiput is almost complete, and undistorted. The bone is quite large, its height as measured from lambda to opisthion is above ranges of all comparative samples (Table 8). Biasterionic breadth, however, is comparatively smaller, below the means of the Neandertal and the (virtually identical) Skhul/Qafzeh samples, and below the Skhul/Qafzeh range. The bone is also reduced in squama thickness (Table 6). For instance at lambda, the thickness value is below the ranges for the comparative samples.

As is the case for the males, the nuchal muscle attachment area takes up a large proportion of the occipital breadth, the ratio distinguishing Mladeč 1 from both the Neandertal and the Skhul/Qafzeh females (Table 8). Comparisons of the absolute values of the nuchal plane breadth are not as distinct, mainly because the more archaic samples have generally broader occipitals and this contributes to their nuchal plane breadth values.

Both along the sagittal plane and the borders, arcs measured on the occipital squama are very large relative to the other European samples. The Levant female Qafzeh 3, however, is even more curved. In part the large arcs are a consequence of bone size, but the arc/chord ratio is also relatively great.

In some respects the occipital of Mladeč 1 is the most Neandertal-like portion of the vault and markedly contrasts with the rounded occipital of Qafzeh 3. Besides the rounded parietal borders, the sagittal contours are rounded because Qafzeh 3 combines very flat nuchal and occipital planes with a marked occipital angulation as seen in the sagittal plane (Table 8). The Levant female is more different from Mladeč 1 than any of the Neandertals in:

– absence of an occipital bun,
– expression of a marked centrally located nuchal torus,
– more vertical orientation of the nuchal plane,
– equality of the nuchal plane's sagittal length to the length of the superior occipital plane.

The occipital bun of Mladeč 1 is better expressed than in Saccopastore 1 (Fig. 6), although not as projecting as in La Quina 5. The rounding for the superior portion of the bun begins at the approximate position of the lambdoidal suture (as in La Quina 5), and the rounding extends evenly down to the position of the external inion. In Neandertals, the inferior border of the bun is almost invariably bounded by a nuchal line, below which the nuchal plane is strongly concave, setting off the bun. In Mladeč 1, the posterior of the bun is evenly rounded, its vertical face is shorter, and at and below the nuchal line, the nuchal plane is convex.

Laterally, a fairly flat surface extending from about 30 mm from the midline to the mastoid region sets off the Mladeč 1 bun. Again, this resembles Neandertals such as La Quina 5 and Spy 1, al-

Table 8. Occipital bone and nuchal region dimensions (mm) and indices

	Mladeč females 1	Mladeč females 2	Mladeč male 5	Skhul/Qafzeh		Neandertal	
				Mean (n)	Range	Mean (n)	Range
Breadths							
Biasterionic	110.4	120.0	126.5	119.5 (2)	119.0–120.0	115.1 (5)	108.5–122.0
Nuchal attach area	106.5	132.0	143.0	101.0 (1)[1]		93.3 (4)	84.0–105.3
Lengths							
l-ast	90.5	94.8	84.0	87.3 (2)	87.0–87.5	85.6 (4)	80.0–89.8
l-o	106.0			92.9 (1)[1]		88.9 (3)	85.0–92.9
l-i	75.1	66.9	62.7	59.6 (2)	53.0–66.1	57.2 (5)	54.5–60.5
i-o	50.0			56.5 (2)	53.0–60.0	45.6 (3)	42.1–47.6
i-ast	64.0	68.7	72.7	68.5 (2)	62.1–69.5	69.3 (5)	64.0–74.0
Inion proj (asterion)	32.4	33.5	35.8			37.3 (5)	25.7–47.0
Arcs							
l-ast	103.0	103.0	92.0	95.0 (1)[1]		95.1 (4)	90.0–103.0
l-o	134.0			108.0 (1)[1]		110.2 (3)	109.0–112.5
l-i	86.0	73.5	69.0	67.5 (2)	66.0–69.0	63.0 (5)	60.0–69.0
i-o	48.0			58.0 (2)	55.0–61.0	46.8 (3)	43.5–49.0
Condyle							
Length	26.0					18.8 (1)[8]	
Breadth	11.0					13.7 (1)[8]	
Foramen Magnum							
Length	38.1					31.5 (2)	30.0–33.0
Breadth	30.7					29.3 (1)[8]	
Indices							
Nuchal/Bi-ast br	96.5	110.1	113.0	84.9 (1)[1]		82.3 (4)	73.1–91.1
l-i/i-o	150.2			105.1 (2)	100.0–110.1	125.8 (3)	116.0–144.0
l-i arc / chord	114.5	109.9	110.0	114.5 (2)	104.4–124.5	110.1 (5)	107.1–114.0
Foramen Magnum L/Br	124.1					112.6 (1)[8]	

[1] Qafzeh 3
[8] Saccopastore 1 only

though not Saccopastore 1. This area is similar to the preserved portions of Cro-Magnon 2 (the occipital plane and the superior aspect of the nuchal plane), although the Cro-Magnon occiput is less projecting (Fig. 16), the flattened area is more perpendicular, and the nuchal plane just below the nuchal line is more concave. The region in Mladeč 1 is quite different from the Předmostí 4 female, in which the occipital plane is much more vertical (i.e., less posteriorly projecting) below lambda and cannot be said to form a bun (Fig. 8). As in the Cro-Magnon female, the nuchal plane is concave beneath the nuchal line in this Předmostí female.

The superior nuchal line in Mladeč 1 seems very weak. It travels in a broad curve across the back of the vault, with a slight ridge forming a downward angulation at the midline producing a small elevated triangle at inion. The base of this elevated triangle is level with the most superior extent of the superior nuchal line. Laterally the superior nuchal line does not reach the mastoid, but rather forms a crest along the paramastoid process. Just superior to this ridge there is a shallow concave patch about 21 mm in breadth and 8 mm in height. This might be perceived as a small suprainiac fossa. The lower border of this fossa is a distinct ridge, paralleling a superior line above it for some

5.5 mm. We interpret this superior line as a supreme nuchal line. Whether because of preservation, obscuring matrix, or the actual morphology, we cannot trace the line beyond this position.

This region differs from both the Neandertal and the Skhul / Qafzeh females. The normal Neandertal condition is for the suprainiac fossa to border a nuchal line or weak ridge that dips slightly inferiorly, but does not form a triangular eminence. In Qafzeh 3, the preserved details of the nuchal line and central torus resemble the Neandertals. Just superior to the center of the nuchal torus, where it crosses the sagittal suture, the occipital plane is flat and vertical for a rectangular region about 20 mm in height and 30 mm in breadth. Just superior to this, some 34 mm above inion (= opistocranion) and only just below lambda, there is a shallow concave region that is literally a suprainiac fossa but not obviously homologous to the Neandertal form, because of its position. Some of the other earlier European Upper Paleolithic specimens more closely resemble Mladeč 1. For instance, the Předmostí 4, Dolní Věstonice 3, and Cioclovina females also have a triangular eminence, even more projecting than that of Mladeč 1, but unlike it not bounded superiorly by a shallow patch. Předmostí 10 does not appear to have a triangular eminence and is more like the Neandertals in this region.

The vault wall is rather thick at inion (Table 6) as compared with the Neandertal and Skhul / Qafzeh females. The inion prominence is in a rather low position. In both its absolute distance from asterion (Table 8) and its posterior extension behind the biasterionic line is below the Neandertal mean value (although above the Qafzeh 3 value). Along the sagittal plane, the nuchal plane is moderate in length. For instance, the ratio of occipital to nuchal muscle attachment area lengths is about 150%, above the means of the comparative samples and above the Neandertal range. It is dramatically greater than the Qafzeh 3 value (94.0%), because as noted above the nuchal plane is longer than the occipital plane.

As noted above, the nuchal muscle attachment area is relatively and absolutely broad, maximum breadth occurring near the position of asterion. The nuchal region is roughly triangular in form, corresponding to the narrowing at the base of the occipital bun as seen in inferior view. The surface is moderately rugose and convex sagittally and transversely. The inferior nuchal line, about half way between inion and opisthion, is distinct. Between the inferior line and inion what remains of the external occipital crest is sharp (distinguishing it from the low and broad development of the crest in those Neandertals that have it at all). Matrix obscures the nuchal surface between the inferior nuchal line and inion, but the rounding characteristic of the nuchal plane posterior to it continues evenly to the condylar fossae. The rim of the foramen magnum is slightly elevated, and there are true postcondyloid tuberosities on both sides. Lateral to the rim, broad and low occipitomastoid and paramastoid crests are about 8 mm apart. The occipitomastoid sutures ridge the paramastoid crests on both sides. Similarly extensive paramastoid crest development is not unknown in the European Upper Paleolithic. For instance, the Cro-Magnon 2 female also has a paramastoid crest, at least as large as that of the Mladeč female. These crests are positioned posterior to the condylar rear, rather than lateral to the condyles as they are in the Neandertals.

Compared with the Neandertal females, the shape and convexity of the nuchal plane is much like La Quina 5, although dissimilar to Saccopastore 1. The development and configuration of the occipitomastoid and paramastoid crests closely resemble some of the Neandertal females, such as Saccopastore 1, but differ from the very marked expression of the paramastoid crest in Spy 1 and Gibraltar (neither of these preserves the region of the occipitomastoid crest).

Finally, part of the region is preserved in Qafzeh 3. The paramastoid crest is broad and low, similar to the expression of the crest in Mladeč 1 and Saccopastore 1.

The Mladeč 1 foramen magnum is longer than any in the two Neandertals, but there is no significant breadth difference. The shape index measured by the ratio of breadth to length therefore reflects the greater relative length. The occipital condyles are also absolutely and relatively long compared with the Neandertals. The surface of the condyle is not doubled, instead forming a continuous face from front to back. Both condyles have deep condylar fossa. Although as discussed above the paramastoid crest is distinctly developed, lateral to the left condyle we find no evidence of a paramastoid process. On the right, matrix covers this region, but the area bulges inferiorly. It is impossible to determine if this is due to a paramastoid process underlying the matrix or simply matrix thickness.

Sagittal measures reflecting the length of occipital base show that the bone has a marked anteroposterior dimension. The distance from the front of the condyle to inion (Table 4) is larger than the Neandertal mean. Anteriorly, the length of the bone is also expanded. As discussed in the section concerned with the position of basion, the basion-hormion distance is long (the *pars basilaris* cannot be measured directly), reflecting the posterioinferior positioning of the foramen magnum compared with Neandertals.

Temporal bones

The temporal squama is tall and long relative to the comparative samples (Table 9). Both dimensions greatly exceed the Neandertal ranges. The posterior border is virtually a straight line from the most superior point on the squama to the parietal notch; in this respect it is like Předmostí females 5 and 10 and also similar to the Neandertal females. The posterior corner of the squama lacks a marked development of the supramastoid and mastoid crests, as it is preserved. Our observations in this region are rendered difficult by a combination of cortical surface loss and adhering matrix. We can delineate the shallow groove separating these crests (about 12 mm in breadth). On the external face of the mastoid process, the mastoid crest can be delineated on the left side, following a course inferiorly along the center of the process to its tip. Since the superior nuchal line is continuous with the paramastoid crest and does not extend onto the mastoid, there is no compound crest formed on the mastoid process as in Mladeč 5.

At the base of the squama, the digastric groove is deep and moderately broad. The mastoid process projects well below the Frankfort Horizontal. Metrically, it exceeds the Neandertal range (projecting more strongly). However, the process does not project dramatically below the digastric sulcus because the cranial base bulges inferiorly just medial to the mastoid. With this reduced expression, the mastoid projection below the sulcus is within the Neandertal range. The basal dimensions of the process are also not particularly large. In fact, basal length is about the same as the Neandertal mean.

Anterior to the mastoid process, the external auditory meatus (much better cleaned on the right side) is elliptical in shape, with a long axis vertical to the Frankfort Horizontal. The axis orientation is similar to Spy 1, differing from La Quina 5 in which the elliptical axis leans posteriorly and Gibraltar in which the long axis is horizontal. Dimensions of the meatus are approximately 12 mm by 8 mm.

Posterior to the petrosal crest, the tympanic ring surrounding the external auditory meatus is continuous with the anterior face of the mastoid, so that this anterior face forms the posterior border of the meatus. This contrasts with the usual Neandertal condition in which there is a posterior aspect to the tympanic ring resting upon the anterior face of the mastoid and often separated from it by a narrow groove. Předmostí 4 and Cro-Magnon 2 conform to the Mladeč 1 condition, but other earlier European Upper Paleolithic females (for instance Předmostí 22) more closely resemble the Neandertals.

On the anterior face of the meatus, a weakly developed post-glenoid process is contiguous with the meatus wall. Its height is below the female Neandertal mean while its breadth is larger. The process is barely distinct, and can only be clearly differentiated from the meatus wall at its most inferior point.

The glenoid fossa (described on the left because of matrix in the right fossa) is like the Neandertal females in the slope of the fossa's anterior face and the lack of a horizontally oriented surface on

Table 9. Temporal and mastoid process dimensions (mm) in female crania

	Mladeč females		Mladeč male	Skhul/Qafzeh	Neandertal	
	1	2	5			
				Mean (n)	Mean (n)	Range
Squama						
Maximum length	72.6	68.5	73.9		58.2 (5)	57.6–59.3
Height above FH	44.0	33.0			36.0 (5)	32.7–40.0
Supraglenoid gutter length	26.6	26.0	28.9	23.2 (1)[2]	24.8 (6)	21.5–29.7
Supraglenoid gutter breadth	15.1	19.1			17.1 (3)	15.6–19.5
Temporal Fossa						
Length	44.0	41.3			44.5 (3)	43.5–46.5
Ant mastoid to ant glenoid	54.9				49.5 (1)[4]	
Breadth	27.3				20.4 (1)[4]	
Postglenoid process						
Height	5.9	6.0	6.1	2.8 (1)[2]	6.3 (6)	1.0–8.4
Base thickness	5.3	6.2	8.6	5.8 (1)[2]	4.1 (7)	1.3–6.3
Mastoid process						
au-ms	37.0	29.7	34.7		31.3 (6)	29.0–33.1
Auricular-mastoid ht	37.6	30.9	32.1		31.1 (6)	27.0–34.1
Digastric height	7.1	3.2	8.5	6.9 (1)[3]	5.0 (6)	4.2–7.4
Basal length[5]	35.0	32.9	43.8		34.7 (7)	30.2–40.5
Glenoid fossa						
Fossa length	18.5	18.9	25.4	22.0 (1)[2]	19.3 (7)	16.0–22.8
Articular length	11.2	11.0	15.6	13.0 (1)[2]	10.8 (7)	8.5–12.8
Fossa breadth	29.8	25.0	20.9		23.6 (5)	21.4–25.7
Fossa depth	6.8	5.0	6.4	2.4 (1)[2]	5.0 (7)	3.0–7.5

[2] Skhul 7
[3] Qafzeh 3
[4] Gibraltar 1

the articular eminence. Most particularly Saccopastore 1, Gibraltar, and La Quina 5 also lack a horizontally oriented surface on the articular eminence. In these Neandertal specimens, however, the fossa is shallower and the anterior face is more sloping. The Spy 1 fossa has a short horizontal surface on its articular eminence, and the slope of the fossa's anterior face is about the same as in Mladeč 1. The entire articular eminence can be said to form the anterior face of the fossa in Mladeč 1 and in three out of the four female Neandertals.

On the other hand, the Mladeč 1 glenoid region differs from the Neandertals in a number of ways. One of these, discussed above, is the orientation of the long axis of the articular surface. In the Neandertal females this is close to being transverse (paracoronal), while in Mladeč 1 there is a marked anteromedial orientation. Another difference is found on the medial wall of the fossa of the Neandertal females, where a fissure, which is the continuation of the fissure separating the post-glenoid process from the tympanic bone, divides the infratubercle process from the *spina angularis*. The fissure is not found in Mladeč 1. The Mladeč 1 glenoid fossa is the broader and deeper than any Neandertal specimen. The single Skhul/Qafzeh specimen, Skhul 7, is similar in length, but much shallower.

Much of the detail on the cranial base is obscured by matrix. In so far as we can determine the angulation of the petrous portion of the temporal and the position of the carotid and jugular foramina do not appear unusual (or different from the comparative specimens). In its remaining details, the cranial base appears to be essentially modern.

Sphenoid

The sphenoid is almost completely preserved, but unfortunately much of its external surface is obscured by matrix. One of the more diagnostic features on the cranial base is the position of the foramen ovale. The foramen ovale of Mladeč 1 is positioned lateral and posterior to the base of the lateral pterygoid plate, a position common in most modern crania. This contrasts with Neandertal females (best seen in La Quina 5) where the foramen is more directly behind the lateral pterygoid plate base and actually posterior to the anterior border of the glenoid fossa (a consequence of the more anterior foramen magnum and associated basal structures of the Neandertals discussed above). In addition, there is no pterygoid-spinous ossification, judging from the intact right pterygoid plate and the foramen ovale is not divided. Matrix obscures other nonmetric observations of the sphenoid's base.

Only the anterior portion of the lesser wing, holding the pterygoid fossa where the plates merge, is preserved. The remaining portions of lamina are encrusted with matrix, much more so on the left than on the right. Fourteen millimeters of lamina remains on the right lateral plate, and somewhat less remains on the medial plate. In height (palatal-basal) this pterygoid process is almost identical to Gibraltar. However, the angulation of the process is at about 45° to the Frankfort Horizontal in Mladeč 1, while in both Gibraltar and Saccopastore 1 the angle is less and thus the pterygoid process is more horizontally inclined.

Lateral to the pterygoid plates, the base of the greater wing of the sphenoid forms a broad, flat surface, bounded by the internal border of the temporal fossa. The width of this surface is roughly double that of the Neandertal females Gibraltar and Saccopastore 1. In the parasagittal plane this surface is distinctly angled in a anterosuperior direction. The angulation, of about 30°, is considerably greater than in the Neandertal females. This reflects the more inferior position of basion in the Mladeč female.

The lateral wall of the greater wing does not differ significantly between Mladeč 1 and the females of the Neandertal comparative sample, in that the sphenoparietal articulation is long. The form of pterion is "H". Within the orbits, the orbital lamina of the sphenoid is obscured by matrix.

Nasal bones

The Mladeč 1 nasal bones are complete from the frontonasal suture inferiorly to a position just above the lower border of the orbit. The most inferior portions of the nasal bones are absent on the right side. On the left the nasal is complete to the lateroinferior corner, although centrally the bone is missing. The most striking feature of the nasals is their narrow "pinched" appearance, which results from a central ridge that is raised well above the nasal processes of the maxilla. The elevation of the nasals involves the whole bone, so that what we refer to as the nasal pillar is comprised of both nasal bones in their entirety, and extends along their full height from nasion to the inferior break. The lateral walls of this pillar are oriented parallel to the parasagittal plane, and thus face in a fully lateral direction.

The closest match to this morphology is found in Předmostí 4, although the nasal bones are considerably broader in this specimen. In the noses of the female Neandertals the internasal suture is also raised above the nasal processes of the maxilla. However, in these specimens (Gibraltar and Saccopastore 1) this suture forms a ridge, and the lateral portions of the nasals are angled to the parasagittal plane and merge insensibly into the nasal processes of the maxilla which continue this angulation to the medial orbital borders. The superior portion of the nasals preserved in Qafzeh 3 is

Table 10. Nasal bone dimensions

	Mladeč females			Mladeč males		Qafzeh	Neandertal	
	1	2	38	5	6	3		
							Mean (n)	Range
Dimensions								
Minimum Breadth	6.5	8.4	9.0		14.0	12.9	13.7 (2)	12.0–15.4
Superior Breadth	10.6	10.1		12.7	16.4	16.7	14.3 (2)	12.0–16.5
Inferior Breadth	18.0						21.6 (2)	19.8–23.4
Nasomaxillary suture length	23.5	23.0					31.4 (2)	27.4–35.3
Indices								
Sup width/anterior iob	41.6	33.8		50.2	62.6		58.2 (3)	47.3–71.7
Min/Max br across bones	36.1						61.2 (2)	56.6–65.8

even less like the Mladeč 1 region and the regions of other early European Upper Paleolithic specimens than the Neandertals are. In this region the face of the bones is very flat, neither ridged as in the Neandertals nor pinched into a nasal pillar.

Relative to glabella the Mladeč 1 nasal root is markedly depressed. In profile the nasal bones are strongly curved and, following the nasal profile of the maxilla, it is clear that this curvature continued in the missing portions of the bones. The extent of the curvature is so great that while the superior portions of the bones are close to perpendicular to Frankfort Horizontal, the most inferior portion must have been almost parallel to this plane. The superior nasals are straight from nasion to about 7 mm inferiorly, and then begin a more gentle curvature. As a result of this curvature, the nasal angle is quite low when the entire length of the nasal bones is considered.

The angulation of the Mladeč 1 nasals to the face, or to the Frankfort Horizontal, resembles the Neandertal females. In Gibraltar the orientation also goes from virtually vertical to parallel relative to the Frankfort Horizontal, although the Saccopastore 1 nasals do not curve quite as much and therefore do not reach equal horizontality. However, the Neandertal nasals begin their angulation in a position further below nasion than do the nasals of Mladeč 1, and their curve is more gentler attaining an equal arc over a longer bone. The superior portion of the nasals preserved in Qafzeh 3 shows absolutely no curvature at all. If the nose of this specimen was like Mladeč 1, enough is preserved to expect to see marked curvature. If the nose was like the Neandertal female noses, the curvature would probably begin below the preserved portion. However, there is no reason to suppose that Qafzeh 3 was like either of these.

Superiorly, the Mladeč 1 nasals are very narrow (Table 10). The superior and minimum nasal breadths are below the Neandertal female sample range. This small superior dimension is reflected in the very small ratios of superior breadth to the interorbital breadth, and the minimum breadth relative to maximum breadth. In both ratios the value is smaller than all comparative specimens. Superiorly, the Neandertals and Qafzeh 3 are considerably broader than Mladeč 1. Moreover, in the Neandertal females the minimum breadth is very similar to the superior breadth, and thus the nasals do not appear as "pinched" as in Mladeč. The Qafzeh 3 nasals are somewhat less pinched. At their inferior border the breadth of the Mladeč 1 nasal bones is smaller than the female Neandertals. The nasomaxillary suture is much shorter than the Neandertals, lying below their range.

Zygomatic bones

Description of the zygomatic bone is based on the left side where there is less matrix and no distortion. A distinct crest follows the course of the zygomaticomaxillary suture from the lower orbital margin (where the suture originates at the lateral border of the infra-orbital foramen) to the base of the bone.

On the anterior surface of the zygomatic crest, just above the base, there is a well-defined zygomatic tubercle. The breadth of the base including the tubercle is 12.1 mm. The zygomaxillary crest marks the angulation between the paracoronally oriented zygomatic process of the maxilla and the lateral face of the zygomatic bone. The angle is approximately 70°. This lateral face of the zygomatic is quite flat. Along the entire lower border the attachment for the masseter is well-developed and results in a thick (6–8 mm) rugosity, terminating in a marked tubercle at the temporal side of the zygotemporal suture.

Comparing Mladeč 1 with the Neandertal females, the lengths (or heights) of the zygomatic bone taken along the zygomaxillary suture or from the bi-*zm* line to the base of the orbit (Table 12), and the heights of the bone from *zm* to *fmt* are almost all the same. However, the Mladeč bone extends more posterolaterally, so that the *zm-ju* distance is greater for Mladeč 1 than for any other specimen, in spite of the fact that the mean bizygomatic breadth for the Neandertal females is greater than the Mladeč 1 value (Table 11). The lateral extension of the zygomatic bone increases from the Neandertal Mladeč 1, even though the bizygomatic breadth decreases. This corresponds to changes in the curvature and angulation of the bone, and a higher position for the superior border of the zygomatic arch in the specimens of the earlier Upper Paleolithic.

Maxilla

The maxillae are complete, although a thin matrix coating covers their surface. Starting at the nasofrontal suture, the maxillary pillars are vertical inferiorly to the lacrimal foramen. At this position they blend evenly into the lower orbital margins, angling at about 45° to the coronal plane. The border of the pillars along the nasal bones is distinguished by a very distinct angle. In contrast, the orbital pillars in the Neandertal females appear to be “pinched” and the medial orbital walls of the two orbits are not parallel to each other. The angulation in the paracoronal plane is about the same, but the nasal bones continue this orientation and thus appear as an extension of the maxillary pillars rather than being separated from them by a sharp angulation. This difference reflects the anterior projection of the Neandertal midface.

Another reflection of this midfacial projection is found in the orientation of the maxilla at the inferomedial corner of the orbit. In the Neandertal females the face of the maxilla in this region approaches horizontality and is continuous with the maxillary border of the lower nasal bones. Thus from the orbital margin at this position to the maxillary border of the nasal aperture the surface of the maxilla is approximately horizontal, and the maxillary surface retains this orientation even more medially, at least to the position of the infraorbital foramen. In Mladeč 1 the maxillary face is also horizontal, but the horizontal region only involves the medial surface of the orbit and extends inferiorly to the position of the most inferior part of the nasal bones, or the inferomedial orbital angle. Lateral to this the Mladeč 1 maxillary face is vertical. The maxillary face is more perpendicular along the sides of the nose, and there is a distinct groove expressing an angulation of the surfaces between the orbital pillars adjacent to the orbital margins and the maxilla adjacent to the nasal aperture. Thus the region lateral to the middle of the nasal aperture is somewhat puffed in Mladeč 1 and is more like the Neandertal females than the other earlier Central European Upper Paleolithic females are. Another expression of this “puffiness” is reflected in the great distance from the nasal aperture at the most inferior point on the nasal bone to the closest point on the inferior orbital margin. This distance is 18 mm in Mladeč 1 but only 12.5 mm in Předmostí 4. In the puffier Neandertal faces the distance is greater, for instance 21 mm in Gibraltar and 23.5 mm in Saccopastore 1.

The nasal aperture is teardrop in shape. The maxillary walls expand laterally inferior to the aperture’s top so that the greatest breadth of the piriform aperture is well above the nasal sill. The maxillary borders surrounding the aperture have a strong anterior projection, angling away from the paracoronal plane to such an extent that they almost fully parallel the parasagittal plane at the aperture’s border. The inferior border of the nose is moderately guttered lateral to the anterior nasal spine, which is elevated above the most inferior portions of the border. There are two distinct nasal lines at the inferior margin. The more inferior of these begins just lateral to the anterior nasal spine, and arcs evenly superolaterally to merge with the lateral border of the nasal aperture. The more superior of the lines originates at the anterior nasal spine where they merge to form its tip, and parallel the inferior lines laterally to the point where they enter the nasal cavity and merge with the internal aspect of the aperture's walls. These two lines are about 2 mm apart and are separated by a groove. The anterior nasal spine is in the form of a prominent triangle, projecting markedly forward from the lower nasal margin. A sharp vertical crest extends inferiorly from the spine's tip, running for about 5 mm below the inferior margin. The guttering described above extends from the sharp superior line and occupies a space medial to the inferior termination of the lower border.

The Neandertal females, as represented by Saccopastore 1, Gibraltar, and La Quina 5, are characterized by a very broad lower nasal margin with a distinct angulation between the floor of the nasal aperture and the anterior face of the maxilla. Some of the specimens, for instance Gibraltar and to a lesser extent Saccopastore have a sharp line at this margin (the remaining portion is more rounded in Spy 1). The two best-preserved margins are almost flat transversely. Moreover, there is only a single nasal line that extends from the anterior nasal spine to merge with the lateral walls of the nasal aperture in these three Neandertal female specimens. Inferior to the anterior nasal spine there is no medial crest on the anterior maxillary face.

However, the morphological features described above are not unique to all Neandertal females. In particular, two late Neandertal females from Vindija cave (Wolpoff et al., 1981) diverge significantly and instead approach the Mladeč 1 condition. Nasal breadths in these maxillae, 28.5 mm and 26.2 mm respectively for Vi 225 and 259, are only slightly greater than the Mladeč 1 value of 25.9 mm. These maxillae combine the double line form of the inferior nasal margin and the anterior maxillary crest inferior to and continuous with the prominent anterior nasal spine that are also characteristic of the Mladeč 1 female.

As measured from the juncture of the zygomaxillary suture with the lower orbital margin, the upper maxillary breadth is reduced in the earlier Central European Upper Paleolithic females when compared with the Neandertal females. Similarly, the minimum distance between the infraorbital foramina is reduced. In both these dimensions Mladeč 1 lies below the earlier European Upper Paleolithic mean.

More inferiorly on the maxilla, however, the midfacial breadth really does not show a significant change. This contrasts with the breadth of the inferior nasal aperture (i.e. nasal sill), which is markedly smaller in Mladeč 1 (Table 11).

Lateral to the area immediately surrounding the nasal margin the maxilla is vertical and transversely flattened. The angulation between this flat zygomatic process and the projecting nasal margin results in a distinct canine fossa. In the Neandertal females the zygomatic process of the maxilla is convex in the vertical plane, and distinctly posterolaterally angled transversely. Thus, the anterior surface of the maxilla flows more evenly into the portion of the maxilla surrounding the nasal aperture. While these surfaces are usually separated by a shallow groove in the position of the infraorbital foramen, this groove represents only a very weak expression of the canine fossa.

The lower orbital margin is rounded, thick and pillar-like. It projects above the floor of the orbit. Předmostí 4 has a similarly pillar-like margin, and this contrasts with the Neandertal condition. In Gibraltar and Saccopastore 1 the lower orbital margins are much less distinct. The most anteroinferior extent of the orbital margin is continuous with the anterior face of the maxilla.

The size of the infraorbital foramina as measured by its approximate area is about the same in the two European samples. The shape of this opening, however, is somewhat different from specimen to specimen. For instance, in Mladeč 1 the breadth is slightly greater than the height while in the Mladeč 2 maxilla (see below) the height is much greater than the breadth.

Table 11. Facial dimensions (mm) for females

	Mladeč			Skhul/Qafzeh	Neandertal	
	1	2	8[1]			
				Mean (n)	Mean (n)	Range
Breadths						
Biorbital breadth	103.5				105.5 (3)	98.5–111.0
Bizygomatic breadth	137.0	.			140.0 (2)	138.0–142.0
Bijugal breadth (ju-ju)	114.0				111.6 (3)	102.7–117.0
Midfacial breadth (zm-zm)	103.1				94.0 (3)	85.0–102.4
Bi-infraorbital foramen br	52.6	55.0			60.3 (2)	55.9–64.6
Upper maxillary breadth	62.7	59.0			66.6 (3)	59.0–73.9
Biangular breadth	64.6	67.2	69.2		70.0 (2)	68.6–71.3
Lengths						
Na bi-fmt proj	17.9	19.6			27.8 (6)	26.5–31.6
Superior zt suture-fmt	26.0				33.6 (2)	32.6–34.6
pr-superior zt sut	85.8				88.4 (1)[3]	
pr-fmo	83.9	87.0			99.8 (2)	97.7–101.8
pr-fmt	91.7	91.3			107.7 (2)	104.5–110.8
pr-zm	59.8				69.7 (2)	66.5–72.9
pr-zpm base	45.0	45.8	45.3	41.5 (1)[2]	53.7 (2)	52.0–55.3
zpm base-alveolar margin	9.9	8.7	12.8	9.0 (1)[2]	15.1 (2)	13.0–17.1
Length Indices						
Gnathic	104.2				106.0 (2)	100.0–111.9
Gnathic from auricular	118.3	126.2			117.2 (2)	108.1–126.3
ufh/na-l	38.5	38.2			48.3 (2)	47.7–48.9
Heights						
br-alveolar point	178.1	163.6			165.1 (3)	150.6–173.7
Orbito-alveolar	44.0	42.1			50.7 (2)	48.0–53.6
na-alv (ufh)	70.1	66.0			81.8 (2)	79.0–84.5
na-zm	69.5				73.3 (3)	72.5–74.6
Pommette height	34.0	30.5			34.7 (2)	30.0–39.3
Alveolar height	20.3		17.5		21.5 (7)	16.3–25.3
Nasal aperture						
Nasal height	50.4				59.4 (2)	57.9–60.9
Nasal Breadth	25.9	25.5	29.1		33.5 (2)	32.9–34.1
Breadth/Height	51.4				56.5 (2)	54.0–58.9
Orbits						
Orbit height	31.5	36.1			38.4 (4)	38.0–39.3
Orbit breadth	39.8	40.5		37.3 (1)[4]	40.5 (4)	38.9–42.3
Orbit depth	56.4				64.1 (1)[3]	
Height/Breadth	79.1	88.0			92.3 (2)	89.8–94.7

[1] Male palate
[2] Qafzeh 5
[3] Gibraltar 1
[4] Skhul 2

The infraorbital foramina are close to the orbit. In vertical distance, the separation is only 7.0 mm, even the maxilla of Mladeč 2 greater (10.5 mm). In the two Neandertal female faces allowing this determination, Saccopastore 1 and Gibraltar, the distances are greater than both of these are (15.3 mm and 11.2 mm). This contrasts with the distance from the foramen to the alveolar margin, which is more-or-less, the same. Thus, the infraorbital foramen position only changes relative to the orbital margin, and one might infer that facial reduction had taken place with some shortening of the vertical dimension of the maxillary sinus.

Inferior to the infraorbital foramen a very distinct groove progresses inferiorly and slightly medial toward the alveolar margin, terminating some 13 mm above it. This canine fossa clearly delineates the laterally extending flat cheeks from the markedly rounded nasal and subnasal regions of the face.

We believe that the changes in the Mladeč 1 maxilla can be attributed to two factors, a reduction in the volume of the nasal cavity and a reduction in the amount of vertical force transmitted through the midface as a consequence of anterior tooth loading. The reduction in nasal cavity volume is indicated by several changes, including the breadth of the nasal aperture (and of the surrounding midface), the breadth of the superior nasal bones, and the height of the nose. The position of the infraorbital foramen provides a clue to the region undergoing reduction in vertical dimension. This foramen marks the position of the maxillary sinus since the infraorbital nerve and blood vessels travel above the sinus. That the positions of the infraorbital foramina do not change relative to the alveolar margin indicates that the sinus does not change in vertical height. As we discuss below, there is no significant reduction in postcanine tooth size, and we contend that the lack of change in the posterior dentition accounts for the stability of the lower portion of the midface. However, the midface does reduce, as indicated by the reductions in facial height, nasal height, and orbit height. We propose that these reductions are all a consequence of reduction in the upper portion of the nasal cavity, decreasing its volume. Effects of this reduction include the reduction in orbit height and the changing relation of the infraorbital foramen to the orbital margin. Thus, the reduction in facial height is primarily in the upper portion of the midface, and with the decreasing nasal breadth these reductions are the primary consequences of decrease in the volume of the nasal cavity.

The second factor influencing this region is a response to decreasing force through the midface that results from anterior tooth loading. Vertical forces are transmitted through the maxillary pillars, forming the frontal process of the maxilla (Endo, 1966; Russell, 1985). In the Neandertal female sample these pillars are thickened, and as we describe above in the region surrounding the nasal aperture they project anteriorly so that the medial portion of the region below the orbital rim is oriented horizontally. As we noted, the horizontal orientation extends no more laterally than the position of the infraorbital foramen. In part the configuration of this region reflects the great volume of the nasal cavity in the Neandertals. However, the maxillary pillars themselves are distinctly thickened in this sample, adding to the projection of the bony surface and the horizontality of the region surrounding the nasal aperture. The horizontal orientation is important in resisting the horizontal component of anterior tooth loading that affects bending moments in the central portion of the midface. Thus, apart from the reduction in this region that reflects the decreased volume of the nasal cavity, an additional change in the earlier Central European Upper Paleolithic females including Mladeč 1 is found in the thinning of the bone forming the maxillary pillars. As a whole, the region therefore appears to be subject to less stress due to anterior tooth loading.

In Mladeč 1 the masseter attachment extends onto the base of the zygomatic process of the maxilla by as much as a half-centimeter. In the Gibraltar female the extension onto the maxilla is about double. However, since the base of the zygomatic process of the maxilla itself is in a more posterior position in the Neandertal females, it is not clear whether the masseter attains a more anterior position in the Neandertals. Indeed, the muscle may actually be more posterior relative to the palate (see below).

The earlier European Upper Paleolithic hominids are said to contrast with the Neandertals in the morphology of the inferior border of the zygomatic process of the maxilla (Howell, 1951; Rak, 1986). We note that in all Neandertal females the lower border of the zygomatic process of the maxilla blends evenly into the external walls of the palate. This border forms a straight line angled at about 45° to the horizontal between the zygomaxillary sutures to the palate's external walls, and there is no angle between the two surfaces. The Neandertal condition has been described as a "flying buttress". In Mladeč 1 the form of this region is more angled than in the Neandertals, but not as distinctly angled as in many other specimens. Just medial to the zygomaxillary suture the inferior border of the zygomatic process of the maxilla begins an even curve which arcs gently to merge continuously with the external wall of the palate. There is no distinct angulation marking where these surfaces meet. However, the base of this arch is very close to the alveolar margin, separated from the M^1 root by no more than 9 mm. The arc is shallow, so that its curvature does not deviate significantly from a straight line.

The alveolar region of Mladeč 1 is characterized by a fairly high degree of alveolar prognathism, extending over the full anterior of the maxilla between the canine sockets. The canine root pilasters are weak but visible, extending up to the level of the lower nasal margin. At their most superior extent they are somewhat lateral to the lateral borders of the nasal aperture. In the subnasal region, the prominence of the anterior nasal spine combined with the alveolar prognathism outlines a markedly concave surface in the sagittal plane. This concavity extends laterally across the subnasal region to the positions of the canine root pilasters. In the Neandertals, the western females lack alveolar prognathism, although there is a shallow transverse groove in the subnasal regions of Saccopastore 1, Gibraltar, and La Quina 5. In the Vindija maxillae there is a closer approach to the Mladeč 1 condition. Especially in Vi 259 there is a distinct concavity below the projecting anterior nasal spine and a moderate amount of alveolar prognathism.

As mentioned above, the base of the zygomatic process of the maxilla is low relative to the tooth row. In Mladeč 1 this distance is only two thirds the mean for two Neandertal females, as it is in Qafzeh 5. However, the distance is as great as in the Neandertal females for Dolní Věstonice 3, the only other Central European Upper Paleolithic specimen allowing the measurement. The thickness of the zygomatic process of the Mladeč 1 maxilla at its base is marked, greater than Saccopastore 1 and Gibraltar, and almost double the thickness of Cro-Magnon 2 (no other early Central European Upper Paleolithic specimen preserves the region). Moreover, the zygomatic process of the maxilla of Mladeč 1 remains thick in other positions. At the zygomaxillary suture it is thicker than any of the comparative female specimens and almost double the Neandertal female means (Table 12). The height of the process at this most medial point on the cheek (pommette height) is quite large for an early European Upper Paleolithic female – almost at the Neandertal female mean. Relative to the tooth row, the center of the zygomatic process of the maxilla base is at the first molar position while its anterior face is positioned between P^4 and M^1. In the Neandertal females the zygomatic process of the maxilla is somewhat more posterior relative to the tooth row. The center of

Table 12. Zygomatic dimensions (mm) for females

	Mladeč 1	Neandertal	
		Mean (n)	Range
Length of zm suture	28.3	30.1 (3)	27.2–33.5
Bi-zm line to base of orbit	23.0	23.2 (3)	18.0–27.5
zm-ju	29.5	21.4 (2)	19.5–23.2
zm-fmt	46.5	46.5 (2)	46.0–46.9
Thickness at zm	13.3	6.7 (2)	6.5–6.9

Table 13. Position of the face in female specimens

	Mladeč 1	Mladeč 2	Neandertal	
			Mean (n)	Range
au-fmo	80.1	80.5	81.3 (4)	76.6–88.7
au-zm	79.4		76.1 (3)	74.3–79.4
ba-pr	108.9		109.0 (2)	104.0–114.0
ba-na	104.5		103.0 (2)	101.9–104.0
Anterior Occipital Condyle-post M^2	60.5		69.8 (1)[1]	
Glenoid pt-M2	64.3	76.0	79.0 (1)[1]	
Glenoid pt-post C	88.3	98.0	101.0 (1)[1]	
Glenoid pt-zm	56.9		58.9 (3)	55.8–62.0
Glenoid pt-center zpm root	64.1	74.5	70.3 (2)	68.2–72.3
Glenoid pt-pr	113.5	117.7	119.4 (2)	117.8–120.9

[1] Saccopastore 1 only

the process is positioned at the M^2 while the anterior face is at the M^1. Of course, in the Neandertals the tooth row itself is in a more anterior position, which leaves open the question of whether the zygomatic process of the maxilla is posteriorly positioned relative to anything else. We believe that it is. For instance, in lateral view the zygomatic process of the maxilla base in the earlier European Upper Paleolithic female sample is approximately level with the position of the anterior orbital margin. In the Neandertal females the zygomatic process of the maxilla base is clearly positioned well posterior to this margin.

The posterior surface of the zygomatic process of the maxilla, which is the anterior face of the temporal fossa, is vertically oriented – the common orientation in the Central European early Upper Paleolithic European females. In contrast, the Neandertal females appear to have a posterosuperior angulation to the temporal fossa's anterior wall.

The Mladeč 1 palate is elliptical in shape, with its greatest breadth across the M^3 positions. The anterior margin of the palate is highly arched and the incisor roots are far forward of the bicanine line. The length of the premaxilla is approximately 14 mm. In the Neandertal females the anterior margin is very flat and the length of the premaxilla is about half as great. Qafzeh 5 appears to be more arched than is usual in the European Neandertals.

Along the midline the incisive foramen is located directly posterior to the central incisor sockets, well below the roof of the palate on its anterior face. There are low ridges paralleling the midline and separated by a groove at the bimaxillary suture. These begin at the incisive foramen, and extend to the position of the M^1, increasing in elevation. Posterior to this, the palate's roof is smooth; there is no ridging or development of a palatine torus. The Neandertal females have an incisive foramen position that is generally more posterior and on the roof of the palate rather than on its anterior face. None of the females in the comparative samples appear to have either the anterior ridge we described for Mladeč 1, or a palatine torus, but this is not the case for other Mladeč specimens.

The breadth across the tooth roots of the palate, in all positions (Table 13), is smaller than both the Neandertal females and Qafzeh 5. Internal breadths between the tooth socket walls are smaller anteriorly (this reflects the larger anterior teeth in the earlier samples) but toward the palate's rear the Mladeč 1 breadths are more similar to the others. However, this might be a misleading comparison since the internal breadths in the molar region can only be taken on a single specimen, Saccopastore 1.

In terms of the standard measures of palate depth, the Neandertal sample (of two) is extremely variable, and thus we do not regard its mean values with confidence. We propose instead a measure of palate depth determined by taking the height at the internal palate wall because this reflects the same morphology but allows a much greater sample size. The comparison of means for the height of the internal palate wall at the P^4/M^1 and M^1/M^2 positions shows the Mladeč 1 value is above the Neandertal mean. The single Skhul / Qafzeh specimen, Qafzeh 5, is also shorter than Mladeč 1.

Palatine bones

The palatine bones are almost perfectly preserved, but covered with matrix. At the mid-palatine suture, the two bones join in an uneven plane, so that the left projects more anteriorly than the right. The posterior nasal spine is very well-developed. Lateral to this, the palatine bones are well arched as seen in palatal view, forming deep impressions on the posterior border of the palate. Thus, staphylion is located 5.8 mm anterior to the posterior nasal spine. The crest for the insertion of *tensor veli palatini* is extremely high and well arched. The only specimen with a comparable region preserved, Saccopastore 1, shows no corresponding development.

Dentition

The only remaining teeth in the palate are the left and right M^1 and M^2, although sockets for all the other teeth are present (Fig. 13). All these teeth have been lost post-mortem since each of the empty sockets is filled with matrix, except for the left P^3 that contains the root (broken off at the cementoenamel junction). As described earlier, these teeth show little wear. Morphological and metric details of these teeth are described in the dental section below. Sockets for all the remaining teeth are present and filled with matrix, except for the left P^3 that contains the broken root of the tooth. The crown was present when discovered and, according to Szombathy, was subsequently broken off. Because of this matrix it is difficult to observe the orientation of the inner surfaces of the sockets for most teeth, except left I^1. For this case, the socket walls are straight, showing no posterior curvature. The lingual margins of the M^3 sockets are barely elevated above the plane defined by the lingual alveolar borders of M^1 and M^2. Because of this position and the fact that the sockets appear to be

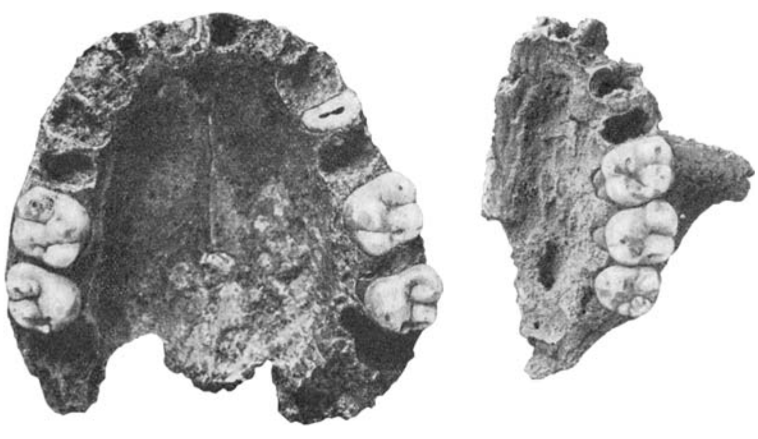

Fig. 13. Palates of Mladeč 1 (left) and 2, after Szombathy (1925). These two female specimens died within a year or so of each other; Mladeč 2 is slightly older

fully open, we believe that the third molars were probably past alveolar emergence and close to their final occlusal position. However, the absence of a distal interproximal facet on the M^2's indicates that the occlusal eruption had not been fully attained. Finally, given the presence of complete alveolar borders for all the anterior teeth and the premolars, there is no indication of any premortem tooth loss, so that all missing teeth were lost postmortem.

The P^3 crown, in fact, must have been lost after discovery since there is no matrix covering the open root surface or imbedded in exposed hollows and cracks. For this tooth the only observation possible is that the pulp chamber is small and does not extend into the root chambers.

On the right side the M^1 and M^2 are in their normal occlusal positions, but on the left, the M^2 has been displaced distally and inferiorly out of its socket. A large mass of breccia fills the interproximal space between M^1 and M^2, separating these teeth by about 5.0 mm. Thus, the occlusal surface of the left M^2 is not in the occlusal plane. Preservation of all teeth is excellent and no asymmetry in wear or morphology occurs. The following morphological description is based on the left side, while metric analysis uses the average of the two sides.

Wear on the M^1's is slight with only pinpoint dentin exposure on the mesiolingual cusp and very minor blunting of the buccal cusps (Stage 2). On the mesiolingual cusp there is a large oval-shaped facet (3.8 mm long, 2.8 mm broad) that extends from the midline of the cusp to the lingual border where it continues onto the lingual face. On the distolingual cusp a round facet (2.5 mm in diameter) occurs in the center of the cusp. Both of these represent normal occlusion with their mandibular opponents. On the mesial face, a large, shallow interproximal facet occurs for the P^4. Lack of depth to this facet indicates little mesiodistal length was lost from interproximal wear.

Seen from the occlusal aspect, the crown is roughly square in shape, although the mesial crown breadth is about 1 mm greater than the distal. The crown is of the 4- type. The distolingual cusp is well separated from the trigone and large, although reduced relative to the other three cusps. The internal faces of the cusps are smooth, with no sign of occlusal wrinkling. Radiographs show a small pulp chamber with a slight enlargement into the mesial root. However, this is limited and does not qualify as taurodontism. The roots are widely divergent and well anchored into the bone.

The M^2's exhibit less attrition than the M^1's with only minor polishing and blunting of (especially) the lingual cusps. This degree of wear corresponds to Stage 1. There are no polished facets on the lingual cusps (as in the M^1's) and the mesial interproximal facet is only lightly etched into the anterior tooth wall. As mentioned above, there is no distal interproximal facet.

The trigone cusps dominate the crown with the hypocone only represented by a small cuspule on the center of the distal border. This arrangement constitutes a 3+ pattern. The pulp chamber resembles the M^1 pattern with a slight expansion into the mesial root, but not to the extent that this tooth can be considered taurodont. The roots are well separated from each other, showing no sign of convergence within the alveolus.

While many of the teeth are missing, something can be said of their size. A number of lengths can be taken along the tooth row, between the socket walls (or roots). The comparisons that can be made (Table 14) involve only females, since they are based on cranial material. They show Mladeč 1 to have an almost Neandertal-like total anterior tooth length. The great distance from prosthion to M^1 and the marked distance between the four incisor sockets verify this contention. The posterior tooth row lengths are even greater, exceeding the small sample of other female specimens.

Actual tooth size is only known for the first two maxillary molars (Table 15). These teeth are large, exceeding the averages of the female Neandertals and Skhul/Qafzeh specimens. However they are smaller than the corresponding teeth in the Mladeč 8 male palate, and the same size or smaller than the teeth in the Mladeč 47 and 50/51 palates described in Frayer and colleagues (this volume).

Mladeč 2

In 1881, Szombathy was excavating a test pit in the part of the cave he designated "b" (see Szombathy, 1925; Svoboda, 2000). He discovered the Mladeč 2 vault within the top 60 cm, as well as two halves of a maxilla we catalogued as Mladeč 7 that were nearby, and the juvenile vault Mladeč 3. Mladeč 7 was subsequently shown to be the same individual as Mladeč 2, and the pieces were attached. A number of postcranial remains were also found in this test pit. Of these, we believe that Mladeč 12–20 (ribs), Mladeč numbers 23 (right proximal humerus), 26 (right radius diaphysis), and metapodials 32, 35, and 36 could be part of the Mladeč 2 individual, although we shall never know.

Preservation

Mladeč 2 consists of the calotte that originally carried that number, and most of a face that we have added to it (see this volume, chapt. 8, Plate II). The calotte includes a nearly complete frontal, left and right parietal bones, and major portions of superior aspects of nasal bones. While in general the bones present are undistorted and complete, there are several missing areas. One of these is the most anteroinferior margin of the frontal, which results in the loss of most of the posterior portions of the orbital roof. There is also a square portion missing from bregma to 47 mm along the sagittal suture, running about 47 mm laterally and inferiorly onto the parietal wall and down the coronal suture. In addition, while both temporal bones are complete in their total lengths, they lack the superior part of the squama. On the right temporal the most medial aspect of the petrosal is broken away, as is the posterior portion of the mastoid tip. Finally, both zygomatic processes of the temporal are broken so that they do not reach the zygotemporal suture.

As Szombathy describes, the skull was found in ten main pieces. In almost all respects his reconstruction appears to be quite accurate, with most of the breaks in the bone well-positioned in their original location. The only area that is incorrectly placed is the left temporal. This piece was indirectly connected to the vault along the occipitoparietal suture, but using plaster between the bone surfaces. We believe that the piece is too low in the sagittal plane, and somewhat rotated in a counterclockwise direction as seen from below, resulting in asymmetry of the glenoid fossae and anterior temporal borders. We did not reposition the left temporal, since the substance used to attach it to the parietal was impossible to dissolve. As much as possible, measurements across the base attempt to compensate for the incorrect position of the left temporal.

The calotte is virtually free of matrix on both the ecto- and endocranial surfaces. A thin coating occurs on the left and right mastoids, extending onto (and into) the external auditory meatus. There is also matrix adhering to the face of the lambdoidal suture for its entire length. The bone is a cream-colored and numerous dark flecks (dendrites) occur, especially, on the endocranial surface. This surface is uneroded. However, externally the bone surface is somewhat less well preserved. The very outer layer of cortex is missing in many areas and some of the surface features such as the temporal lines are difficult to delineate (Fig. 14 and 15).

Where the cranial pieces were glued together a plaster-like substance was used as described above. In preparation the plaster was evidently smeared where these pieces fit together in many cases obscuring morphological detail. This is probably most serious on the frontal where a large triangular piece with its apex at about metopion and its base at the orbital borders was connected with a good deal of plaster on the left side. The plaster was smeared from the frontal squama, onto and over the orbital border, and onto the orbital plate.

Szombathy originally suggested that the maxilla (Mladeč 7 by our cataloging) might belong to the same specimen as the cranium. He believed that the two maxillary halves represented the same specimen as the Mladeč 2 vault because they were lying close together. Like other specimens from Mladeč, the bone is gray or ash-white in color and contains small dendrites. In the Naturhistorisches

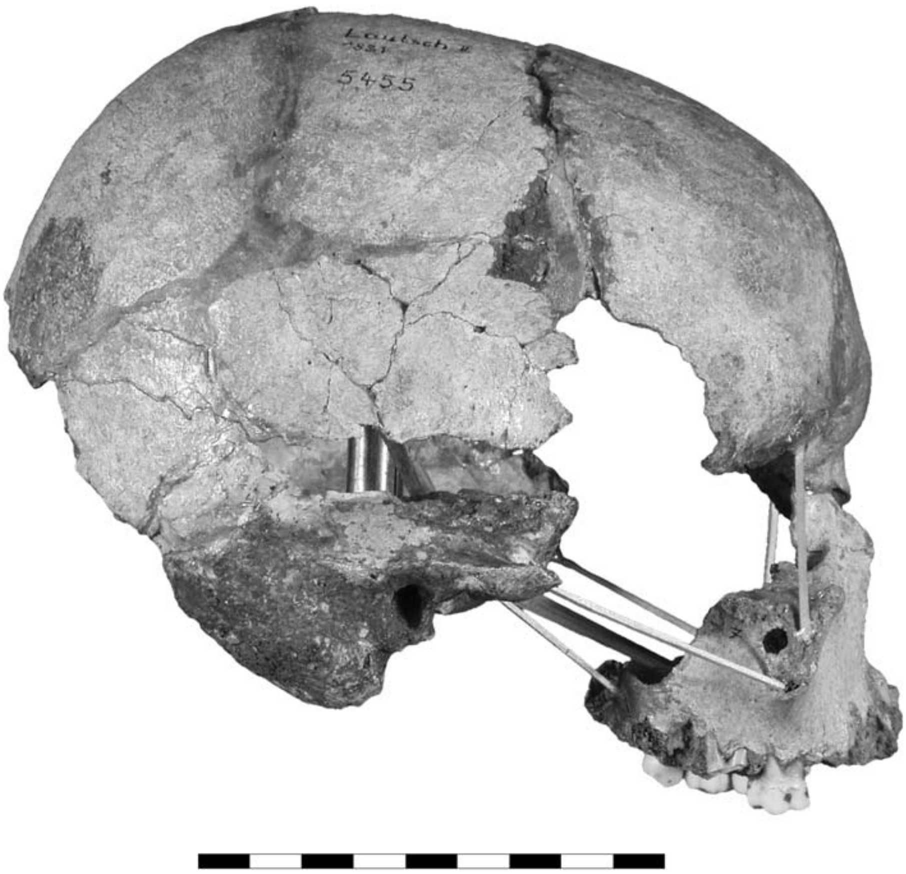

Fig. 14. Lateral view of the reconstructed Mladeč 2

Museum Wien, we had the palate cleaned and some additional cleaning was done on the frontonasal suture of Mladeč 2. From this we discovered a join between a right frontal process of the maxilla (including the lacrimal duct and the portion superior to it) and the inferior lateral segment of frontal process of the maxilla that remained on the Mladeč 2 calotte, about 5 mm inferior to the frontomaxillary suture. We positioned the face on the vault using this join, the continuity of the orbital margin, horizontality between the first molars and symmetry of bilateral points on the anterior of the palate from lambda (since the left temporal was improperly positioned, symmetry from the cranial base could not be determined). The sagittal orientation was the most difficult. We relied primarily on the join itself, the orbital margin, and the angle of the molar row. We will refer to the reconstructed cranium and face as Mladeč 2.

The facial skeleton of Mladeč 2 is undistorted and consists of two halves of the maxilla, originally broken apart along the midpalatal suture. The right half is more complete and includes the inferior portion of the nasomaxillary suture, the lower part of the frontonasal pillar (12 mm superior to the lower orbital margin), the lacrimal foramen, the inferior orbital border to the maxillosphenoidal suture, the zygomatic process of the maxilla which includes the medial most 13 mm of the zygomaxillary suture (and a small piece of zygomatic adhering to it), nearly the entire maxillary sinus, the lateral border of the piriform aperture, the entire alveolar portion of the maxilla, the anterior inferior portion of the palatine bone, and the nasal floor (Fig. 22). But, the very most anteroinferior region of the maxilla is damaged, so that nothing remains of the lower nasal mar-

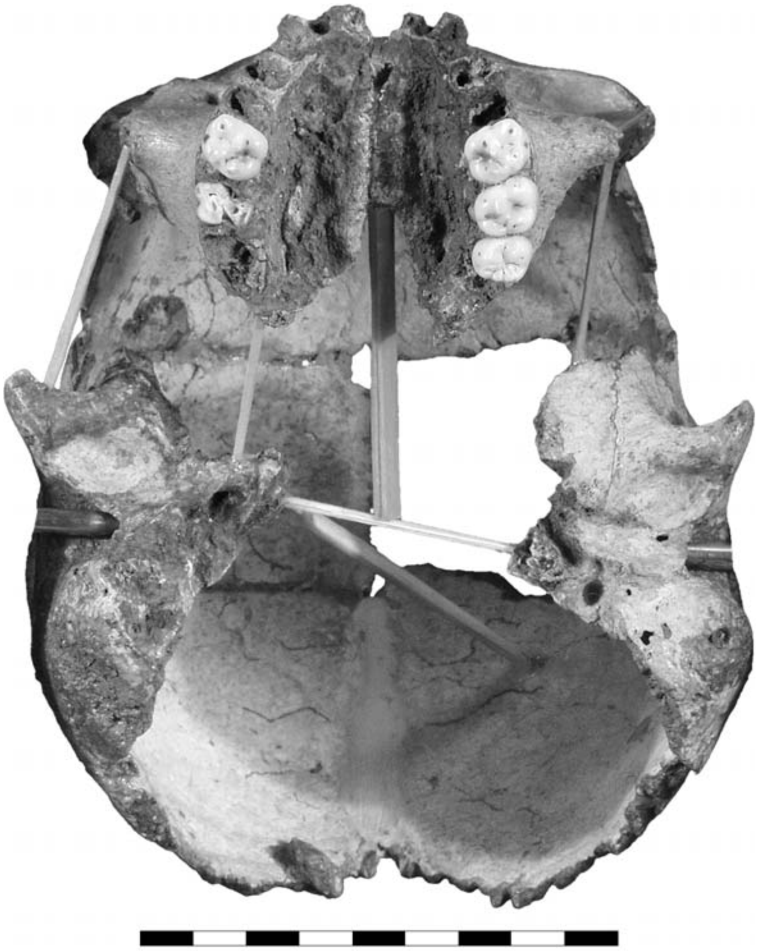

Fig. 15. Basal view of the reconstructed Mladeč 2

gin or anterior nasal spine. Sockets for all permanent teeth are present, while the only tooth crown present is M^1.

The left side is less complete, comprising mainly the entire alveolar portion with sockets for the incisors, canine, and premolars. M^1, M^2, and newly erupted M^3 are still located in the jaw. Besides the alveolar arch, the fragment includes the posterior lateral part of the palatine bone, the inferior most portion of the zygomatic process of the maxilla, the basal portion of the maxillary sinus, and the floor of the piriform aperture. Extensive damage to the subnasal area has destroyed the inferior nasal margin.

During the reconstruction, the two halves of the maxilla were separated for cleaning and then positioned together, but precise contact along the mid-palatine suture did not occur. Perhaps this is because they were originally cemented together with a number of reindeer bones and these covered the mid-palatine suture. According to Szombathy the two halves do not fit together perfectly, due to erosion of the mid-palatine suture on the left side. However, by orienting the pieces with respect to the incisive foramen, transverse palatine suture, and left and right M^1's, it is possible to produce an accurate reconstruction of the dental arcade. In our reconstruction a small amount of filler was used to reconstruct the missing portion of left mid-palatine suture.

Association of the palate with the cranium allows a clear determination of sex and age. In so far as sex is concerned, the gracility of the cranium, especially the supraorbital region, indicates the sex was female. Dimensions of the teeth and palate size, in comparison with Mladeč 1 and Mladeč 8, also suggest that this specimen was probably female. Szombathy reports that before reconstruction all the cranial sutures were open, and the sutures are of simple form, concluding that the specimen was a juvenile. As was discussed in the section on Mladeč 1, the dental age of this specimen is 16±1 years, thus slightly older than Mladeč 1. The third molar of Mladeč 2 had apparently just erupted, since there is only slight polishing wear on its occlusal surface. Based on this criterion Mladeč 2 must be regarded as a young adult, but in fact we regard her as virtually identical in age to Mladeč 1.

Total skull

After reconstruction, we found that the Mladeč 2 face is particularly similar to the face of the Cro-Magnon 2 female (Fig. 16). Therefore, even though this Western European female is not part of our general comparative sample, we will make certain comparisons and discuss relevant aspects of the vault in the text below. These two females share very small flat faces, broad interorbital areas, moderate superciliary height development (in the context of modern European females), minimal projection of the superciliary arches, and relatively large basal dimensions of the mastoids. Of course, the skulls are far from identical. Mladeč 2 is the more prognathic (alveolar prognathism and index of prognathism, Table 11). Her orbits are higher and markedly rounder, the top of the vault is flat (in Cro-Magnon 2 the top is keeled), vertex is 45 mm behind bregma (in Cro-Magnon 2 vertex and bregma are coincident), the malar notch is only weakly developed, the mastoid is less projecting, and the cranial base is much broader.

Mladeč 2 is slightly smaller than Mladeč 1. The cranial capacity we have determined is 90% the Mladeč 1 value (Table 2) and while Mladeč 1 is the largest female vault in the Central European early Upper Paleolithic, this Mladeč 2 capacity is below the female mean. The Mladeč 2 cranial lengths can only be measured to lambda. These are very small, at the bottom of the Central European early Upper Paleolithic female range, for the most part the same as Qafzeh 3, and smaller than the Neandertal female means. Mladeč 2 is a very curved skull in the sagittal plane, resembling Qafzeh 3 in this regard and contrasting with the much flatter Neandertal female vaults – this can be seen in comparing various chord/arc indexes.

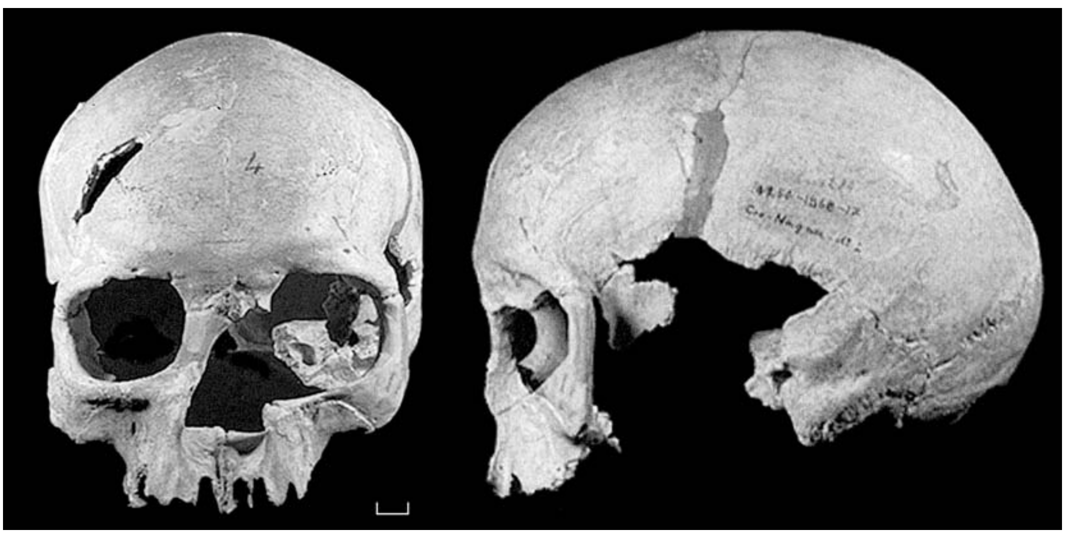

Fig. 16. Cro-Magnon 2, a female with marked facial similarities with Mladeč 2

Fig. 17. Comparison of Mladeč 1 and 2 in facial view

The breadths of the vault are quite the opposite, in that this is a very broad vault, with its greatest breadth at the cranial base. The maximum cranial, biparietal and estimated occipital breadths are the same as Mladeč 1, but because of the much shorter vault, relative breadths for Mladeč 2 are quite high. While relative breadths are even greater in Qafzeh 3, they are much less in the elongated Neandertal female crania. The absolute values for the vault breadths are close to the Neandertal female means, while the basal breadths are above the ranges. Biasterionic breadth can be estimated from the parietals and is above the Neandertal female mean.

Cranial height from the auricular point (Table 3) is low, very small, below the Central European early Upper Paleolithic female minimum and below the Neandertal female mean. Relative to nasion-lambda length (Table 2), however, this height is not much different from Mladeč 1 or the female Neandertals.

In sum, the vault as preserved suggests the cranium was short, low, and broad. Except for details at the rear of the preserved cranial base, it is generally a smaller, more gracile, more rounded vault than Mladeč 1. The exceptions are the marked breadth across the cranial base and the rugose development of the mastoid processes, which result in unusually great relative breadth proportions. These comparisons illustrate what most practicing paleoanthropologists know full well – even the smallest samples can encompass very significant variability.

In lateral view, the glabellar area shows a very slight anterior projection and a weak sulcus above it, like Mladeč 1 and Cro-Magnon 2. The nasal bones protrude below. Relative to the auricular point (Table 3) the glabellar and nasion projections are smaller than Mladeč 1 and much smaller than the Neandertal females. The frontal forms a nearly vertical plane to metopion and then curves sharply angling up to the low bregma. The elevation of the cranium continues along this line to a point about 45 mm behind bregma and from here the contour drops sharply along a gentle curve toward lambda (Fig. 14). Interestingly, as in the Mladeč males' vertex also forms the apex of triangle of bone flattened across the rear of the parietal bones. The base of the triangle at the lambdoidal suture is about

50 mm in breadth. Thus, the posterior parietal area is flattened, although this is not evident from a strictly lateral view. This vault contour, with a vertex well separated from bregma, is also seen in Cioclovina. However in Mladeč 1, vertex and bregma are coincident and, consequently, the back of the parietal bones and occiput are not as steeply sloped.

The sagittal and transverse contours are more curved than the Mladeč 1 female, according to the arc/chord indices (Table 2). The curvatures are greater than the Neandertal females, although markedly less than the highly-curved Qafzeh 3. The transverse curvature is less, at the female Neandertal mean (the European samples do not differ in transverse curvature).

The face is prognathic – both the facial angle is high and the alveolar region shows additional prognathism. Measured from the auricular point, what we might call the "auricularognathic" index is higher than Mladeč 1, and identical to the Neandertal maximum. However, the magnitude of the difference between the two Mladeč females (8 index points) is not unusual, even in these small samples. The two Neandertal females differ by 18 index points and the two Skhul/Qafzeh males differ by 17 index points. The marked prognathism in this Mladeč female is matched or exceeded by a Neandertal and a Skhul/ Qafzeh hominid. It is possible that the greater prognathism in the two Mladeč females and the two Skhul/Qafzeh males has significance. However, given the closeness of the mean indices for the combined sex samples (117 for the Neandertals and 120 for two Skhul/Qafzeh males), especially in the context of the marked sample variances, it is difficult to clearly delineate a significant pattern to this variation. The anterior position of the face is also indicated by the marked sagittal distance of prosthion from the auricular point (Table 3). This is 95% the Neandertal female mean value. The auricular-nasion distance only reduces to 85% the Neandertal mean, which accounts for the large *index* of prognathism as calculated from the auricular point.

There is an even greater measurement from the glenoid point to prosthion although this might be misleading. Unlike the measurements from the auricular point, which are projected into the sagittal plane, the measurements from the glenoid point to positions along the tooth row (Table 13) are directly measured between the points. These show a marked anterior positioning of the posterior dentition. But, distances from the glenoid point to the anterior of the palate, at the midline, are more difficult to interpret because they also incorporate great breadth of the vault. While the auricular distances (Table 3) are probably a better indication of the face's midline position since these are projected into the sagittal plane, together these clearly reflect the marked facial prognathism of the specimen.

Unlike Mladeč 1, the lower orbital border is anterior to the upper border in the Frankfort Horizontal (this morphology is like that of Cro-Magnon 2). The anterior face of the zygomatic process of the maxilla is located over the first molar as it is in Mladeč 1. Anterior to it the midnasal projection does not seem to be as great (as described above). Prognathism of the alveolar region is similar, although the area between the lateral nasal border and the canine alveolus does not appear quite as deep or curved as in Mladeč 1.

The discussion of prognathism in the sagittal plane indicates that the dentition is more anterior in Mladeč 2 than in Mladeč 1, while the upper part of the face is not more anteriorly projecting. Indeed, the lateral portion of the upper face is also in a similar position in these two specimens (Table 13). This portion is very anterior; in fact, the lateral facial length is the same as in the much larger female Neandertal faces. This combination shows that both Mladeč faces are transversely flatter than Neandertals. Moreover, measurements that reflect the more medial position of the Mladeč 2 middle (below nasion) and lower face are very similar to the Neandertal female mean values. The *combination* of transverse flattening and lower facial prognathism is unique in this specimen. The Mladeč 2 face *could* be transformed from a Neandertal female condition mainly through vertical shortening and reduced anterior projection for the midline facial positions of nasion and glabella. The lateral portion of the face and the regions above (bregma) and below (prosthion) the upper nose remain in a more stable location. It is as if the same guy who created the Neandertal face by pulling on the nose changed his mind and pounded it back in!

Fig. 18. Mladeč 2 from the rear. The greatest breadth of this cranium is at its base, and there is a broadly depressed sagittal groove

As seen from the front, the coronal contour forms an almost circular arc (Fig. 22). The brows are weakly developed and below them the very wide innerorbital area contrasts with the very narrow superior nasal bone breadth. The index of the superior nasal breadth to the anterior interorbital breadth (33.8, see Table 10) is by far the smallest of any other female discussed here. The brows are very much like Cro-Magnon 2 and more weakly developed than in Mladeč 1. However, the superciliary development falls well within the early Central European Upper Paleolithic, exceeding the three Dolní Věstonice females.

The orbits are high (Table 11) and their contour is rounded. Indeed, it is the great height of the orbits that convince us that no bone is missing from the contact between the maxilla that was designated as Mladeč 7 and the small piece of maxilla adhering to the Mladeč 2 vault. Because of the high orbits, there is a contrast between the low broad face and the high rounded orbits in this specimen as compared with the low, broad face and low, broad orbits of Mladeč 1 (Fig. 17). The orbit breadth does not vary significantly between the samples. Because the orbit breadth resembles the Neandertal condition, and the orbit height is almost within the Neandertal range, the shape index for the orbits of Mladeč 2 more closely approximates the round orbits of the Neandertals than does any other Central European early Upper Paleolithic female. Even still, however, the index is below the Neandertal range.

From the rear, the parietal bones are somewhat less parallel sided than in Mladeč 1, canting laterally inferior to the weakly expressed parietal bosses. Also in contrast to Mladeč 1 the mastoids angle medially to the supramastoid crest. This can be more accurately seen on the right than the left,

Fig. 19. Superior view of three Mladeč crania. From the left these are crania 5, a male, and the females 1 (center) and 2 (right)

due to the improper position of the left mastoid (as discussed above). In the pneumatization of the cranial base and contour of the parietal walls this otherwise very gracile specimen is rather male-like. Superior to the parietal bosses the paracoronal plane is evenly curved and is not as pentagonal as seen in Mladeč 1. However, if the skull is tipped somewhat anteriorly, the flattening across the back of the parietal bones results in a horizontal contour across the top. Finally, the most posterior aspect of the mastoids shows a flat, somewhat posteriorly oriented surface (Fig. 18).

In superior view, there is a broad glabellar prominence. Lateral to this, the superior orbital borders extend in a straight line, which roughly corresponds to the paracoronal plane. There is only slight postorbital constriction. The temporal fossa is very short (no breadth can be ascertained). From the *ft* point to the parietal boss, little curvature of the frontal and parietal lateral walls occurs. The bosses are evident, but not especially prominent; in fact, in Mladeč 2. Posterior to the bosses, the cranium curves evenly and markedly toward the lambdoidal suture. This contrasts with the flattened surface in this region outlining the occipital bun in Mladeč 1 (Fig. 19). The cranial base is so broad that the superior portions of the mastoids are visible in superior view. The superior surfaces of the mastoids are located just posterior to the bosses when observed vertical to Frankfort Horizontal.

On the maxilla in superior view the lacrimal foramen and inferior orbital plate can be observed and the anterior border of the orbit is preserved to just past the suture with the zygomatic. This border runs in a straight line laterally, as does the maxillary area inferior to it, reflecting the flattened face in Mladeč 2. Since the sphenoid is broken away, the maxillary sinus is open. This large structure occupies a very low position, actually extending well below the roof of the palate, laterally to near the zygomaxillary suture, and posteriorly to well beyond the M^3 socket.

Inferiorly, only the orbital plates and the petrous portions of the temporal bones along with the mastoids are preserved on the cranial base. On the frontal, the base of the frontal sinus is visible bilaterally, divided by the anterior portion of the frontal spine. For the posterior vault, the asymmetry due to the position of the left temporal/sphenoid fragment is most apparent. For instance, from the auricular point to nasion on the left side is 119 mm, while on the right the correct value is 110 mm. The distances from the auricular point to bregma are about the same, but to lambda the inaccurately positioned left side is about 4 mm closer to lambda than the right.

The great breadth of the cranial base discussed above is evident in this view. Had the zygomatic arches been preserved, they would surely have greatly exceeded the bizygomatic breadth of Mladeč 1. For instance, the breadth across the zygomatic processes of the temporal bones (where they are broken just anterior to the glenoid fossa) is already 145 mm and, therefore, exceeds the total bizygomatic breadth of Mladeč 1 (Table 11), which is in a more anterior position.

The long axes of the glenoid fossae appear to angle and turn laterally as they do in Mladeč 1. However, this in an artifact of the improperly positioned left temporal. Actually, the orientation of these long axis is almost exactly paracoronal. The tooth row is much more anterior to the glenoid fossae than it is in Mladeč 1 (Table 13 shows the direct measurements between these). The distances to the tooth row, in fact, approach the Neandertal condition.

Frontal

Compared with Mladeč 1, the frontal of Mladeč 2 is smaller, higher and more arched, generally more gracile, and even thinner. Like Mladeč 1 there is no frontal boss (Fig. 20). Sagittal lengths are particularly short. Frontal chords from both nasion and glabella are actually below the Neandertal means (Table 5). The sagittal lengths are considerably shorter than Qafzeh 3.

The frontal breadths are moderate, not as large as Mladeč 1. Maximum breadth is greater than the Neandertal mean. However, these samples differ little for maximum frontal breadth, and this is almost the case for minimum frontal breadth. The Mladeč and Neandertal females are quite similar; both contrasting with the much greater minimum breadth is Qafzeh 3. The ratio of minimum to maximum breadth is less than the Neandertal mean value in both Mladeč females. Frontal thicknesses are extremely small, near or below the minima for the comparative samples (Table 6).

The temporal lines arch strongly superiorly as they leave the temporal notch, more so than in Předmostí 4, but similar to Zlatý Kůň and Mladeč 1. It is our observation that the temporal line divides into superior and inferior lines some 20 mm posterior to the supraorbital notch. Anterior to this division, the line forms a weak ridge. The inferior line follows a smooth curve to the coronal suture, while the superior line arcs markedly upward from the point where the lines divide. None of the other early Central European Upper Paleolithic female specimens show this division of the temporal lines (into a superior and inferior line) on the frontal. In their more posterior aspect the temporal lines are much more weakly expressed and are barely discernable where they cross the coronal suture. On the coronal suture, the inferior and superior lines are about 10 mm apart. The high position of the temporal lines (also characteristic of the Mladeč males) is reflected in the bistephanion breadth (Table 5). This measurement, taken between the left and right superior lines, is very small (102 mm). It lies be-

Fig. 20. Comparison of the Mladeč females in angled view

low the minima of the comparative sample. The low value is not an artifact of small frontal size, as is shown by the fact that the index of the bistephanion breadth to the maximum frontal breadth is also below the minima for the comparative samples. Turning to the inferior lines, breadth across the points where these pass over the coronal suture measures 112 mm. In either case, the inferior and superior lines cross the coronal suture above the maximum breadth of the frontal as opposed to being coincident with it.

While in most comparisons this frontal is generally smaller than that of Mladeč 1, the superior facial breadths are greater, and the distances across the orbits approximate the Neandertal female means. Distances between the orbits exceed the Neandertals. These breadths also exceed the Skhul/Qafzeh females (different specimens are involved in different comparisons).

There is a weak supratoral sulcus separating the squama from the supraorbital region. The highly arched squama is neither keeled nor does it show a boss or a small bump similar to that in Mladeč 1. The arc/chord index from glabella is virtually identical to Mladeč 1, above the means of the comparative samples. The vault appears more arched than Mladeč 1 because the glabellar projection is minimal and the squama is more evenly curved in the sagittal plane. The Skhul/Qafzeh females have narrow anterior squamae, with the large central boss offset by a lower flatter region medial to the temporal lines. Moreover, the Levant frontal bones are not as high and have supratoral sulci deeper than those in the European Neandertal females.

Like Mladeč 1 the Mladeč 2 supraorbital region is modern in its form. The region is also similar to that of Mladeč 1 in that the superciliary arch is vertically tall, but projects very little. The glabellar area is continuously thick in its vertical dimension across central supraorbital region and extends to about the mid-orbital position. Mladeč 2 has the most gracile supraorbital region of the early European Upper Paleolithic females, less developed than the region in Mladeč 1. The glabellar prominence is weak, although it is very broad, and the nasal root shows little depression below it. Lateral to the superciliary arches the superior orbital margins are extremely thin and lack any toral development. Even at the temporal notch the thin orbital border continues. The temporal line lies just behind the orbital margin at the zygofrontal suture, separated by only 5 mm. The supraorbital notch is only poorly developed, as in Mladeč 1. It is best expressed on the right side where it can mainly be seen as a weak depression at and just above the superior orbital margin. Mladeč 2 is markedly similar to Cro-Magnon 2 in the supraorbital region. However, the Cro-Magnon female combines a more projecting glabellar region and a prominent frontal boss with a vertical face to outline a shallow supratoral sulcus. Moreover, the central and lateral orbital margins are thicker.

Metrically, the heights of the superciliary arches (medial and high point supraorbital heights, see Table 5) are greater in the early Central European Upper Paleolithic females than in the Neandertals (the Skhul/Qafzeh females are intermediate). The Mladeč 2 dimensions exceed the means of all of these and are at the high ends of the ranges. This contrasts with the lack of toral development over the center-orbit and lateral portions of the Mladeč 2 orbit. Even at its most lateral aspect the Mladeč 2 supraorbital region shows little development. For instance, on the orbital pillar the *fmt-fmo* distance is below the means of all the comparative samples, below the Neandertal range, and so far below the Skhul/Qafzeh range that is close to half the minimum value. Reflecting these variables, the ratio of orbit center to medial height is much less than even the minimum Neandertal and Skhul/Qafzeh values, although it is closer to the Neandertal range than it is to the range of the Levantine females. Lateral supraorbital reduction is reflected in the very low lateral to medial ratio, again very small compared with the Neandertal and Skhul/Qafzeh means and ranges but more like the former than the latter. Both of these ratios in Mladeč 2 are below the Mladeč 1 values.

Unlike Mladeč 1, it is possible to measure the projection of the supraorbital region anterior to the internal face of the frontal squama in this specimen. Projected lengths to the medial and orbit center positions are large in the Neandertals and only slightly less in the Skhul/Qafzeh female. These supraorbital lengths for Mladeč 2 are very small, invariably lower than the minima in the two comparative samples. However, projection of the Mladeč 2 supraorbital region at the lateral position is close to the same as the comparative samples.

The distances along the supraorbital margins, from nasion to *fmt* and to *fmo* are somewhat greater than they are in Mladeč 1. These longer supraorbitals reflect the more angled upper face in the Mladeč 2 female. Thus, the projection of nasion anterior to the bi-*fmt* line (Table 11) is greater. Like Mladeč 1 the upper face is somewhat less angled than the Neandertal females.

Behind the superior orbital margin the orbital roof angles upward. Insofar as the preserved region can be compared with Mladeč 1, these females do not differ. The superior orbital border possesses a supraorbital notch, which is not bridged as in Mladeč 1. The notch is extremely shallow and is located in a medial position, just lateral to the orbital angle.

The interorbital region is extremely broad, both anterior interorbital breadth *(mf-mf)* and the breadth between the superomedial orbital angles (orbital angle breadth) exceeds Mladeč 1 (Table 5). Orbital angle breadth exceeds Neandertal and Skhul/Qafzeh means, while anterior interorbital breadth exceeds all other specimens compared.

Internally, where it is not obscured by plaster or matrix, the surface of the frontal squama is irregular, but shows no distinctive grooves for the meningeal arteries. This surface lacks pacchionian depressions and details of the superior sagittal sinus are either broken away or covered by plaster.

Nasals

Whether considered absolutely or relative to the very broad interorbital area the preserved superior portion of the Mladeč 2 nasal bones are surprisingly narrow (Table 10). The superior nasal breadth is below the ranges of the comparative samples and the ratio of this width to the anterior interorbital breadth is even more dramatically below these ranges. Similarly, the minimum nasal breadth is quite small. The minimum breadth is markedly less than the superior breadth, so like Qafzeh 3 the nasals can be described as having a distinct waist. Similar to the other Mladeč specimens, the nasals form a pillar at the internasal suture. As a whole, the bones project above the frontal processes of the maxilla and are separated from these by a groove. The nasals are set at a moderately high nasal angle. For their preserved length the bones are straight and are angled parallel to the inferior portion of the frontal squama above the supratoral sulcus. They have a higher angulation than the equivalent section of the Mladeč 1 nasals show. While only 12 mm of the bones remain, their continuation on the nasal border of the maxilla's frontal process shows that below this portion the nasal bones must have angled very strongly and, thereby, had they been preserved, would have projected strongly in front of the face. If anything, the angulation of the nasals in Mladeč 2 would have exceeded that in Mladeč 1 had these bones been complete.

The nasal bone lateral length is almost the same as Mladeč 1. Like it, this value is below the Neandertal range.

Parietal bones

The parietal is fairly small, especially along the superior and posterior borders (Table 7). Since the biggest difference in parietal dimensions between the Central European early Upper Paleolithic females and the Neandertal females is in the much *longer* superior border of the Neandertal parietals, the contrast in Mladeč 2 is dramatic. Of the transverse dimensions, the krotaphion-lambda chord does not differ significantly between the Neandertals and Mladeč 2. For the bregma-asterion chord, Mladeč 2 is also like the Neandertal mean in size (Qafzeh 5 is much larger than both). If the parietal radius is taken as a measure of overall size, Mladeč 2 only very slightly exceeds the Neandertals. Mladeč 1 is much larger in all of these dimensions, and we believe that for the most part their magnitudes correspond to the differences in their cranial capacities.

Fig. 21. Comparison of Mladeč 2 and the La Quina 5 female crania in posterior view. Both specimens shown are casts. Differences in cranial contour are evident, including the shape of the sides (rounded in the Neandertal, more slab-sided with a distinct angle at the temporal line in Mladeč), and the position of the greatest breadth (mid-vault in the Neandertal, at the cranial base just over the mastoid in Mladeč)

The parietal angles reveal a pattern similar to Mladeč 1. The top of the bone appears expanded relative to the Neandertals while the rear of the bone is contracted.

Curvature of the parietal as a whole is best indicated by the arc/chord indices for the transverse dimensions. These are very similar to Mladeč 1, only somewhat more curved along the sagittal border. This is also the case in the Neandertal comparison, and the Neandertal parietals are also flatter transversely.

The course of the inferior temporal line is very difficult to discern, but from its high position at the coronal suture (the chord and arc to it from bregma is shorter than those of all the other females) it seems to pass through the apex of the parietal boss and eventually becomes continuous with the supramastoid crest on the temporal. The superior line travels somewhat more medially after it crosses the coronal suture, reaching its highest position some 33 mm behind stephanion. After this the line curves to meet the lambdoidal suture about 39 mm above asterion and for most of the distance that it parallels the lambdoidal suture there is a weak, but distinct angular torus. The line continues onto the mastoid.

Internally, the bone shows good preservation of the surface details. The superior sagittal sinus is weakly expressed and lateral to it are two shallow pacchionian depressions. The anterior and posterior branches of the middle meningeal artery reach the inferior border of the parietal separately and the middle branch is an offshoot of the anterior branch. There is no Breschet's sinus. A distinct double branched form of this sinus is characteristic of European Neandertals (Heim, 1976) and we have found in other early Central European Upper Paleolithic specimens, such as Zlatý Kůň and Vindija 208.

Although none of the occiput was preserved, some of its metric characteristics can be ascertained from the rear of the parietal bones (Fig. 21). For instance, as previously mentioned the biasterionic breadth as estimated from the parietals, 117.1 mm, is very large, between the Neandertal mean and (larger) Skhul/Qafzeh means. On the other hand, the lambda-asterion chord and arc dimensions are quite small. This suggests a short, widely flared occipital plane (commensurate with the small size of the vault) atop a very broad nuchal plane. The arc/chord index is the same as the Neandertal female mean.

Temporal bones

The temporal bones contrast markedly with the frontal of this specimen. While the frontal is gracile and quite modern in appearance, the temporal bones are very robust and in some aspects archaic. The temporal squama is shorter than Mladeč 1 (Table 9), and also appears to be vertically smaller. The squama's length is above the Neandertal range. The height is much smaller and within the Neandertal range, as measured above the Frankfort Horizontal to the highest position on the beveled edge of the parietal's inferior border (not necessarily the highest point on the temporal squama since much of the superior border was broken away). Thus, the proportions of the Mladeč 2 temporal more closely approximate the long, vertically short temporal bones of the Neandertals than do those of Mladeč 1. The squama, like the other vault bones, is quite thin.

The supraglenoid region is of the same length as Mladeč 1 but is somewhat wider. In fact, the gutter breadth is almost at the Neandertal maximum (the Neandertal mean is greater than the Central European early Upper Paleolithic mean). In spite of the small size of the vault, a substantial posterior *temporalis* bundle lay in this gutter. Behind the auricular point position, where the supramastoid crest is continuous with the top of the zygomatic process, a shallow extension of the gutter continues all the way to the rear of the bone. This condition is unlike Mladeč 1, but does resemble Cioclovina and Předmostí 4 to some degree. The superior temporal line and the nuchal line, where they appear as the supramastoid and mastoid crests, come as close together as 7 mm. They are separated by an extremely shallow groove. Both sides show a very similar morphology in this region.

The superior nuchal line extends from asterion to the midline of the mastoid, and then arcs inferiorly to the apex of the process. This line delineates a posterior mastoid surface with a backwards orientation that seems to represent an extension of the nuchal plane similar to that described for Mladeč 5. This configuration also resembles the Předmostí 4 and Cioclovina females, but differs from Dolní Věstonice 3 and Cro-Magnon 2, which have a sharp edge rather than a rearward oriented face at the posterior of the process.

Medial to this posterior mastoid face, a relatively shallow digastric sulcus is bordered by a projecting paramastoid crest. The paramastoid crest projects inferiorly to the approximate level of the mastoid's apex. This differs substantially from the other early European Upper Paleolithic females, which either lack the paramastoid crest (Předmostí 4), or have a projection of the mastoid's apex inferior to it (Mladeč 1, Cioclovina, Dolní Věstonice 3, and Cro-Magnon 2). Lateral to the paramastoid crest the posterior of the temporal is not preserved.

The mastoid (unbroken on the left) is rather small in size, blunted at its apex, and vertically oriented in lateral view. The mastoid process *appears* massive, an impression gained from its shape. This appearance results from the fact that the form is squat and fairly evenly thick to the apex rather than triangular as it is in most other early Central European Upper Paleolithic females. Dimensionally the Mladeč 2 mastoids are small, below the Neandertal female means in the dimensions of the process. Mastoid height as measured by the auricular point-*mastoidale* distance is so low that it is barely within the Neandertal range and the projection of the mastoid's apex inferior to the digastric sulcus is below it.

The difference between the Mladeč 2 mastoid and the Neandertal structures lies in three aspects of its morphology. The Neandertal mastoids contrast with this specimen in their sharp posterior borders and lack of posteriorly oriented surface, a much more triangular form with a narrow apex, and a deeper and more posteriorly extending digastric sulcus which defines a broader basal length dimension. Thus, the Mladeč 2 mastoids present a mix of features, some of which specifically resemble the Neandertals and others do not. The Skhul/Qafzeh females, for the most part, resemble the Neandertals in these features. Qafzeh 3, with the best preserved mastoid region, has a mastoid process that closely resembles the European Neandertals in size and form. Although broken at the paramastoid crest, the remaining crest already projects almost as inferiorly as the mastoid's apex. While the expression of the paramastoid crest resembles that in Mladeč 1 (as described above) and is less pronounced than in Mladeč 2, the combination of mastoid and paramastoid form in this specimen is more Neandertal-like than any of the Mladeč specimens.

The external auditory meatus is oval, with a long axis that slants in an anterosuperior direction as in Mladeč 1. Also like Mladeč 1, the anterior wall of the mastoid forms the posterior wall of the meatus. Posterior to the tympanic ridge, the meatus wall merges with the mastoid's face.

The glenoid fossa is deep and has a distinct vertical anterior face, separated from a horizontal articular surface anterior to it by a sharp angle. This is clearly not an age-related difference. Compensating for the wrongly positioned left side, the orientation of the two fossae is close to paracoronal, and thus the anteromedial angulation of the fossa's long axis is only slight. The glenoid fossa differs substantially in Mladeč 1. Her fossa has a significant anterolateral orientation. In Mladeč 2 the post-glenoid process merges with the anterior wall of the external auditory meatus and the posterior face of the glenoid fossa, including articular surface, extends to the tympanic ridge. The dimensions of the post-glenoid process exceed Mladeč 1 (as well as Skhul 7). The height of the process is close to the Neandertal female mean value while the base is thicker. Length measures of the glenoid fossa are virtually identical to Mladeč 1, while the depth and breadth are somewhat less. The Mladeč 2 dimensions resemble the Neandertals when these earlier females are distinct.

Besides the metric similarities, the paracoronal orientation of two of the three Mladeč fossae (crania 1, 2, and 5) and the merger of the post-glenoid process with the anterior external auditory meatus wall resemble the Neandertal condition. Of these three, the Mladeč 2 fossa is the least like the Neandertals in the perpendicular angulation of its anterior face.

Much of the petrous portion of the temporal bone remains on the right. Just anterior to the supratubercular process a broad groove extends medially from the roof of the glenoid fossa. The angular spine is not present. The region is probably similar in Mladeč 1 although the adhering matrix makes observations of the details difficult. This groove is absent in Předmostí 4. A similar groove in the Neandertal females Gibraltar, Spy 1 and La Quina 5 is narrower, deeper, and more posteriorly positioned. The groove is lacking in Saccopastore 1. The morphology of this region on the medial glenoid fossa surface is variable in the earlier Central European Upper Paleolithic females. The males of this sample, including Mladeč 5, more consistently resemble the Neandertal males (and females).

Medial to the region described above the petrous is broken away on both sizes exposing the cancellous internal structure of the bone but leaving little else for comparison. The vaginal foramen is clearly present on the left side and there is no evidence preserved of an ossified styloid process within it. Finally, dehiscence of the tympanic plate (foramen of Huschke) occurs bilaterally.

Sphenoid

Little of the sphenoid bone remains in this specimen. On the left side the base of the greater wing medial and anterior to the glenoid fossa is preserved. There is nothing particularly diagnostic concerning this area.

Maxilla

Of the portions remaining of the Mladeč 2 face, there are some similarities to various comparable parts of Mladeč 1 and Cro-Magnon 2 (Table 11). These include the widths of the central part of the midface, nasal narrowing, the large medial height of the cheeks (pommette height), the subnasal angulation away from the plane of the face above, and the low base of the zygomatic process of the maxilla. However, there are also a number of contrasts. In particular, the main morphological differences are found in:

- the thinner root of the Mladeč 2 zygomatic process (in the anteroposterior direction),
- the lesser amount of anterior projection around the lateral nasal border (the distance from the medial inferior orbital corner to the lowest point on the nasal maxillary suture is only 10 mm compared with 18 mm in Mladeč 1),
- the shallower palate (lacking a distinct angle between the roof and the premaxillary area, but possessing a distinct palatine torus confined to the mid-palatine suture), the markedly greater gnathic index,
- the much higher rounder orbits (the latter two are also distinctions from Cro-Magnon 2).

There are a number of similarities shared by the two Mladeč females that contrast with the Cro-Magnon 2 condition. The maxilla is less well preserved than that of Mladeč 1, lacking a good deal of bone along the mid-palatine suture and not extending to the base of the zygomaxillary sutures. However, comparing preserved portions, these two faces are similar in some respects. Along the lower border they lack a distinct malar notch and have an only weakly developed canine fossa. The anterior border of the base of the zygomatic process of the maxilla is over the mesial portion of the first molar. Along the orbital margin, both share a tubercle just lateral to the most medial point of the zygomaxillary suture. The tooth row is evenly curved anterior to the bicanine line, and there is a moderate amount of prognathism along the alveolar margin. The alveolar margin is curved following the inverse of the mandibular curve of Spee.

The Mladeč 2 maxilla is low and broad, for instance the orbital alveolar height to M1/M2 is less than Mladeč 1, but we believe the maxilla was broader because the most lateral of the facial breadths

Fig. 22. Mladeč 2 in facial view

preserved (bi-infraorbital foramen and biangular breadths) are greater. Moreover, the greatest distance across the preserved elements of the zygomatic portion of the maxilla (which does *not* extend laterally enough to include the *zygomaxillare* point on either side) is almost as large (95 mm) as the total midfacial breadth of Mladeč 1 (103.1 mm). The zygomatic processes swing quite laterally and a weak canine fossa extends from under the infraorbital foramen. The frontal pillars are not as puffy as in Mladeč 1, so that the sides of the nose anterior to the orbital rim are never horizontal, as they are in the other Mladeč female. The breadth of the nasal aperture is only slightly less than Mladeč 1. It is likely that the nasal index would have been greater, since the height of the Mladeč 2 face is significantly less. The nasal breadth is very small compared with the Neandertals, well below their range. However, if we assume that nasal height is proportional to upper facial height, the expected nasal height of Mladeč 2 would result in a nasal index within the Neandertal range. These data suggest that in relative terms, the Mladeč 2 nose is broad.

Lateral to the lacrimal foramen a suture line connects an accessory infraorbital foramen with the orbital margin. This small accessory infraorbital foramen is located superiorly and medial to the infraorbital foramen, 8.5 mm from it and 4.2 mm below the orbital margin. The main infraorbital foramen is 4.7 mm in breadth, preserved on the left side. This is somewhat less than the foramen breadth in Mladeč 1, and between the two Neandertal female values (3.6 mm and 4.7 mm.). As mentioned above, unlike Mladeč 1 the height of the foramen is greater than the breadth. The center of the foramen is 10.5 mm below the orbital margin, and 28.7 mm above the alveolar margin. In absolute distance this is closer to the orbit than in the Neandertal females, but the Mladeč 2 face is low and in actuality the ratio of orbital distance to distance from the alveolar margin falls within the Neandertal range. The suture line continues posteriorly into the orbit where it appears to join the maxillosphenoidal suture. The base of the zygomatic process of the maxilla is low but seems to be somewhat more angled (relative to the external palate wall) than it is in Mladeč 1. The distance from the alveolar margin to the base of the process is smaller than in any other of the females considered here. However, the height from this base to the lower border of the orbit, the pommette or medial cheek height, is larger. This in fact is just above the Neandertal minimum.

In terms of facial heights, Mladeč 2 is slightly shorter than Mladeč 1 and a good deal shorter than the Neandertal females. As mentioned above the Mladeč 2 face is very prognathic. The index of prognathism based on sagittal projections to nasion and prosthion from the auricular point is very high – virtually identical to the Neandertal maximum. Further reflecting these size relations are several measures that combine all three of these elements (facial height, breadth, and prognathism). These are the measures from prosthion to various lateral elements on the face. The combination of a short and prognathic face makes the Mladeč 2 face appear to be even lower.

From the palatal orientation, the shape of the tooth row is broadly parabolic anterior to the third molars, although lingually these are closer together than the second molars. In the anteroposterior direction the palate is short; the anterior palate length is less than that of any other female discussed (Table 14). However, like the breadths of the face, the breadths of the palate are marked, compared to the breadths of the palates in the other samples. Thus, the breadth across the incisor roots is large, at the Neandertal mean. The breadths across the more posterior teeth are not as great, below the Neandertal means. Mladeč 2 is similar to Qafzeh 5 in these breadth dimensions.

The palatal length and breadth dimensions are combined in measures taken along the tooth row. The more anterior lengths are reflective of palate breadth, and therefore are large enough to be close to or within the Neandertal range. However, because of the short anteroposterior dimension of the palate, tooth row lengths encompassing most or all of the palate, such as the distance from prosthion to the back of the M^3, are comparatively much shorter.

The most distinctive feature of the palate is the moderately developed mid-palatine torus. This structure begins as a low ridge directly behind the incisive foramen and increases in width and height posteriorly. At its widest point (approximately at the transverse palatine suture) it is 15.5 mm. The

Table 14. Palate and tooth row dimensions (mm) for females

	Mladeč females 1	Mladeč females 2	Mladeč male 8[1]	Qafzeh 5	Neandertal Mean (n)	Neandertal Range
Palate Lengths						
Alveolar length	55.2		55.5		62.5 (1)[2]	
Palate length	48.5		46.5		53.1 (1)[2]	
Anterior palate length	36.2	33.4	34.5		41.2 (2)	37.5–44.8
Tooth row lengths						
pr-postcanine	23.9	23.5	24.6	22.4	25.6 (4)	24.3–27.3
pr-post M1	46.7	39.5	46.1	41.3	44.7 (3)	39.5–41.1
pr-post M3		55.0	57.2		59.7 (3)	58.4–62.0
I1-C (roots)	22.4	21.0	23.0	21.7	22.9 (4)	20.0–25.9
C-M2 (roots)	43.6	41.0	43.9		34.0 (6)	29.8–42.0
P3-M2 (roots)	35.0	33.8	35.6		32.7 (4)	31.6–33.7
Palate wall depths						
P4/M1	14.2	9.1		12.2	13.5 (4)	8.4–23.9
M2/M3	15.3	10.7			14.8 (2)	11.1–18.5
Palate depths						
P3/P4	13.6	10.0			16.5 (2)	9.0–24.0
P4/M1	17.5	10.5	11.5		17.5 (2)	11.0–24.0
M1/M2	16.5	10.5	11.6		23.0 (1)[2]	
Palate breadths						
Incisive foramen	4.7			3.9	3.8 (2)	3.3–4.2
External I2 (roots)	28.2	30.2	31.0	29.0	30.2 (2)	29.3–31.9
External C (roots)	42.7		48.3	43.5	44.1 (2)	43.1–45.0
External P4 (roots)	54.0	53.8	61.0	54.1	59.4 (2)	57.5–61.0
External M2 (roots)	65.0	63.2			67.0 (3)	65.5–68.5
Internal P3 (roots)	30.3	29.8	37.4	32.7	33.9 (1)[3]	
Internal M2 (roots)	43.1	41.4			42.7 (1)[2]	

[1] Male palate
[2] Saccopastore 1 only
[3] Gibraltar 1 only

greatest height is about 2.5 mm from the palatal roof. The torus extends onto the palatine bones (where it is not as broad) and terminates at the level of mid-M^3. These heights show the palate to be shallow and fairly even in its depth.

Since the two halves of the palate were separated when we studied the material, an internal view was possible. From this perspective, the mid-palatine torus can also be seen. This thickening produces a maximum inferosuperior diameter of 8.5 mm for the hard palate. The shape of the floor of the hard palate is a feature distinguishing Mladeč 2 from Mladeč 1. The slope of the palate's roof only deepens slightly behind the incisive foramen. There is no true vertically oriented anterior face to the palate, rather only a shallowly sloped superior one anterior to the foramen. The palate slope is not simply a consequence of the palatine torus. Our measurements of the internal palate wall along the alveolar margin also reveal a gradually deepening palate roof, shallower at all points compared to Mladeč 1. Thus, the palate depth measurements were not small as a consequence of the torus development alone. Either measurement set shows Mladeč 2 to have one of the shallowest palates of the European females, and if the single measurement from the Levant (the palate wall height measurement of Qafzeh 5) is indicative Mladeč 2 has a very shallow palate in comparison with these females as well.

Palatine bones

As mentioned above small portions of the palatine bones remain on both halves of the maxilla. On the right side the palatine torus extends across in the mid-palatine suture on to the palatine bones. Since matrix still adheres to most of the palatine bones, it is impossible to determine more precise information concerning their morphology.

Dentition

The maxilla for this specimen is similar in preservation to Mladeč 1 in that only teeth of the posterior tooth row are preserved and that empty sockets for the other teeth are filled with matrix. Only the left M^1, M^2, and M^3 and the right M^1 are preserved. All other teeth were erupted, but lost postmortem, except for the right M^2 which appears to have been broken off during (or since) excavation. For this tooth the root is exposed in the socket, but is not covered with matrix. Besides preservation, Mladeč 1 and Mladeč 2 are also similar in that they both show minor wear on the existing teeth, although wear in Mladeč 2 slightly exceeds Mladeč 1. Consequently, we aged this specimen about 17 years at death.

Left and right M^1's show pinpoint dentin patches, with some minor asymmetry between the two teeth. The left M^1 exhibits dentin exposures of approximately equal size on each of the four cusps, while on the right the mesial exposures are larger than the distal ones. These differences are very minor, representing only idiosyncrasies of the normal attrition process. Relatively large interproximal facets occur on the mesial and distal walls, but these do not cut significantly into the surface and little reduction in mesiodistal length has occurred.

From the occlusal aspect, it is clear that the M^1's form a 4+ pattern, and the distolingual cusp is large relative to the other cusps, representing about a quarter of the total occlusal surface. Compared to Mladeč 1, the hypocone of Mladeč 2 is considerably larger and more bulbous. Like Mladeč 1, there is no surface wrinkling and radiographs show a small, normally configured pulp chamber.

The left M^2 has little wear – there is minor cusp blunting and polishing on all four cusps, but no dentin exposure. Interproximal facets are represented as etchings of the mesial face, with no cavitation of the mesial wall. The cusp pattern is of the 4-type and, compared to Mladeč 1, the hypocone is considerably more developed. Internally, the pulp chamber is small and does not extend into the roots.

The Mladeč 2 third molar has reached the occlusal plane, but based on the extremely minor surface polishing, it appears to have been only newly erupted. Its mesial face rests against the distal wall of M^2, but no interproximal facet has formed. Together, this evidence suggests that the M^3 came into functional occlusion a short time before the individual died.

Unlike the M^1 and M^2, the crown of the M^3 shows a great deal of wrinkling and formation of small cuspules within the inter-cusp surfaces. The hypocone is broken into two small cuspules, located on the distal border and there are fovea and crenulations on all the cusps of the trigone. This type of wrinkling is similar to the isolated maxillary third molar (Mladeč 10) described by Frayer and colleagues (this volume).

Tooth row lengths along the anterior teeth, and the breadth across the four incisor roots, suggest that like Mladeč 1 the missing anterior teeth were probably quite large. The three molars reduce in size from mesial to distal. The M^1 and M^2 are smaller than Mladeč 1 but larger than Neandertal and Skhul/Qafzeh female means. M^3 is reduced, below the means but still within the ranges.

Other adult female cranial remains from the Main Cave

The Mladeč 38 frontal (destroyed)

The specimen is a female frontal discovered by Fürst along with Mladeč 4 (a male) and the Mladeč 37, 44 and 45 children. It was described as an 8.5 cm by 9.5 cm fragment from the anterior portion of the bone, preserving a portion of the nasals and extending on to the frontal squama. Szombathy (1925, 73) describes the forehead profile as flatly arched, and notes the following:

> *"The superior orbital borders are rather flat across, merging centrally to form a weak glabellar prominence and delimiting a strongly expressed trigonum supraorbitale. Nasion, although covered over with matrix, does not appear to be deeply depressed. The nasals are rather narrow (minimum breadth about 9 mm), but are strongly prominent. In contrast to Mladeč 4, this specimen exhibits a voluminous frontal sinus."*

The minimum breadth of the nasal bones, in fact, is slightly larger than the two female nasals (Table 10) but much smaller than the Mladeč 6 value of 14 mm. This measurement is small, whether compared with Qafzeh 3 or the Neandertal female sample, where it is below the range.

Mladeč 41

Discovered by Knies along with Mladeč 39, 40, and 88–91, this small, poorly preserved fragment consists of a portion of unidentifiable cranial bone (this volume, chap. 8, plate XVII, c). The fragment is very roughly triangular with a 43 mm height and a 35 mm breadth. The exterior surface is broken into several pieces, which are slightly displaced from each other, and the interior surface still contains a large piece of adhering matrix. The fragment is quite thin, nowhere exceeding 5 mm in thickness.

Mladeč 42 parietal fragments (destroyed)

Five "very small fragments of adult parietal were found in locus "e" of Chamber E by members of the Litovel Museum Association, along with Mladeč specimens 43, 47, and 62.

Conclusions: Sexual dimorphism and phylogenetic issues

Almost three decades ago when two of the authors (D.W.F. and M.H.W.) first encountered the Mladeč skeletal remains, the specimens in the Naturhistorische Museum Wien were studied before the material in Brno. In many respects the Vienna material conformed to our expectations then about the variability in Upper Paleolithic skeletal remains, which for the most part (especially in the late Upper Paleolithic sample) is represented by males and females with greater size and robusticity, but essentially "modern" morphology. Since the "classic" Upper Paleolithic specimen (Cro-Magnon 1) from France was the most famous, the most accessible and the best known (it was included in most cast collections even at small colleges in the US), our expectations of Aurignacian specimens were influenced by it. Thus in many ways, Mladeč 1 was concordant with what we expected to find in the early Upper Paleolithic. Its high forehead, reduced brows, and small facial dimensions all resembled Cro-Magnon 1. Yet, it possessed a more pronounced bun and distinctive nuchal area that hinted at links to earlier European populations. In addition, the large size and robusticity of the Mladeč 8 palate and Mladeč 30 talus (both males) suggested a morphological pattern atypical of other (generally later) Upper Paleolithic specimens. However, we underestimated and did not appreciate the importance of the great differences between male and female morphology at Mladeč until we later examined Mladeč 5 and a cast of Mladeč 6 in the Moravské Muzeum, Brno. We did not clearly discriminate between what features were robust and what features were Neandertal-like, nor did we fully realize that these were not necessarily the same thing. At our first glance, however, it was apparent that Mladeč 5 was very different from what we expected to find in the Upper Paleolithic. It also was at odds with what W. W. Howells (1982) once observed about Upper Paleolithic crania – that they were instantly recognizable as modern. In general we concurred with Howells' view, but on first sight, the Mladeč material in Brno destroyed this perspective. Mladeč 5 distinctly differed from Cro-Magnon 1, Mladeč 1 and virtually all the early Upper Paleolithic skulls we had seen to that point. It possessed a Neandertal-like frontal, was a low, broad skull and had a well-developed occipital bun and robust nuchal area. These were instantly recognized by us as something different – still modern, but possessing a variety of features which greatly contrasted with the considerably more gracile Mladeč 1 and 2 in Vienna. Clearly, the separation of the Mladeč remains, with the chance allocation to Brno of the primarily the Quarry Cave material which included the two male vaults, and to Vienna primarily the female crania and juvenile from the Main Cave hindered male and female comparisons. Moreover, in those days of Soviet domination and communism in the former Czechoslovakia, it was difficult to go to Brno, so the material there was not known to most American and British paleoanthropologists. In fact, other than Szombathy's description in 1924 (which we subsequently consulted) we can find no photographs or line drawings in the literature of Mladeč 5 or 6 prior to 1978. Finally, since most of the earlier studies included only complete crania in their reviews of the Upper Paleolithic (Riquet, 1970), the Mladeč males were eliminated from consideration and "off our radar screen." Of course, one of us (J.J.) was under no such illusions since he was well-acquainted with the total sample. His publication in 1969 reviewed the Central European material and discussed the great variability at Mladeč, reviewed the distinctive sexual dimorphism at Mladeč, and even suggested evidence of a Neandertal heritage for the early Upper Paleolithic (Jelínek, 1969).

As we recognized the influence of dimorphism on our comparisons, we made special efforts to hold sex constant as we worked on the material and analyzed our results. We now can sum-

Table 15. Dimensions for female maxillary teeth. Length and breadth are in millimeters, areas in square millimeters

	Mladeč			Neandertals		Skhūl/Qafzeh	
	1	2	5				
				Mean (n)	Range	Mean (n)	Range
M^1 length	11.2	10.5	10.8	10.9 (5)	10.0–11.5	10.9 (3)	9.9–11.5
breadth	12.2	12.3	13.6	12.0 (6)	11.4–12.8	11.4 (4)	11.1–11.8
M^2 length	11.5	10.4	10.7	10.2 (5)	9.9–10.3	8.8 (1[2])	
breadth	11.9	12.3	13.7	12.3 (5)	11.4–13.4	12.2 (1[2])	
M^3 length		9.0		9.3 (3)	8.7–9.9	9.2 (3)	8.8–9.6
breadth		11.3		12.3 (3)	11.3–13.8	11.1 (3)	10.3–11.7
M^1 area	136.0	129.2	146.9	124.4 (5)	116.0–132.3	124.9 (3)	109.9–133.4
M^2 area	137.4	126.7	146.6	125.7 (5)	112.9–136.5	106.2 (1[2])	
M^3 area		101.3		114.9 (3)	97.6–130.4	101.5 (3)	93.7–112.3

[1] Male palate
[2] Skhul 7

Fig. 23. Mladeč 5 and 1, the best-preserved male and female crania from the site

Fig. 24. Comparison of the Zlatý Kůň (below, female) and Pavlov (male) vaults. This variation in Central European crania from the early Upper Paleolithic address sexual dimorphism in the Mladeč sample, as it is similar to the comparison of Mladeč 1 and 5 (Fig. 23)

marize the pattern of dimorphism through the comparison of Mladeč 5 and 1 (Fig. 23, and virtually all of the tables) and also in the corresponding comparison of the Central European male from Pavlov and the Zlatý Kůň female (Fig. 24). The distinctive morphology of the four crania portray textbook size and shape differences used to separate males and females. Male crania are long and low with massive brows and distinctive muscle markings, while females are more gracile in all features. Some of these differences are related to greater robusticity as some have argued, but on the male skulls there is a constellation of features, beyond just size and muscularity, which represent the retention of Neandertal morpology. These are consistently absent in females and along with size differentials make the male/female contrast greater than what is found in subsequent European samples. It is important to note that this is not the only example in the Central European Early Upper Paleolithic. Similar conclusions result from comparing different sex pairs of Předmostí specimens such as 4 and 5 or other males and females samples from Dolní Věstonice. But these are beyond our focus here.

These sex differences are not just size related, since males from Mladeč consistently show features that are diagnostic of European Neandertals as defined by Stringer et al. (1984) and others[6]. In the males these include (but are not limited to) overall lateral profile, an occipital bun with flattening extending onto the parietal, a elliptical suprainiac fossa (in Mladeč 6), a small mastoid process, and the broad lateral incisor and specific nasal features in the Mladeč 8 palate which Schwartz and Tattersall (1996) consider unique to Neandertals. Combined with the generally greater size and robustness in the males, these mainly male features lead to distinctive differences between the males and females from Mladeč. These distinctions are more than simple robusticity differences and, as argued elsewhere (Frayer, 1986), may signal different timings of modernization for early Upper Paleolithic males and females[7]. For example, while there are some

6 The Neandertal features are not necessarily a consequence of the robustness that is associated with being male, which is why we discuss these different components of male morphology separately.

7 Such a difference, of course, does not mean that women became modern in Europe before men did, but relates to our perception of what "modernity" means, and emphasizes that "modernity" is often uncritically used interchangeably with "gracility" (Wolpoff and Caspari, 1997).

similarities in occipital morphology and in nasal angle, it is difficult for us to point to many other morphological similarities between Neandertal and Mladeč females; indeed the women of these two samples show many, fundamental differences (see Figure 6). In contrast, numerous links occur between Neandertal and Mladeč males (Frayer, 1997; Frayer et al., this volume, Fig. 9) that go beyond mere size and we believe signal a significant phylogenetic relationship (Wolpoff et al., 2001). These traits, such as suprainiac fossa, occipital bunning, lambdoidal flattening, mastoid features, expanded lateral maxillary incisor size, and others became uncommon in Upper Paleolithic males after 18,000 years ago (Frayer, 1993). In females, the same traits drop out much earlier, at least judged from the current samples of early Upper Paleolithic females at Mladeč. Obviously, gathering larger samples are important to test these observations, but based on the patterns at Mladeč (and other central European sites not reviewed in this work) it is important to entertain the possibility that different evolutionary forces affected males and females through time.

In this regard it is regrettable that we are unable to perform a systematic ancestry analysis in females as we did in males. This is in part because of the very small sample sizes of European Neandertal females, but is primarily related to the nearly complete absence of adequately preserved Skhul/Qafzeh females. Yet, viewed from the existing samples in Europe and the degree of difference between Neandertal and Mladeč females, a question of "dual ancestry" would be much more difficult to sustain, not because one ancestral source is predominant, but because even visual inspection of the Mladeč females compared to a Neandertal female (Fig. 6), a Qafzeh female (Fig. 7), or most distantly to an African female (Fig. 12) suggests that no special link to any of them is obvious. Females and males of the early Upper Paleolithic certainly co-existed, but the types of evolutionary forces operating on females seem to be different from the males. Whether this has biological meaning or simply is the result of inadequate sampling awaits future work, but it is obvious to us that no case for a special or unique African ancestry can be established at this time. In this regard, the females provide the same information as the males.

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