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Human Remains from the Moravian Gravettian: Morphology and Taphonomy of Isolated Elements from the Dolní Věstonice II Site

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The excavation and palaeoanthropological analysis of the early Upper Palaeolithic site of Dolní Věstonice II has yielded a series of incomplete and isolated human remains, comprising cranial vaults, teeth (including a series from an infant), ribs, arm bones, hand phalanges, leg bones, tarsals, metatarsals and pedal phalanges. Morphologically and morphometrically the elements are similar to those from buried individuals at Dolní Věstonice I and II and Pavlov I, as well as to other European early Upper Palaeolithic human remains. They differ principally in the high percentage of cortical areas of the distal humerus and femur. The Dolní Věstonice 36 infant's teeth may well derive from an undisturbed burial with *in situ* bone destruction. Geological processes are unlikely to have produced the taphonomic patterns observed, and the preservation and damage patterns of the elements (other than Dolní Věstonice 36) suggest that the original bodies were processed by some combination of scavenging agents. Moreover, the original number of burials at Dolní Věstonice II may have been greater than the four currently known.

Keywords: UPPER PALAEOLITHIC, HUMAN PALAEONTOLOGY, TAPHONOMY.

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Table 1. Contexts of the isolated human remains from Dolní Věstonice II

	Anatomical unit	Site square	Archaeological context	Associated C^{14} date(s)
DV 11	Calvarium	12c	Marginal area between settlement zones 7 and 9	
DV 12	Frontal bone	-4a	Northern part of the settlement zone 7	
DV 17	Parietal fragments	20d	Western marginal area of settlement concentration 9	
DV 33	Tooth	IV/8	Inside the southern settlement unit near the central hearth	27,070 ± 170 BP (GrN 15324)
DV 34	Hand phalanx	V/-3	Inside an artefact concentration, midway between the northern and eastern settlement units of the upper western slope	
DV 36	Nine teeth	F 9	Inside settlement unit 4 near a hearth	26,970 ± 200 BP (GrN 21122)
DV 39	Navicular	F 9	Inside settlement unit 4 near a hearth	26,970 ± 200 BP (GrN 21122)
DV 40	Femur	Aa-20	Inside settlement unit 1 near the central hearth and skeleton DV 16	25,740 ± 210 BP (GrN 15277) 25,570 ± 280 BP (GrN 15276)
DV 41	Humerus	Aa-19	Boundary (densely occupied) between settlement units 1 and 2	
DV 42	Fibula	Aa-19	Boundary (densely occupied) between settlement units 1 and 2	
DV 43	Femur	Aa-20	Inside settlement unit 1 near the central hearth and skeleton DV 16	25,740 ± 210 BP (GrN 15277) 25,570 ± 280 BP (GrN 15276)
DV 44	Metatarsal	B/C-8-7	Periphery of the settled area	
DV 45	Rib	B 5	Periphery of the settled area west from settlement unit 4	
DV 46	Cuneiform	B 6	Periphery of the settled area west from settlement unit 4	
DV 47	Metatarsal	B-19	Inside settlement unit 2 near the central hearth	26,920 ± 250 BP (GrN 15279)
DV 48	Fibula	C-15	Peripheral area between settlement units 2 and 3	
DV 49	Metatarsal	D 9	Inside settlement unit 4 next to a hearth	26,970 ± 200 BP (GrN 21122)
DV 50	Radius	D-16	Peripheral area between settlement units 2 and 3	
DV 51	Rib	N-1	Inside settlement unit LP/1–4 at the central hearth	26,390 ± 190 BP (GrN 21123)
DV 52	Foot phalanx	M-2	Inside settlement unit LP/1–4 at the central hearth	26,390 ± 190 BP (GrN 21123)
DV 53	Hand phalanx	A-7-8	Section 1. Margin of the excavated area	

Introduction

The Pavlovian (or regional earlier Gravettian) archaeological sites of Dolní Věstonice I and II and Pavlov I in southern Moravia are well known for their rich faunal, artefactual, and site structural assemblages (Absolon, 1945; Klíma, 1963, 1995; Svoboda, 1991*a*, 1994; Svoboda & Škrdla, 1997), as well as for yielding a series of human burials (Jelínek, 1954; Klíma, 1987*b*; Svoboda, 1987; Vlček, 1991, 1992, 1997; Trinkaus & Jelínek, 1997). Considerable focus has been placed on the mid-1980s discoveries of two burials containing four individuals at the Dolní Věstonice II, particularly the triple burial containing individuals Dolní Věstonice (DV) 13 to 15 (Klíma, 1987*a*; Vlček, 1991).* However, the original excavation and analysis of faunal remains from Dolní Věstonice II have yielded a series of human isolated cranial, dental and post-cranial human remains (Table 1). These elements provide additional human palaeontological morphological data on these middle Upper Palaeolithic human foraging populations, data which can be used to address issues of biological affinity and functional morphology. They also raise questions about their taphonomic histories, which have implications for the depositional history of the Dolní Věstonice II site, the pattern of use by these localities by both hominids and carnivores, and the mortuary behaviour of the social groups involved.

*The different Upper Palaeolithic site localities within the jurisdictions of the villages of Dolní Věstonice and Pavlov are designated by Roman numerals, whereas the individual human fossil specimens are designated by "Arabic" numerals, following the Catalogue of Fossil Hominids (Oakley *et al.*, 1971). Note that the Dolní Věstonice human specimens derive from both the DV I and the DV II sites, and they were numbered in the order in which they were recognized in the field or the laboratory (Table 1; Vlček, 1971; Klíma, 1990). In addition, several specimens previously considered to be human are now known to be non-hominid.

The Site of Dolní Věstonice II

Dolní Věstonice II (Figure 1) occupies one of the loess elevations at an altitude of *c.* 240 m, rising above the Dyje River toward the Pavlovian Hills (altitude 550 m). The central parts of this site were excavated as a salvage project during industrial loess exploitation between 1985–1991. The excavation results are presented in two monographs (Svoboda, 1991*a*; Klíma, 1995), with separate articles treating other archaeological aspects (Klíma *et al.*, 1962; Klíma, 1987*b*; Svoboda, 1990, 1991*b*; Svoboda *et al.*, 1993) and the burials of DV 13–15 and DV 16 (Klíma, 1987*a*; Svoboda, 1987). Portions of the site remain unpublished, and some are in the course of being surveyed (site IIa).

The site is one of the largest hunter–gatherer settlements in Moravia. However, a lower density of the occupations, less stable dwelling structures, a rarity of art objects, and other characters of archaeological record suggest that Dolní Věstonice II was not settled as densely as the nearby sites of Pavlov I and Dolní Věstonice I. Dolní Věstonice II was probably occupied repeatedly, but in a more time-limited manner and with more specialized functions.

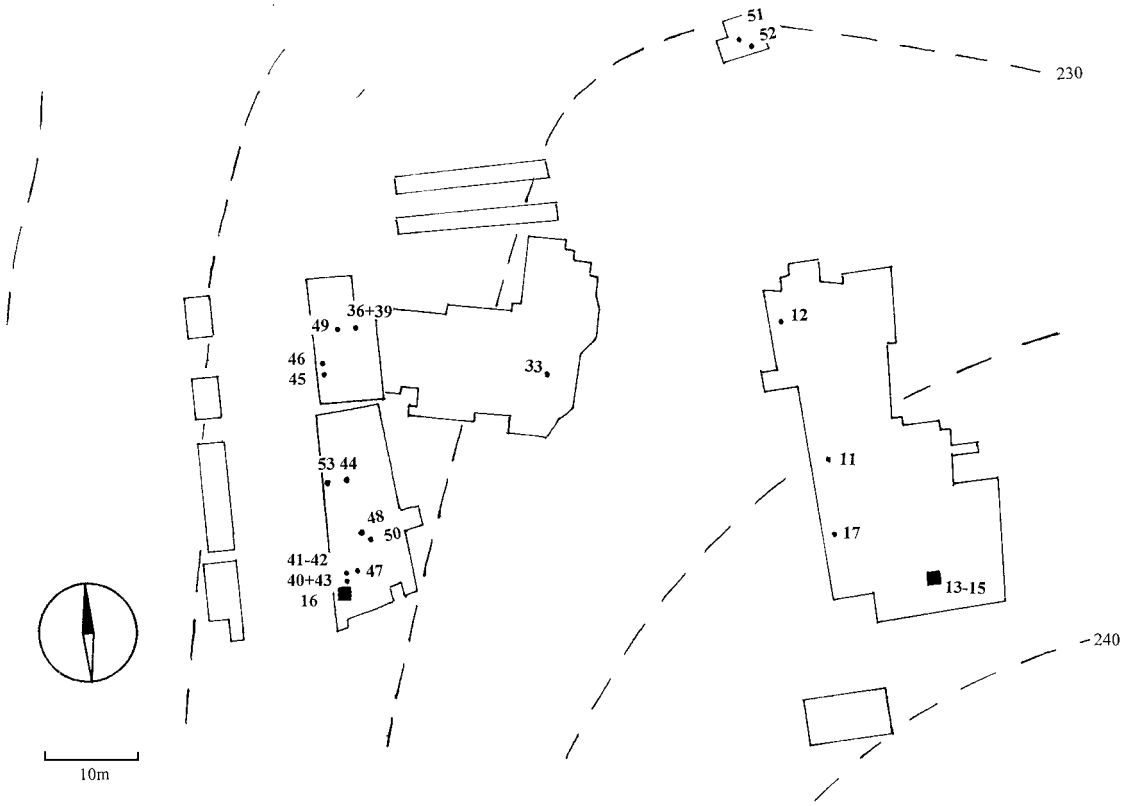

Figure 1. Plan of the Dolní Věstonice II site, with the locations of the hominid remains within the excavation areas indicated. ■, DV 13–15 and DV 16 associated skeletons; ●, the individual isolated human remains. The 230 m and 240 m above sea level contours are provided; the hillside slopes down to the north–northwest.

On June 14, 1986, excavations between settlement concentrations at the upper part of the Dolní Věstonice II site revealed the isolated calotte of an adult individual (DV 11) and 6 days later a frontal bone fragment (DV 12) in one of the settlement concentrations. On August 13, 1986, inside the same settlement concentration, the exceptionally well preserved triple burial was unearthed (DV 13 to 15), probably covered originally by burnt spruce logs and branches (Klíma, 1987*a*). On April 28, 1987, in another settlement concentration near a hearth on the western slope of this site, a male burial (DV 16) was uncovered (Svoboda, 1987). Additional smaller finds and fragments were recorded during the excavation (DV 17, 33, 34; Klíma, 1990) or during subsequent laboratory processing of the archaeozoological material (DV 36, 39–53; West, Trinkaus & Fišáková in 1997 & 1998).

During the excavation, finds were recorded according to their position within 1 m^2 grid squares. Following this system, we are able to determine the contextual associations of the new finds relative to archaeological features (skeleton, hearths, artefact accumulations) (Table 1). Two of the finds (the DV 40 and 43 femoral pieces) lay *c.* 1 m from the DV 16 skeleton. A large group of finds were located within the radius of *c.* 1 m from the central hearths of the individual settlement units (DV 33, 36, 39, 40–43, 47, 49, 51–52); these are either teeth or post-cranial remains. Finally, several post-cranial elements derive from the peripheral areas (DV 44–46, 48, 50, 53).

Currently, most of the isolated finds derive from the western slope of the site, all except DV 11, 12 and 17, which derive from the upper part, and DV 51 and 52, which originate from the northern slope (Table 2).* Chronologically, the finds from the western slope that were directly associated with the dated hearths belong to the two major occupation stages distinguished in this area. The earlier, and more extended stage (units 2–4) dates to *c.* 27,000 BP (DV 33, 36, 39, 47, 49), and the later stage is spatially limited to the area of unit 1, and dates to *c.* 25,500 BP (DV 16, 40, 43). The settlement concentration in the upper part (DV 11, 12, 17) most probably falls in the interval between (based on the dating of the nearby triple burial *c.* 26,600 BP), and so does an isolated settlement unit at the northern slope, LP/1–4 (DV 51–52, *c.* 26,400 BP).

*It is possible that further isolated human skeletal elements will be identified from the main portion of the Dolní Věstonice II site (as well as from Dolní Věstonice I and Pavlov I), pending further analysis of the fauna from those excavations.

Table 2. Regional concentrations of human remains at Dolní Věstonice II. The associated skeletons are in parentheses

Site region	Excavation	Human remains
Upper part of the site	Klíma, 1986	DV 11, 12, 17 (DV 13–15)
Western slope: upper part	Klíma, 1987	DV 33, 34
Western slope: lower part	Svoboda, 1987	DV 36, 39–50, 53 (DV 16)
Northern slope	Svoboda, 1987–1988	DV 51, 52

The Dolní Věstonice II Isolated Human Remains*

Dolní Věstonice 11

DV 11 consists of an isolated calotte (Figure 2), with squamous portions of the frontal, both parietal and occipital bones. The bone is in good condition with the endocranial surface well preserved. There is minor root etching on the endocranial surface of the squamous frontal on either side of the midline, and the superior exocranial surface between the temporal lines from the mid-frontal to posterior of lambda has been evenly and moderately root-etched.

The frontal bone consists mainly of the right squamous portion, from near the right stephanion to the supraglabellar area on the midline (68 mm from bregma). The coronal suture is present from the right stephanion to 42 mm left of bregma, sufficiently to permit the estimation of the position of the left stephanion. The right parietal is intact except for the two inferior angles, and the left one is less complete, lacking both inferior angles and the squamous sutural margin. The occipital bone preserves the occipital plane and up to 9 mm of the nuchal plane below the external occipital protuberance, primarily on the left side. The lambdoid suture is preserved for 72 mm on the right side of lambda and 70 mm on the left. There is a small exocranial depression along the broken right anterior edge of the frontal bone. The maximum preserved length of the calotte is 192 mm, and the maximum preserved breadth is 139 mm.

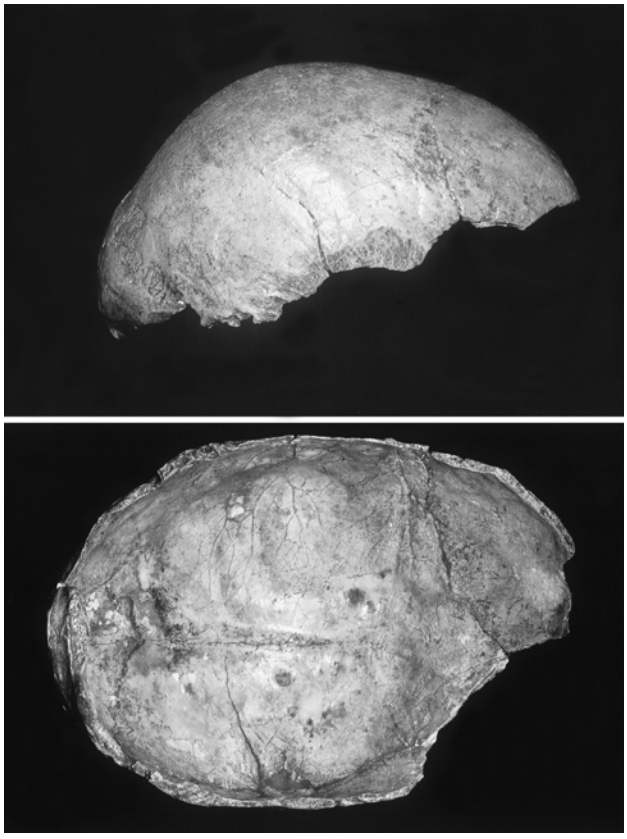

Figure 2. The Dolní Věstonice 11 calotte in *norma lateralis* right (above) and *norma basalis* (below—anterior is to the right). Note the relatively low mid-sagittal profile and hemi-bun in *norma lateralis* and the irregular breakage along the calotte's inferior margin. For scale, the preserved length of the specimen is 192 mm.

Dolní Věstonice 12

DV 12 consists of a supraorbital section of the frontal bone (Figure 3), from just to the left of the midline to the mid-lateral right superior orbital margin, extending upwards into the squamous frontal along the midline to 46 mm above glabella. The piece preserves nasion with a fragment of the right nasal bone, glabella, the right *arcus superciliaris* and its *sulcus supraorbitalis*, and the right supraorbital notch. It is notable for a healed pronounced depression centred *c.* 30 mm above

*Five isolated pieces of mammalian post-cranial bone from Dolní Věstonice II were identified as human and given hominid numbers DV 18 to 22 (Klíma, 1990; Vlček, 1991; Jelínek, 1992; Jelínek & Orvanová, 1999). These pieces are either non-human or insufficiently preserved to indicate their taxon. DV 18, identified as a "fragment of an epiphysis" (Klíma, 1990), is a fragment of a long bone articulation (maximum dimension is 26·5 mm), possibly a section of a human humeral head but too incomplete for confirmation of that identification. DV 19, identified as a "patella" (Klíma, 1990), is a fragment of an unfused articular epiphysis of a mammalian long bone, possibly of a humeral head but the curvature of the articular surface is too flat for a human humeral head (maximum dimension 30·0 mm). DV 20 and 21, both identified as femoral epiphyses (Klíma, 1990), are non-human (maximum diameters 43·2 and 40·1 mm). They are most likely humeral heads since each one lacks a *fovea capitis*, but they are largely formed yet show no signs of fusion with the greater and lesser tubercles. DV 22, identified as a human femoral diaphysis (Klíma, 1990), is a femoral shaft section of *Rangifer*. Even though these specimens are no longer included in the human sample from Dolní Věstonice II, their numbers have not been reused so as to prevent confusion with published inventories.

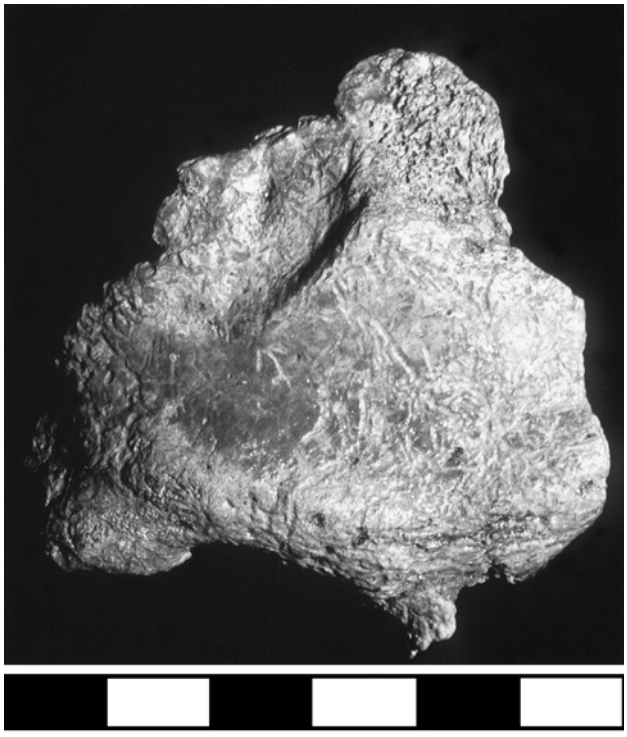

Figure 3. The DV 12 mid and right frontal piece in *norma frontalis*. The depression above the right mid-orbit is from the healed traumatic injury. The scale is in centimeters.

the supraorbital notch, primarily involving the external table and the diploë, but also producing a slight internal deviation of the endocranial surface. This is interpreted as a depressed fracture of the cranial vault, which was fully healed and remodelled leaving an irregular surface.

There is moderate to heavy root etching on all surfaces of the piece, but especially on the exocranial one. The maximum preserved height of the specimen is 64 mm, and the maximum preserved breadth is 63 mm.

Dolní Věstonice 17

DV 17 consists of two fragments of immature parietal bone, variably blackened on the surfaces. No sutures are present, but the internal surfaces preserve meningeal vessel sulci. Maximum dimensions are 33·0 mm and 23·0 mm.

Dolní Věstonice 33

DV 33 is a much reduced upper left molariform tooth. It may be a third molar or a supernumerary maxillary molar. The crown plus about half of the root are formed, and it had not reached occlusion.

Dolní Věstonice 34

DV 34 is a complete but heavily root-etched mature middle hand phalanx (Figure 4), probably from digit 2 or 3 based on its length compared to the other Pavlovian remains. Maximum length is 32·1 mm.

Figure 4. Dorsal views (from left to right) of the Dolní Věstonice 34, 44, 47, 49 and 52 hand middle phalanx, metatarsals 2, 3 and 5, and pedal proximal phalanx, respectively. Note the breakage patterns on the metatarsals (including the proximal plantar loss of the metatarsal 2) and the root etching of the phalanges. Scale in centimeters.

Dolní Věstonice 36

This consists of a series of six deciduous and three permanent teeth identified from among the faunal remains. DV 36a is a deciduous first upper right incisor (di^1). The crown surface is well preserved, despite small fissures. The occlusal surface shows slight attrition, but the root is about one-third developed with the lingual margin broken. DV 36b is a deciduous first upper left molar (dm^1). The crown is fully developed, but only a trace of the roots has formed. The crown enamel is well preserved and unworn. DV 36c is a deciduous second upper left molar (dm^2). The crown is well preserved, and there are small fringes of root (some broken) beginning to form. The occlusal surface is unworn. DV 36d forms the occlusal surface and part of the crown sides of the permanent first upper left molar (M^1). The cervix and roots are absent, and the pulp chamber is open. DV 36e is a deciduous first lower left incisor (di_1), with a fully developed and well preserved crown. The incisal edge exhibits mamelons without a trace of wear, and the tooth was therefore unerupted. The root is about one-half developed. DV 36f is a deciduous second lower left molar (dm_2) with a fully developed crown, and the roots have just started to form. It is unworn and hence unerupted. DV 36g forms the occlusal surface and part of the crown sides of a permanent first lower left molar (M_1) without the cervix or the roots. DV 36h consists of the right antimere of 36g (M_1), in the same stage of development and preservation condition. DV 36i forms the occlusal margin of the right maxillary permanent first incisor (I^1), complete as far as it was developed.

Dolní Věstonice 39

DV 39 is a right navicular bone, preserving the body with the dorsal and lateral two-thirds of the talar surface and the dorsal halves of the cuneiform facets

Figure 5. Diaphyseal sections of the Dolní Věstonice II long bones. From left to right, the DV 41 distal right humerus (anterior), DV 41 distal right humerus (posterior), DV 50 proximal left radius (anterior), DV 43 proximal right femur (posterior), and DV 40 distal right femur (posterior). Scale in centimeters.

plus the abraded dorsal surface. The maximum (mediolateral) dimension of the preserved specimen is 30·3 mm.

Dolní Věstonice 40

DV 40 is the full cross-section of a mid-distal right femoral diaphysis (Figure 5). The proximal transverse break is located at the level of the distal linea aspera, whereas the anteroproximal to posterodistal distal break is at the level at which the medial popliteal crest has faded out. The entire surface was subjected to mild root etching. The maximum length of the preserved shaft is 88·7 mm.

Dolní Věstonice 41

The distal diaphysis of a right humerus from just distal of midshaft to the olecranon fossa level is also shown in Figure 5. Proximally the medial side continues to close to midshaft, but the lateral side was split off obliquely 40 mm distal of the most proximal preserved point. There is no evidence of the deltoid tuberosity. Distally, the bone continues anteriorly to the beginning of the capsular rugosity on the lateral side, but it was sheared off through the olecranon fossa and medial pillar. The distal lateral portion was also broken off obliquely. The surface is covered with root etching. The maximum length of the preserved shaft is 118·7 mm.

Dolní Věstonice 42

DV 42 is the midshaft of a right fibula (Figure 6). The posterior surface is complete for the preserved length, but the proximal end is broken obliquely posteroproximal to anterodistal and the distal end is broken obliquely anteroproximal to posterodistal with rounding of the medial and lateral corners. The maximum length of the preserved shaft is 85·1 mm.

Dolní Věstonice 43

DV 43 is the proximal diaphyseal section of a right femur (Figure 5), which may derive from the same bone as DV 40 (see below). The bone is preserved from the middle of the gluteal tuberosity to the proximal end of the linea aspera. The distal break is transverse, but a chip of bone was removed for 19 mm proximal of the distal break along the linea aspera. Proximally, the bone is broken irregularly obliquely from lateroproximal to mediodistal. The surface is gently root etched. The maximum length of the preserved shaft is 71·3 mm.

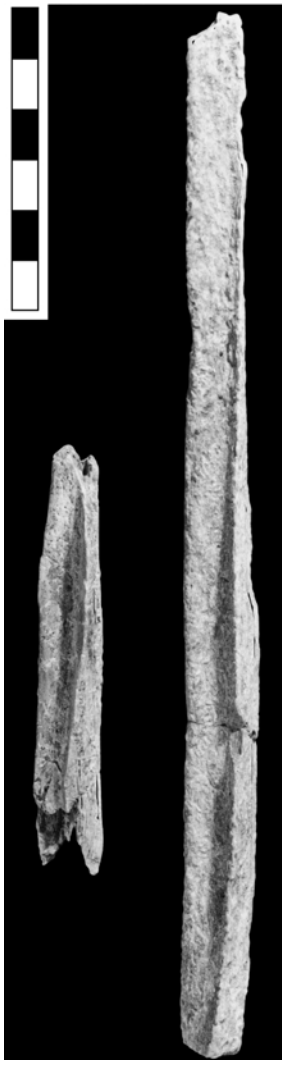

Figure 6. Anterior view of the Dolní Věstonice 42 (left) and 48 (right) right fibulae. Scale in centimeters.

Dolní Věstonice 44

DV 44 is a left second metatarsal with the dorsal half of the proximal half plus all of the distal half of the shaft (Figure 4). The distal end preserves only the flare for the dorsomedial tubercle. The medial and lateral intermetatarsal facets are absent. All epiphyses are fused,

and the specimen is therefore from a mature individual. It has moderate root etching. The maximum preserved length is 71·7 mm.

Dolní Věstonice 45

DV 45 is an upper left rib section, probably from rib number 4, with the portion around the angle. It has caudal margin erosion on the distal half of the piece and moderate root etching. The maximum preserved length along the body is 68·5 mm.

Dolní Věstonice 46

DV 46 is a left medial cuneiform with erosion of the bone surface and loss of the plantar margin, especially medially. There is moderate root etching. The maximum dimension (dorsoplantar) is 30·7 mm.

Dolní Věstonice 47

DV 47 is a right adult third metatarsal base with lateral damage plus the plantar portion of the proximal shaft (Figure 4). The maximum length along the preserved bone is 41·0 mm.

Dolní Věstonice 48

DV 48 is an eroded and root-etched right fibular shaft from the proximal beginning of the anterior crest to the distal end of the anterolateral sulcus (Figure 6). It consists of two pieces *in situ* which rejoined cleanly despite minor bone loss at the break on the anterior crest and anteromedially. The maximum length of the preserved shaft is 209·0 mm.

Dolní Věstonice 49

DV 49 is the base and shaft of a right fifth metatarsal (Figure 4). There is surface erosion to the base, especially on the articular facets and the proximal tuberosity. The lateral shaft is complete to the flare for the head, but the distal third of the medial shaft was split away. There is moderate root etching. The maximum preserved length of the bone is 57·9 mm.

Dolní Věstonice 50

DV 50 is a proximal section of a left radius with all of the neck (Figure 5), the tuberosity with its dorsal, ventral and proximal margins, and the lateral and especially dorsal proximal shaft with the beginning of the interosseous crest. The maximum preserved length of the specimen is 62·0 mm.

Dolní Věstonice 51

DV 51 is a proximal section of a right third rib with the curve of the angle and the scalene rugosity on the cranial surface. The maximum preserved length along the body is 64·0 mm.

Dolní Věstonice 52

A largely complete but heavily root etched left hallucal proximal phalanx (Figure 4), with erosion to the dorsomedial base and the dorsal middle of the head, is DV 52. The maximum length is 34·5 mm.

Dolní Věstonice 53

DV 53 is a largely complete middle hand phalanx with damage to the left and dorsal base, probably from digit 4 based on the symmetry of the head and its modest length. The maximum length is 25·9 mm.

Materials and Methods

Comparative samples

These isolated remains from DV II are compared primarily to the Pavlovian remains from Brno (Brno 2), Dolní Věstonice [DV 3, 13, 14, 15 and 16 associated partial skeletons (bearing in mind the pathological nature of some aspects of DV 15)], Pavlov I (Pavlov 1 to 3, 6 to 12, 19 and 20), and Předmostí (Matiegka, 1934, 1938). They are also compared to these remains pooled together with other European earlier Upper Palaeolithic (EUP) human remains, and including specimens from Arene Candide, Barma Grande, Caldeirão, Cisterna, Cro-Magnon, Fond-de-Gaume, Fontéchevade, Grotte-des-Enfants, Isturitz, Kent's Cavern, Koněprusy (Zlatý kůň), Lagar Velho, Miesslingtal, Mladeč, Paglicci, Abri Pataud, Paviland, Le Placard, La Quina, Les Roches, La Rochette, Les Rois, Vachons, Vogelherd, and Willendorf.

Methods

The majority of the morphological comparisons involve standard osteometric linear and angular measurements (Trinkaus, 1983; Bräuer, 1988). In addition, the DV 40, 41 and 43 diaphyseal sections had their diaphyseal cross-sections at 35%, 35% and 65%, respectively, of bone length (with 0% at the distal end) reconstructed. Given the incomplete natures of these elements, the proximodistal locations of the sections are based on morphological features of the diaphyses and comparisons with the locations of the sections on the complete humeral and femoral diaphyses of DV 13, 14 and 16 and of Pavlov 1. The external subperiosteal contours were transcribed using polysiloxane molding putty (Cuttersil Putty Plus, Heraeus Kulzer). The endosteal contours were interpolated using cortical thicknesses to provide a reference. The DV 43 cortical thicknesses were measured directly at its distal break; those of DV 40 and 41 were measured from biplanar radiographs and corrected for parallax. The resultant cross-sections were digitized and cross-sectional parameters were computed using SLICE (Nagurka & Hayes, 1980; Eschman, 1992). Given the loss of a chip of bone on the dorsodistal DV 43 shaft piece, the dorsal external contour was reconstructed in plasticene following the contours of the adjacent shaft; if

Table 3. Dolní Věstonice 11/12 cranial metrics and comparative earlier Upper Palaeolithic and recent European [Hungarian, N=54 males and 45 females (Howells, 1973)] data. Summary statistics include mean ± S.D. (N)

	Bistephanic breadth (mm)	Bregma-lambda arc (mm)	Bregma-lambda chord (mm)	Parietal angle (°)
DV 11/12	(120·0)	133·0	121·0	135°
Pavlovian	117·7 ± 3·9 (6)	132·9 ± 8·2 (14)	120·8 ± 6·5 (14)	136·4° ± 6·1° (6)
Early Upper Palaeolithic	116·2 ± 5·2 (14)	129·9 ± 8·3 (27)	117·8 ± 7·4 (27)	136·3° ± 4·8° (17)
Recent human males	117·0 ± 5·1	—	115·5 ± 5·0	132·7° ± 3·3°
Recent human females	113·6 ± 5·5	—	110·6 ± 5·6	133·6° ± 3·3°

anything it is likely to have underestimated the development of the pilaster at that level.

Comparative Morphology

Cranial remains

The DV 11 and DV 12 remains were discovered about 15·5 m apart in June 1986 during the initial salvage excavations of Dolní Věstonice II. They were initially considered to be separate individuals. However, the two specimens represent portions of an adult neurocranium that do not overlap anatomically and are similar in size and morphology. The possibility that they derive from the same cranium was confirmed by the presence of the superior margin of an exocranial depression along the broken anterior edge of the DV 11 frontal squamous that makes a logical continuation of the lesion on the DV 12 frontal squamous. It is therefore probable that the two pieces derive from the same individual.

The age-at-death is that of an older adult, since the coronal and sagittal sutures are closed endocranially and are partially obliterated exocranially. The lambdoid suture is damaged but partially fused internally. There are pronounced Pacchionian depressions on either side of the sagittal suture.

The DV 11/12 calotte presents prominent development of the cranial superstructures (Figures 2 & 3). Supraorbitally, there is a prominent glabellar region with a distinct supraglabellar depression, the superciliary arch is strongly projecting and bordered by a clear supratoral sulcus, and the lateral orbital margin is prominent and only slightly flattened. Although not strictly forming a supraorbital torus (*sensu* Cunningham, 1908), the development of these features is among the more pronounced for early Upper Palaeolithic humans, similar to those of Mladeč 5 and Pavlov 1. Similarly, the external occipital protuberance presents a wide (18 mm) lip of bone which extends 7 mm downward. Lateral of it are well defined superior nuchal lines. In these features, it is closest to the male Brno 2, DV 16, Pavlov 1 and Předmostí 3 crania, and more robust than those of the DV 13 and 14 males and especially the DV 3 female. They suggest that DV 11/12 is male.

The median sagittal contour is similar to those of other early Upper Palaeolithic humans. The parietal angle [PAA of Howells (1973)] of 135° is in the middle of the Pavlovian range of variation, between the more rounded parietals of DV 13 and 15 and the flatter ones of Pavlov 1 and DV 14 and 16 (Table 3); this is echoed in the central positions of both the bregma-lambda arc and chord relative to other EUP crania. There is an even curve through the frontal and parietal bones with a slight flattening around bregma. This is accompanied by a gradual supralambdoid flattening leading onto a distinct notch at the lambdoid suture and an occipital hemi-bun. The position of DV 11/12 in relative neurocranial breadth, measured as bi-stephanic breadth versus bregma-lambda length [the only available standard length versus breadth measurements (Figure 7)], is in the middle of the Pavlovian and earlier Upper Palaeolithic distributions.

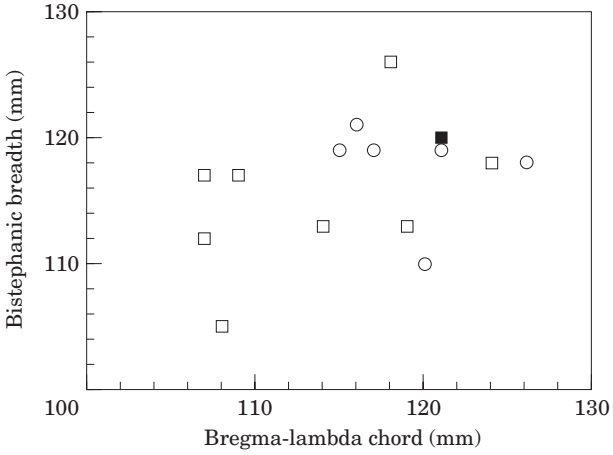

Figure 7. Bistephanic breadth (as an indicator of neurocranial breadth) versus parietal (bregma-lambda) chord (as an indicator or neurocranial length), for DV 11 (■), Pavlovian remains (○) and other earlier Upper Palaeolithic crania (□).

Table 4. Dolní Věstonice 33 and 36 dental inventory and dimensions

Specimen	Tooth	Side	Mesio-distal diameter (mm)	Bucco-lingual diameter (mm)	Labial crown height (mm)	Lingual crown height (mm)
DV 33	$M^{3/4}$	Right	8·1	7·6	5·4	5·3
DV 36a	di^1	Right	7·0	5·3	7·5	7·4
DV 36b	dm^1	Left	7·4	9·7	6·7	6·3
DV 36c	dm^2	Left	10·2	10·9	—	—
DV 36d	M^1	Left	10·5	10·3	—	—
DV 36e	di_1	Left	4·2	3·9	5·8	6·5
DV 36f	dm_2	Left	10·9	8·6	—	—
DV 36g	M_1	Left	11·2	9·4	—	—
DV 36h	M_1	Right	11·1	9·2	—	—
DV 36i	I^1	Right	8·3	—	—	—

Table 5. Comparative permanent molar dimensions for Dolní Věstonice 33 and 36. The earlier Upper Palaeolithic sample includes the Pavlovian specimens; data from Mallegni & Parenti (1973), Sergi et al. *(1974), Legoux (1975), Frayer (1978), Borgognini Tarli* et al. *(1980), Formicola & Repetto (1989), and Trinkaus (pers. meas.). Recent human data for Europeans from Twiesselmann & Brabant (1967);* N=*89–106. Summary statistics include mean* ± S.D. *(*N*)*

	M^1 MD (mm)	M^1 BL (mm)	M_1 MD (mm)	M_1 BL (mm)	M^3 MD (mm)	M^3 BL (mm)
DV 33					8·1	7·6
DV 36	10·5	10·3	11·1, 11·2	9·2, 9·4		
Pavlovian	11·1 ± 0·8 (15)	12·1 ± 0·6 (15)	11·8 ± 0·8 (17)	10·9 ± 0·5 (19)	9·7 ± 1·3 (11)	11·7 ± 1·9 (11)
Earlier Upper Palaeolithic	10·9 ± 0·8 (33)	12·2 ± 0·7 (33)	11·6 ± 0·8 (40)	11·0 ± 0·8 (43)	9·6 ± 0·9 (19)	11·9 ± 0·9 (19)
Recent humans	10·0 ± 0·6	11·2 ± 0·5	10·0 ± 0·9	9·5 ± 0·7	8·3 ± 0·9	10·1 ± 0·9

Dental remains

Dolní Věstonice 33. This isolated specimen is an upper left molariform tooth which can be considered as either a reduced (peg) maxillary third molar (M^3), or given the reduction of the crown in size and complexity, it could be a supernumerary (or fourth) maxillary molar (M^4). The state of its root, about one-half formed, indicates a mid-adolescent age for the individual if it is an M^3; it could represent a mature individual if it is supernumerary. The gently rounded crown presents three cusps, a reduced protocone, a relatively large paracone, and a groove down the buccal face of the crown.

Its diminutive size is reflected in its crown diameters (Tables 4 & 5) well below those of definite EUP M^3s and below those of most recent European M^3s. However, an isolated tooth from Pavlov, Pavlov 21, which is also a peg M^3 or a supernumerary molar, has even smaller dimensions (MD: 6·5 mm, BL: 6·8 mm).

Dolní Věstonice 36. The series of teeth attributed to DV 36 (Table 4) appear to derive from a single set of maxillary and mandibular teeth and represent an infant. This is supported by their similar developmental ages (given normal variation in relative calcification), their spatial association, and the preservation of the right and left M_1 germs (DV 36g and 36h, which are mirror images of each other). Given the presence of antimeres as well as associated maxillary and mandibular teeth, it is likely that at least the maxillae and the mandible were originally intact within the area represented by the F9 excavation square, but that all of the child's bone was destroyed and only the harder dental tissue remains. This would not be surprising, since much of the trabecular bone of the adjacent DV 16 adult burial was damaged or absent and all of the bone was fragile at the time of excavation.

The age-at-death of DV 36 is indicated by the stages of calcification of its deciduous and permanent teeth. The completion of the crowns of the di^1, dm^1, di_1, dm^2 and dm_2 indicates a modal age between 10 and 11 months (Lunt & Law, 1974). In addition, the two M_1s have crown development between C_{oc} and $C_{1/2}$ of Moorrees *et al.* (1963), which provides modal ages between *c.* 10 and 15 months (Smith, 1991). Taken in combination, these suggest a modal age of between 10 and 12 months.

The DV 36a di^1 presents a markedly asymmetrical crown with a mesially bulbous labial surface and a pronounced distal convexity to the crown. There is a clear marginal ridge along the vertical, almost straight mesial margin, leading onto a raised lingual cervical margin with a distinct lingual tubercle. Metrically, its labiolingual diameter is matched by two of the smaller EUP di^1s and falls slightly above a recent Euro-american mean (Table 6). The DV 36e di_1 is notable

Table 6. Comparative deciduous dental bucco(labio)-lingual diameters for the Dolní Věstonice 36 remains. Summary statistics include mean ± S.D. (N). The Early Upper Palaeolithic sample includes the Pavlovian remains; data from Legoux (1975), Frayer (1978) and Trinkaus (pers. meas.). The recent human data are for Euroamerican males (N=69) and females (N=64) from Black (1978)

	di^1 (mm)	di_1 (mm)	dm^1 (mm)	dm^2 (mm)	dm_2 (mm)
DV 36	5·3	4·1	9·9	10·1	8·6
Pavlovian	5·3	—	8·8, 10·0	9·6, 10·2	9·1 ± 0·3 (4)
Earlier Upper Palaeolithic	5·3, 5·7, 5·7	4·4	9·2 ± 1·0 (4)	10·4 ± 0·8 (9)	9·2 ± 0·6 (17)
Recent human males	5·1 ± 0·5	3·9 ± 0·4	8·8 ± 0·5	9·5 ± 0·5	8·9 ± 0·4
Recent human females	5·2 ± 0·5	3·8 ± 0·3	8·6 ± 0·6	9·4 ± 0·5	8·7 ± 0·4

Table 7. Morphometrics of the DV 41 distal humeral and the DV 40 and 43 femoral diaphyseal sections. Circumference and diameter in mm, cross-sectional areas in mm^2, and second moments of area in mm^4. Anatomically oriented second moments of area are not provided for the DV 41 distal humerus given difficulties in orienting it precisely relative to its original anteroposterior plane

	DV 41 35%	DV 40 35%	DV 43 65%
Distal minimum circumference	56·5		
Supraolecranon AP diameter	17·7		
Total area	249·4	495·2	516·6
Cortical area	220·4	402·9	439·4
Medullary area	29·0	92·3	77·2
AP second moment of area		20,801	17,712
ML second moment of area		17,981	24,431
Maximum second moment of area	5634	22,440	24,483
Minimum second moment of area	4279	16,342	17,660
Polar moment of area	9913	38,782	42,143

only for its development of a modest lingual tubercle. Its labiolingual diameter is between recent Euroamerican means and the diameter of the other EUP di_1s.

The three deciduous molars are similar in size to those of EUP humans and slightly larger than those of recent Euroamericans (Table 6). The dm_2 is relatively narrow, but its mesiodistal diameter of 10·9 mm is well above the recent Euroamerican male (9·9 ± 0·5 mm) and female (9·7 ± 0·5 mm) means, indicating a rather long and narrow dm_2 for DV 36. Occlusally, the dm^1 presents a two-cusp morphology with a distinct mesial marginal ridge and a prominent tubercle of Zuckerkandl on the buccal crown side. The dm^2 has a well developed protocone and hypocone, but a modest paracone and a diminutive metacone. It also has a pit form of the Carabelli crown variant and a supernumerary cusplet on the lingual side of the mesiobuccal cusp. This is combined with well-developed mesial and distal marginal ridges. The dm_2 has five distinct cusps, with modest crenulations between the cusps and a small anterior fovea.

The permanent first molar germs are notable primarily for their modest buccolingual diameters, since all of them fall well below the means of the EUP samples and even below those of the recent human comparative sample (Table 5). These dimensions, as well as their modest mesiodistal diameters, may be the result in part of their incompletely calcified crowns. The maximum buccolingual diameter in molars occurs only a little above the cervical margin of the crown and so would be much more affected by the lack of complete crown development than the mesiodistal diameter, which is positioned further to occlusal. The mesiodistal dimensions are small but reasonable for EUP Europeans, whereas the buccolingual ones are at least two standard deviations below the EUP means. Morphologically, the M^1 presents four full cusps plus a distinct Carabelli's cusp and a supernumerary cusplet on the mesiobuccal cusp, whereas both M_1s present five full cusps and a large sixth cusp.

Axial remains

The two pieces of human rib, DV 45 and 51, are too small to provide morphological detail.

Upper limb remains

The DV 41 humeral diaphysis preserves little surface detail (Figure 5; Table 7). At the mid-distal (*c.* 35% of length) level, the diaphysis is rounded anteriorly and posteriorly, with just a slight change in the convex profile posteromedial and posterolateral for the supracondylar crests. The distal minimum circumference of 56·5 mm is within the Pavlovian female right humeral range (52·0, 58·0, 58·0, 63·0 mm) and below the male one (62·0, 65·0, 66·0, 67·5, 68·0, 68·5 mm). The shaft is

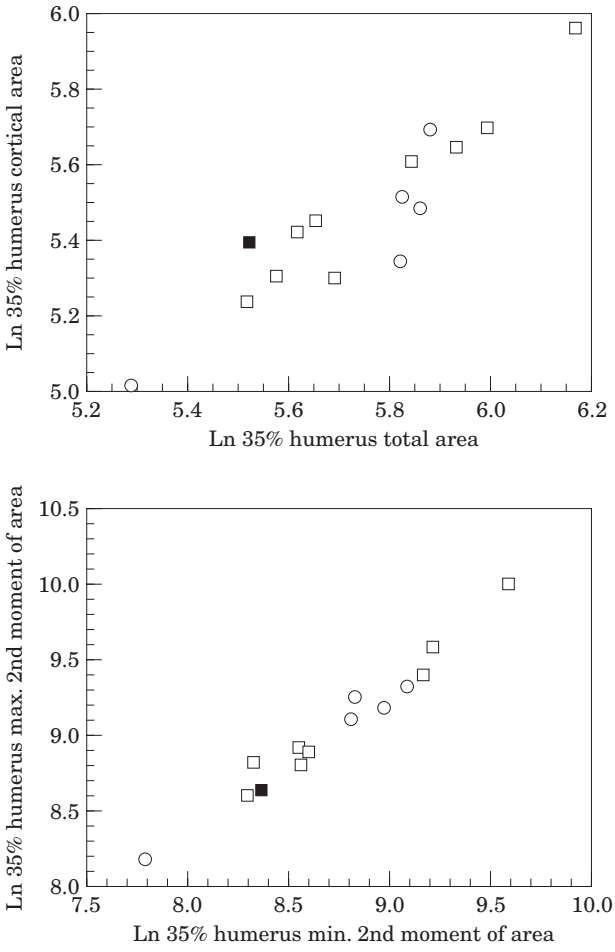

Figure 8. Diaphyseal cross-sectional comparisons of the DV 41 mid-distal humerus. Cortical area versus total subperiosteal area (above) and maximum second moment of area versus its perpendicular (minimum) second moment of area (below). ■, DV 41; ○, Pavlovian humeri; □, other earlier Upper Palaeolithic humeri.

notable for its high cortical area versus total subperiosteal area. In a plot of cortical versus total area (Figure 8), it falls slightly above the distribution of other EUP humeri. At the same time, a plot of maximum versus minimum second moments of area places it along the less circular margin of the earlier Upper Palaeolithic distribution (Figure 8).

The size of the DV 50 proximal radial piece (Figure 5; Table 8) is indicated by its estimated total cross-sectional area of the neck (using an ellipse formula) of 106·5 mm^2; this value is small for an earlier Upper Palaeolithic human, being below the known ranges of Pavlovian (144·2 ± 21·4 mm^2, N=5) and EUP (150·2 ± 22·0 mm^2, N=11) samples. At the same time, its radial tuberosity breadth of 14·0 mm is average for these samples (14·2 ± 2·6 mm, N=10 and 14·2 ± 2·7 mm, N=16, respectively), making its neck rather narrow or its tuberosity breadth large.

At the same time, DV 50 exhibits a volar positioning of the radial tuberosity, such that the interosseus crest

Table 8. Morphometrics of the DV 50 proximal radius (in mm). Tuberosity position following Trinkaus & Churchill (1988)

Neck antero-posterior diameter	12·0
Neck medio-lateral diameter	11·3
Neck maximum diameter	12·5
Neck minimum diameter	11·2
Neck circumference	39·0
Tuberosity breadth	14·0
Tuberosity position	2
Neck-shaft angle	(12°)

is in line with the dorsal third of the tuberosity. This arrangement is found in 72·7% (N=11) of Pavlovian radii and 80·0% (N=25) of EUP radii (the remainder exhibit a more volar positioning of the tuberosity). Its estimated neck-shaft angle (*c.* 12°) falls on the averages for these two samples (11·6° ± 2·5°, N=10, and 12·1° ± 2·6°, N=15, respectively).

The two middle hand phalanges, DV 34 and 53 (Figure 4, Table 9), are unremarkable in their proportions. DV 34 has been heavily root etched, making its surface morphology obscure. DV 53 is notable for the strong markings of the *M. flexor digitorum superficialis* tendons on its palmar surface.

Lower limb remains

The two pieces of right femoral diaphysis, DV 40 and 43 (Figure 5, Table 7), derive from the same square of the site grid and are similar in colour and preservation. To test whether they might be portions of the same bone, the DV 43 65% cortical area and polar moment of area were compared to the same measures for the DV 40 35% section. The cortical area comparison places the combined data point at the lower margin of the pooled EUP sample, with a z-score (based on raw residuals from the reduced major axis line of the EUP sample) of − 2·34, whereas the polar moment of area distribution places the specimen at the upper limits of the EUP distribution with a z-score of 2·31. These values imply that these bones are best considered as deriving from separate individuals. The DV 40 femur has a relatively high cortical area, but both of these femora have modest polar moments of area, between the male and one female Pavlovian specimens.

The DV 40 mid-distal femoral shaft presents only a few features of note. The linea aspera is smooth but broad (8·3 mm at the proximal break), and it is bordered by a distinct dorsolateral concavity but only a hint of a concavity dorsomedially. This suggests a modest pilaster, similar to the DV 3 and 13 and Pavlov 1 femora. A plot of anteroposterior versus mediolateral second moments of area (Figure 9), however, places it in the middle of the Pavlovian and broader EUP samples. Its relative cortical thickness (Figure 9) is higher than those of any of the other known EUP femora for whom data are available.

Table 9. Morphometrics of the Dolní Věstonice manual phalanges, metatarsals and hallucal phalanx in mm and degrees.

	DV 34 manual middle phalanx	DV 53 manual middle phalanx	DV 44 metatarsal 2 left	DV 47 metatarsal 3 right	DV 49 metatarsal 5 right	DV 52 hallucal proximal phalanx left
Maximum length	32·1	25·9	—	—	—	34·5
Articular length	30·6	25·2		—	—	29·5
Midshaft height	5·1	5·5	8·5	—	7·9	10·8
Midshaft breadth	8·5	8·1	8·6	—	10·9	14·0
Proximal maximum height	9·5	—	—	20·6	14·9	16·2
Proximal maximum breadth	13·0	—	—	13·6	21·5	20·7
Proximal articular height	6·5	—	—	(17·5)	12·8	13·6
Proximal articular breadth	11·6	—	(11·5)	(13·0)	12·2	(19·0)
Metatarsal 4 length					7·7	
Tuberosity length				17·7		
Distal height	5·7	6·0	—	—	—	9·3
Distal maximum breadth	9·8	9·8	—	—	—	16·1
Distal articular breadth	8·8	8·1	—	—	—	(15·0)
Head horizontal angle	1° left	3° right				3° left
Base horizontal angle			12°	24°	30°	
Torsion angle	—	—	—	—	—	(0°)

The DV 43 mid-proximal femoral piece presents the distal end of a gluteal buttress and associated gluteal tuberosity. The former is rounded and exhibits an anterior flattening with no evidence of a sulcus between it and the anterior diaphyseal contour. The tuberosity reaches a breadth of 7·5 mm at the proximal break, but its original maximum breadth was probably slightly greater. The distal cross-section (with mid-dorsal restoration) provides a relative cortical area which is similar to, if moderately higher than, those of other EUP femora (Figure 10), but anteroposterior to mediolateral second moments of area proportions that place it at the more platymeric edge of the EUP distribution. It is possible that the reconstructed portion should include the proximal end of a pilaster, in which case the anteroposterior to mediolateral proportions would be more similar to those of other EUP femora but the cortical area would end up being relatively large.

The two human fibular diaphyses (DV 42 and 48) (Figure 6, Table 10) have midshaft "areas" (maximum multiplied by minimum diameters) of 201·7 and 217·1 mm^2. These values are close to the means of Pavlovian ($202·8 \pm 48·2$ mm^2, $N=9$) and EUP ($228·2 \pm 68·2$ mm^2, $N=14$) samples, close to the values for the Pavlovian males (164·0–249·3 mm^2) and above those of Pavlovian females (133·9–189·3 mm^2). Otherwise, both fibulae are notable for the marked depths of the ventral sulci and the presence of clear if shallow dorsal sulci (Table 10). In this last feature, they resemble the male fibulae from Dolní Věstonice II.

The DV 39 navicular bone and the DV 46 medial cuneiform bone are unremarkable as human tarsals. DV 39 provides only the non-standard measurements of proximodistal thickness between the dorsal talar facet and the medial (17·5 mm) and lateral (9·9 mm) cuneiform facets. The DV 46 cuneiform bone has superior and middle lengths of 23·5 and 21·3 mm, and navicular and metatarsal 1 articular breadths of *c.* 14·0 and *c.* 14·5 mm. The navicular facet is strongly concave and twisted, and the metatarsal 1 facet is largely flat with rounded dorsomedial and plantolateral margins and a marked dorsoplantar torsion of the facet surface.

The three metatarsal bones, DV 44, 47 and 49, present few features of note (Figure 4, Table 9). The DV 44 metatarsal 2 has a mediolaterally concave tarsal facet and a flat dorsal diaphyseal surface with a higher dorsolateral margin, indicating normal metatarsal torsion. The DV 47 metatarsal 3 exhibits a large and prominent plantar tubercle for the short plantar ligament. The DV 49 metatarsal 5 exhibits a modest proximal tuberosity.

The DV 52 proximal hallucal phalanx is a relatively large bone (Figure 4, Table 9), with its maximum length (34·5 mm) falling within the range of Pavlovian male bones (31·0, 33·7, 34·5, 35·5 mm) and above the one female specimen (21·0 mm). The bone is relatively stout, has a distinct pit 5·5 by 6·7 mm just proximal of the plantar head, and a hypertrophied attachment around the base for the articular capsule and associated tendons.

Summary

These isolated human remains from DV II are therefore similar to those of other Pavlovian and European earlier Upper Palaeolithic humans. Among their morphologically diagnostic features, the only ones of note are the high percentage cortical area of the DV 40 and

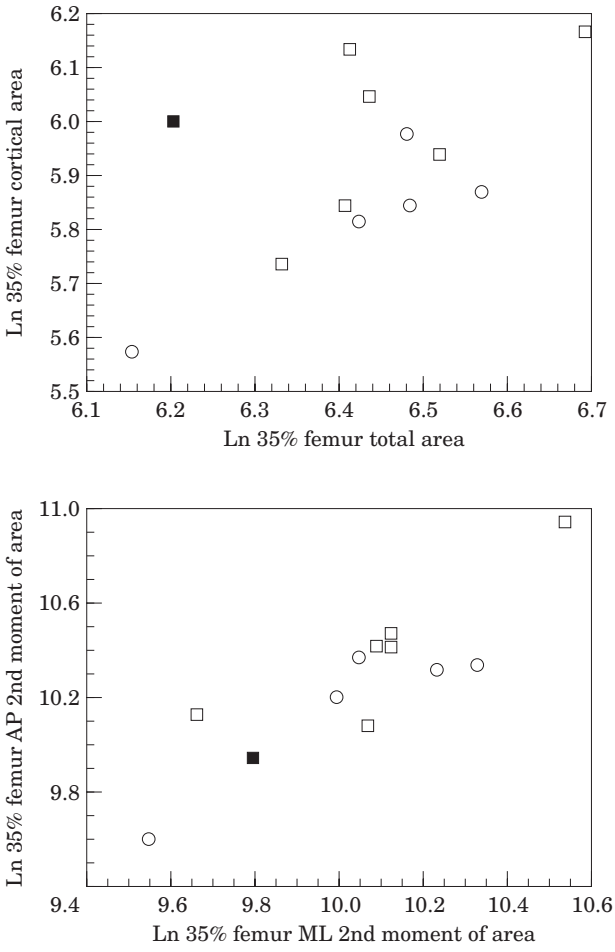

Figure 9. Diaphyseal cross-sectional comparisons of the DV 40 mid-distal femur. Cortical area versus total subperiosteal area (above) and antero-posterior versus medio-lateral second moment of area (below). ■, DV 40; ○, DV and Pavlov; □, other earlier Upper Palaeolithic femora.

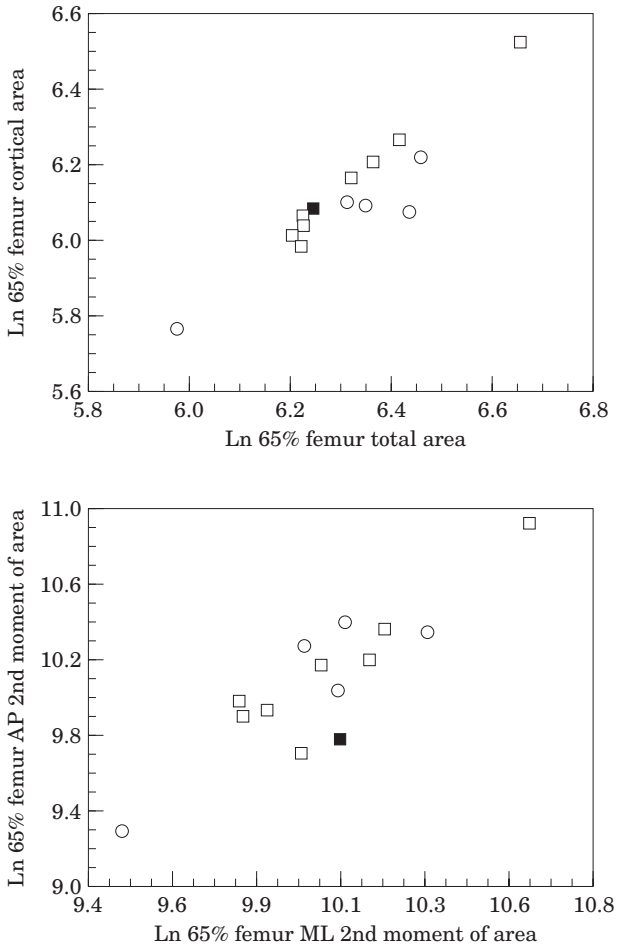

Figure 10. Diaphyseal cross-sectional comparisons of the DV 43 mid-proximal femur. Cortical area versus total subperiosteal area (above) and antero-posterior versus medio-lateral second moment of area (below). ■, DV 43; ○, DV and Pavlov; □, other earlier Upper Palaeolithic femora.

41 mid-distal femur and humerus. Other features, such as the supraorbital and iniac rugosity of DV 11/12, the proportions of the DV 11 calotte, the general morphology and size of the DV 36 teeth, the position of the DV 50 radial tuberosity and its estimated neck-shaft angle, the cross-section morphology of the DV 40 and 43 femoral diaphyses, the mid-shaft cross-sectional morphologies of the DV 42 and 48 fibulae, and the general size and robusticity of the DV 34, 52 and 53 phalanges, are well within the ranges of variation of generally contemporaneous European human remains and some, such as the fibular cross-sectional shapes, are particularly close to those of the associated skeletons from Dolní Věstonice.

Taphonomic Considerations

At the same time, these human remains raise a series of taphonomic questions. At Dolní Věstonice II, as well as at Dolní Věstonice I, Pavlov I and Předmostí, there were associated skeletons which represent intentional burials plus incomplete and scattered human remains. What depositional or post-depositional processes could have resulted in this contrast?

Table 10. Morphometrics of the DV 42 and 48 fibular diaphyses

	DV 42 (mm)	DV 48 (mm)
Midshaft maximum diameter	18·5	15·4
Midshaft minimum diameter	10·9	14·1
Midshaft circumference	47·0	48·0
Dorsal sulcus depth	0·9	0·5
Ventral sulcus depth	3·8	2·9

Age-at-death and minimum number of individuals (MNI)

The age-at-death distribution of the isolated remains consists of one infant (DV 36), one child (DV 17), one

Table 11. Post-mortem damage patterns on the isolated human remains from Dolní Věstonice II. + indicates present and moderate; ++ indicates pronounced or dominating the damage pattern; − indicates absence or trivial presence of the damage pattern (breaks are not present on the tarsals, hence the absence of indications for them)

	Skeletal element	General erosion	Transverse breaks	Oblique breaks	Root etching
Cranial					
DV 11	Calotte	−	+	−	+
DV 12	Frontal	−	+	−	++
DV 17	Parietals	−	+	−	−
Dental					
DV 33	Tooth	−	−	−	−
DV 36	Teeth	+	+	−	−
Axial					
DV 45	Rib	+	+	−	+
DV 51	Rib	−	+	−	−
Long bones					
DV 41	Humerus	−	+	++	++
DV 50	Radius	+	−	++	+
DV 40	Femur	+	++	+	+
DV 43	Femur	+	+	++	+
DV 42	Fibula	+	+	+	++
DV 48	Fibula	+	++	−	++
Hands/feet					
DV 39	Tarsal	++			−
DV 46	Tarsal	++			+
DV 44	Metatarsal	+	−	++	+
DV 47	Metatarsal	+	−	++	−
DV 49	Metatarsal	+	−	+	+
DV 34	Phalanx	−	−	−	++
DV 52	Phalanx	+	−	−	++
DV 53	Phalanx	+	−	−	−

possible adolescent (DV 33), one older adult (DV 11/12), and at least two late adolescent or adult individuals (one of which may be the same as DV 11/12). The last assessment is based on the mature or nearly mature isolated axial and appendicular remains, and the presence of two right fibulae (DV 42 and 48), neither of which could derive from the associated skeletons, combined with the low probability that DV 40 and 43 derive from the same femur. It is possible that the isolated mature postcrania derive from more than two individuals, but the fragmentary state of most of the elements makes it difficult to assess the probabilities of association.

The actual number of individuals represented is higher, since the remains derive from a series of concentrations, or likely occupation episodes, which span *c.* 1500 years (Tables 1 & 2). Assuming that the concentrations were distinct depositional episodes with no subsequent horizontal mixing, the MNI can be refined. The first concentration (upper main site) has two individuals plus the triple burial, the second area (upper western slope) yielded at least one individual, the third area (lower western slope) produced at least three individuals plus the DV 16 burial, and the northern slope yielded at least one individual. The total MNI, based on these criteria, is therefore seven individuals plus the four burials.

Post-mortem damage patterns

The isolated Dolní Věstonice II remains have been categorized by the presence and general degree of four patterns of post-mortem damage (Table 11). The first is general erosion, reflecting the degree to which the original surfaces and margins of breaks were abraded, eroded and/or rounded. Post-mortem breaks were divided into transverse breaks versus oblique breaks, with "+" stating the presence of such fractures and "++" indicating that the dominant pattern is one or the other. Both forms of breaks are known to occur with fresh bone, but dry bone appears to result mainly in more transverse breaks (F. Marshall, pers. comm.; Johnson, 1985; Lyman, 1994).

In addition, the presence and degree of surface root etching was noted (Table 11). The cultural levels at Dolní Věstonice II were covered by several metres of loess overburden (Svoboda, 1991*a*; Klíma, 1995). This loess cover, deposited during and after the Upper Würmian Pleniglacial, reaches 3·5 m in the upper part of the site and *c.* 2·5 m on the western slope, making it unlikely that the root etching on these remains, as well as the extensive root etching on the DV 13 to 16 remains, was the result of Holocene plant action. It is therefore probable that the degree of root etching on the remains reflects their proximity to the Late Pleistocene land surface.

The surfaces of the cranial, dental and axial remains are in generally excellent condition, with pronounced root etching primarily on the DV 12 frontal piece and minor erosion on some of the DV 36 teeth and the DV 45 rib section. In contrast, most of the appendicular remains exhibit abrasion of the surfaces and clear root etching, in several cases sufficiently pronounced to have removed much of the original surface bone without changing the shape of the specimen.

The breakage patterns also follow a consistent pattern. The tarsals and phalanges appear to be mostly surface eroded, and in this they resemble the condition of the hand and pedal remains from the DV associated skeletons. The long bones and metatarsals, however, show a combination of transverse and oblique breaks, with the DV 41 humerus, the DV 50 radius, the DV 43 femur and the metatarsals having all or mostly oblique breaks. This is particularly evident in the proximolateral removal of a flake on the DV 41 humerus, and in the proximolateral and distoposterior bone removals from the DV 43 femur. This suggests that these bones were broken while the bone tissue was still fresh (Johnson, 1985), bearing in mind that in cold climates the ''fresh'' nature of bone may last for a considerable period of time (West, 1997; Andrews & Armour-Chelu, 1998).

The cranial vault pieces all have irregular breaks along their margins, in addition to a couple of breaks across the DV 11 calotte where it was broken and the pieces slightly displaced *in situ* (Klíma, 1987*c*). Some of these breaks are largely transverse (perpendicular to the exocranial surface), whereas others bevel inwards or outwards (see Vlček, 1991). Some of the breaks are rounded internally and/or externally, whereas others are clean and angular.

There are two exocranial areas which present sets of parallel marks. One of these areas is on the right superior nuchal line and along the adjacent lambdoid suture, and it consists of a dozen fine horizontal scratches. The other area is on the right frontal squamous portion and consists of two partially overlapping sets of broader and deeper grooves. The lines on the occipital bone have the appearance of fine marks made with a sharply pointed implement that only affected the subperiosteal surface bone. The frontal marks are more difficult to interpret and could derive from post-depositional damage to the frontal region; they also resemble bone surface scoring from carnivores (Haglund *et al.*, 1988). No similar marks were noted on the isolated post-cranial remains.

Discussion

The damage patterns on these isolated human remains from Dolní Věstonice II therefore include some damage from post-depositional sediment compression and movement plus general skeletal decomposition; included in this are various transverse breaks of the bone and eroded margins. In addition, there appears to have been considerable damage to the bones, while the bones still contained considerable organic material; this would include the various oblique breaks, plus possibly some of the transverse breaks, as well as the fine marks on the DV 11 occipital bone. On top of these alterations is the variably extensive root-etching of most of the remains.

At least as concerns macroscopic post-mortem damage, the patterns observed among these isolated human remains from Dolní Věstonice II are similar to those known for the isolated human elements from Dolní Věstonice I. The DV 1 and 2 crania consist of calottes with breakage patterns similar to those observed on DV 11/12, with irregular and sometimes angular breakage around the inferior margins of the squamous portions of the frontal, parietal and occipital bones (Malý, 1939). In addition, the DV 35 proximal femoral diaphysis (Trinkaus *et al.*, 1999) has oblique breaks proximally and distally with large chips of bone removed. The other isolated human elements from Dolní Věstonice I consist of cranial vault fragments (DV 4–6, 23–25, 28, 30) and isolated teeth (DV 7–10, 26, 27, 29, 31, 32, 37, 38) (Jelínek, 1953; Klíma, 1990; Hillson, pers. observ.). The pattern of element preservation and post-mortem damage seen on the Dolní Věstonice II isolated remains therefore may well be characteristic of isolated elements from these sites.

In addition, the patterns of general erosion of the bone surfaces and the extensive root-etching is very similar to that seen on the DV 13 to 16 remains, whose long bones all show moderate to extensive root-etching and whose smaller bones and long bone epiphyses are frequently eroded along the margins.

The deposition of the human remains at Dolní Věstonice II follows two patterns. There are the two intentional burial events, the DV 13 to 15 triple burial and the DV 16 isolated burial. The DV 36 associated dentition may also represent an undisturbed burial whose infant skeletal elements (as opposed to teeth) were destroyed solely through chemical disintegration and sediment compaction. And then there are the various isolated elements from at least seven (six without DV 36) individuals.

Moreover, the isolated human remains were distributed in the cultural layers of the site in a pattern that does not differ basically from any of the other cultural objects [see distribution maps in Klíma (1995), Svoboda (1990, 1991*a*), and Svoboda *et al.* (1993)]. The associations of several of the remains with hearths follow, in fact, the general distribution pattern in the densely settled areas. To explain this pattern, three non-mutually exclusive processes should be considered.

Geological disturbance. All of the sites within the Dolní Věstonice–Pavlov area are located on slopes in loess sediments, so that movements of the blocks of sediments, layers, groups of objects or individual pieces should be expected. This was the case with the Pavlov 1 burial, which was located at the edge of an erosional

channel (Klíma, 1997); a large portion of the skeleton was nonetheless preserved (Vlček, 1997).

The sediments at DV II were penetrated by fissures that caused step-like sinking of blocks of loess (Klíma, 1995). In addition, we observed ice-wedges, effects of solifluction on the surface of the cultural layer, and deformation of the small pits (Svoboda, 1991*a*; Klíma, 1995). These deformations explain short-distance movements of objects. However, the features and the artefact accumulations form relatively regular patterns over the excavated areas. In this situation, we should expect the displacement of objects, but not for long distances and not the disappearance of major portions of the bodies. This conclusion is reinforced by the human burials from both DV I (DV 3) and DV II (DV 13 to 16), which show little disturbance beyond that expected from corporeal decomposition and sediment compaction (Klíma, 1991; Trinkaus & Jelínek, 1997).

Human behaviour. Evidence from Upper Palaeolithic sites in Moravia documents a considerable variability in mortuary behaviours, including one burial with rich associated remains (Brno 2) (Oliva, 1996), several burials with a few or no associated objects (DV 3, 13–15, 16, Pavlov 1) (Klíma, 1963, 1991, 1997), an accumulation of bodies at one spot (Předmostí) (Maška, 1895; Absolon & Klíma, 1977), and, possibly, bodies deposited through chimneys into karstic cavities (Mladeč, Koněprusy) (Svoboda, 2000). Given this variability, the pattern of isolated human remains at Dolní Věstonice II (and DV I) may correspond to another type of mortuary behaviour, with the human remains scattered and, if the marks on the DV 11 occipital are humanly-produced cut-marks, some intentional disarticulation.

Carnivore activity. Alternatively, it is possible that the distribution and post-mortem damage patterns of these isolated human remains reflects the activities of carnivores scavenging human bodies from shallow graves. The depths of the burial excavations (shallow depressions rather than real pits) and extensive root-etching on the DV 13 to 16 burials indicates that they were close to the surface, and it is possible that the individuals represented by the isolated remains were similarly buried. The root etching on their bones, however, could have resulted after the remains were disturbed.

The carnivores known skeletally from Dolní Věstonice II include fox (*Alopex lagopus* and *Vulpes vulpes*), wolf (*Canis lupus*), plus an additional small canid. In addition, hyena (*Crocuta crocuta*) was present in central Europe during the Pleistocene (Kurten, 1968: 69) and is indicated at Dolní Věstonice II by characteristic gnawing on juvenile mammoth bones (West, pers. observ.). Wolverine (*Gulo gulo*) and bear (*Ursus arctos* and *U. spelaeus*) are known from other Pavlovian sites (Musil, 1997).

Foxes can excavate, disperse, and fracture bones (Grambo, 1995; Mondini, 1995). However, these small carnivores have difficulty breaking bones of medium-sized mammals, including the major bones of humans (Andrews & Jalvo, 1997; Andrews & Armour-Chelu, 1998). The types of breaks exhibited by the larger human remains from Dolní Věstonice are therefore unlikely to have been made by foxes even though these small furbearers were abundant in the area. Wolves and smaller canids are capable of breaking human bones into the spiral fractures documented at DV II and produce considerable damage to epiphyseal regions (Binford, 1981; Brain, 1981; Haglund *et al.*, 1988). There is little evidence suggesting wolves excavate soil to acquire carcasses, although they are capable of digging through snow to retrieve carcasses. The large number of wolves represented at Pavlovian sites suggests that this carnivore could be a contributor to the bone breakage and damage patterns occurring on isolated human bones from DV II. Extant hyenas (*Crocuta crocuta* and *Hyaena hyaena*) in the Near East and Africa have been documented to rob shallow human graves (Sutcliffe, 1970; Horowitz & Smith, 1988), producing (among other damage patterns) bowl-like calottes from human crania as a result of accessing the brain tissue through the cranial base. Hyenas easily crush and, more so than wolves, splinter human bones (Andrews & Jalvo, 1997). Hyenas could also have excavated, gnawed, destroyed and dispersed human bones. In addition, wolverines can scavenge and modify bone (Coues, 1877), and bears will excavate carcasses, consume them and gnaw, puncture and split human bones (Haynes, 1983; Carson *et al.*, n.d.).

It is therefore possible that the damage patterns, dispersal, and partial destruction of the skeletons represented by these isolated human remains was produced by one or more of these carnivores exploiting the human remains after abandonment of the DV II site. However, even though the damage patterns are all compatible with such a scenario, there are no distinct carnivore-related damage patterns on these human remains.

Summary. A consideration of the post-mortem damage on the isolated human remains from the Dolní Věstonice II site indicates that geological processes (other than sediment compaction and minor erosion) are unlikely to have produced the taphonomic patterns observed, but that human and/or carnivore processing of the bodies were responsible for the observed distribution. Given the limited range of skeletal elements represented among these isolated remains, agents which systematically destroy bones (large carnivores) seem more likely to have been involved than less destructive agents (humans and small carnivores). Regardless of the original processes involved, it is nonetheless apparent that there were considerably more human burials at Dolní Věstonice II (and probably other earlier Upper Palaeolithic sites) than is indicated by the well-preserved human burials.

Summary

Continued analysis of the rich palaeanthropological remains from the Pavlovian site of Dolní Věstonice II has provided a series of isolated human remains, representing at least seven individuals. These elements, including cranial vault remains, isolated and associated teeth, and post-cranial elements, are morphologically similar to those known from the Dolní Věstonice and Pavlov human burials and other European earlier Upper Palaeolithic remains, differing principally in the high percentage cortical area of the distal humerus and femur. Taphonomically, their pattern of preservation and fracturing suggests that the human bodies from which they were derived were processed extensively by agents, most likely but not necessarily exclusively large carnivores, who split and destroyed the bones. If this interpretation is correct, then the number of intentional burials at the Dolní Věstonice II site may have been much greater than we normally perceive.

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