The Significance of Cremations in Early Neolithic Communities in Central Europe

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Dedicated to my Mom and Dad

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“Sometimes the questions are complicated and the answers are simple”

- Dr. Seuss

A. Introduction

The Linear Bandkeramic culture (LBK) represents the first appearance of neolithic people in Central Europa and has therefore been the subject of multiple studies and discussions. Many authors have specialized on the different aspects of the LBK culture. For many years, the LBK was viewed as a homogeneous culture that rapidly spread westward from its place of origin in south-eastern Europe along the major rivers as far west as the Paris Basin and north into Poland until it reached the North and Baltic Seas. Recent studies have shown that the LBK was much less uniform in the later phases than was previously assumed. Distinctive ceramic patterns, the construction of trenches and wells, evidence of warfare and diverse burial forms indicate that the culture was changing toward the end of the LBK. The burial practices, in particular, are very interesting because they represent the first organized cemeteries and burial sites within settlements of this dimension to be found in Europe. Previous Mesolithic burials were either found as single burials in caves or underneath abris or in small groups. Primary body burials of unburned individuals were recovered from cemeteries dating throughout the LBK. The 12 known cremation-bearing cemeteries all date to the younger phase of the LBK. In total, over 3,500 burials were recovered from 57 cremations and over 170 settlements throughout the LBK. The 350 cremations sited in the literature make up 10% of the burials identified in the LBK.

The very first discovery of cremations, dating to the younger LBK, was made by Wolff in 1907. These findings, known as the "Wetterauer Cremations", caused quite a stir because they were unique for the LBK and were accompanied by exceptionally rich burial goods such as beautifully shaped pearls and beads. In the years leading up to World War I, nearly 100 Bandceramic cremations were recovered. Although a number of authors questioned the authenticity of these findings, the cremations were accepted by the scientific community. However, in 1958, Loewe expressed doubt at the genuineness of the graves. Upon further study, it became clear that the cremations were only discovered at sites excavated by Wolff and his assistant. In 1920, Wolff's assistant completed his last excavation, afterwards, no more cremations were recovered. Also, the pearls and beads found alongside the burials goods were not fashioned with neolithic tools or materials. The drill holes were too small and regular to have been made with a flint tool. Instead, the grooves and diameter resemble those made by a dentist's drill. Some of the beads were fashioned out of slate used to manufacture school blackboards! Loewe (1958) showed that the graves had been faked and the Wetterauer finds and LBK cremations lost their credibility. In 1973, Hoffmann rehabilitated cremations for the LBK by showing that cremations truly did exist in the LBK. It is no wonder that cremations from LBK have not received as much attention during excavations and in the literature.

Nevertheless, 350 cremations from 12 cemeteries were cited in the literature. Of these, only the cremations from Wandersleben and Aiterhofen-Ödmühle had previously been evaluated. Birkenbeil analyzed the cremations from Wandersleben and Lantermann the body burials and cremations from Aiterhofen-Ödmühle, however, the results were not published (A catalog of the cremations from Aiterhofen-Ödmühle was later published in Nieszery 1995). Therefore, a complete investigation of the cremations from the LBK was long overdue.

My Master's thesis, completed at the University of Tübingen in June 2003, was a pilot study of the cremations from the cemeteries of Schwetzingen „RNK" and Fellbach-Oeffingen „Obere Tauber" in Baden-Württemberg. The aim of the study was to find out whether there were obvious biological of physical differences between the people who were cremated and the unburned body burials. The purely morphological evaluation of the 15 cremations from Schwetzingen and the 33 cremations from Fellbach-Oeffingen showed that cremated remains are a valuable source of information and it is important to study them as thoroughly as the remains of unburned individuals. The sex was determined for 14 of the 48 (29%) individuals and individuals from all six age categories (defined by Martin 1957) were identified. The weight of the cremated remains ranged between less than 1 g and nearly 1 kg, yet it was not the volume of material that was important for the evaluation. A small handful of the right pieces was enough to determine the sex or age of an individual. The evaluation of my results showed that the cremation process was not limited to a certain sex or age category. Therefore, reasons other than pure biological differences must have led to the difference in burial form. The cremated material was treated with a great amount of care as the presence of small fragments such as teeth and finger bones in 27% of the cremations evidenced. In addition to the knowledge that a cremation was a costly form of burial, both in the sense of value and time, it was concluded that it was more likely that the cremated individuals were people of a higher status, rather than a lower status.

This comprehensive study of the cremations of the LBK includes the cremated materials from the cemetery of Elsloo in the Netherlands, a reevaluation of the cremations from Schwetzingen and Fellbach-Oeffingen as well as the one possible LBK cremation from Stuttgart-Mühlhausen from Baden-Württemberg and the cremated remains from Wandersleben and Arnstadt in Thuringia, all in Germany. The cremations from Aiterhofen-Ödmühle and Stefansposching in Bavaria were not available for study, but the data about sex, age and preservation for the cremated remains from Aiterhofen-Ödmühle, documented in the catalog in Nieszery (1995), was also included. The analysis consisted of a classic morphological evaluation as well as metrical analyses adapted for the fragmentary cremated material based on Wahl (1980; 1988). The histological analyses include the tooth cementum annulation method (TCA) as described by Grosskopf (2005) and Franken (2006) and an evaluation of the thin section of the femoral diaphysis (Grosskopf 2005; Maat et al. 2005).

The aim of this thesis is to determine whether the initial results from the Master's thesis can be confirmed for all of the cremated remains from the LBK. The goal was to find out why a certain group of individuals within the LBK was subjected to different burial rites from the rest: Cremation. If for purely biological reasons, such as a specific age group or only individuals of one sex, cannot be identified, then are there other characteristic features that distinguish the cremated individuals from the rest? Metrical analyses can help determine whether the cremated individuals belonged to the same population as the unburned individuals. If there are differences, are they identical across all cemeteries in this study? Epigenetic and pathological evidence is very rarely preserved in cremated materials, therefore it will not be possible to look for kinship ties or manner of death due to violence or illness. A number of interpretations and parallels from the ethnographic record are discussed to shed light on the possible social, cultural or religious reasons for cremation.

Chapter B presents an overview of the LBK including its origins, dispersal and interaction with neighboring cultures. A brief introduction to mtDNA and isotope analyses provides some insights into the question of agricultural colonization versus cultural adaptation of the culture. It also presents a summary of the archaeological tradition including ceramic styles, stone and flint tool types, longhouses and trenches and food and subsistence patterns. The different burial practices in the LBK are discussed in Chapter C. The chapter includes a compilation of LBK cemeteries and burials, as well as a summary of the settlement burials, isolated skeletal remains such as the skull caps from Herxheim and the mass graves from Talheim and Asparn/Schletz. The history and methods of the field of investigating cremations and cremated remains is discussed in Chapter D. It includes detailed descriptions of the chemical and physical heat induced changes to the skeleton, methods for determining the sex, for example, from the Pars petrosa and age from a cremated skeleton. The methods used to determine the age include, next to the morpho-metrical analyses, tooth cementum annulation and histological thin sections from the anterior portion of the femur. Definitions of the measurements used in the analysis of cremated material and their application to determining the height of an individual are also presented. Some of the particularities of working with cremated materials are illustrated in Chapter E. The detailed results from the evaluated cemeteries of Elsloo, Schwetzingen, Fellbach-Oeffingen, Wandersleben and Arnstadt are presented is Chapter F. The chapter also includes a brief summary of the cremations from Aiterhofen-Ödmühle and Stephansposching. The corresponding catalog are located in the appendix. Chapter G features the discussion and interpretation of the results presented in the previous chapter. Concluding remarks and goals for future research will be summarized in Chapter H.

B. Development and Characteristics of the LBK

The transition from the Palaeolithic to the Neolithic began 10,000 years ago in the Near East. From here, neolithic farmers and herders spread out and quickly expanded into Europe and the rest of the world. The people of the Linear Bandkeramic culture (in German, 'linearbandkeramische Kultur' and hereafter called LBK) were the first neolithic population to settle Central Europe. The LBK originated in the neolithic communities along the middle Danube about 7,500 years ago (Lüning 1988; 2005; Gronenborn 1999; Bentley et al. 2002, Price and Bentley 2005). Extensive studies of the characteristically banded LBK pottery have placed its origins in the Starčevo-Körös-Criş and the subsequent Vinča cultures of Hungary. The Starčevo-Körös-Criş culture is a grouping of three cultures that date from 6,500 to 5,500 B.C. in Serbia, Romania and Hungary, respectively (Schubert 1999, 20ff.; Tringham, 2000; 23). The pottery is generally plain and monochrome. The clay was tempered with organic materials and painted with white, red or dark spirals and linear designs prior to firing at temperatures between 500-600°C (Schubert 1999, 13ff.). Clay was also used to manufacture figurines and weights. Houses were constructed using clay and mud bricks. The subsistence pattern was based on domesticated animals and plants while wild animals and plants were rarely incorporated into the diet (Tringham 2000; 23ff.). Circa 150 burials have been excavated in the area attributed to the Starčevo-Körös-Criş cultures, all deposited within settlements. Primarily females and children were found: The dead were deposited in settlement pits and accompanied by very few burial goods such as ceramic vessels or jewelry. Mass graves containing between 5 and 17 individuals were found. Another specialty were the houses for the dead, built out of stone and wood. Typically, the dead were placed inside the house which was then burned down (Preuss 1988). The Vinča culture followed the Starčevo-Körös-Criş

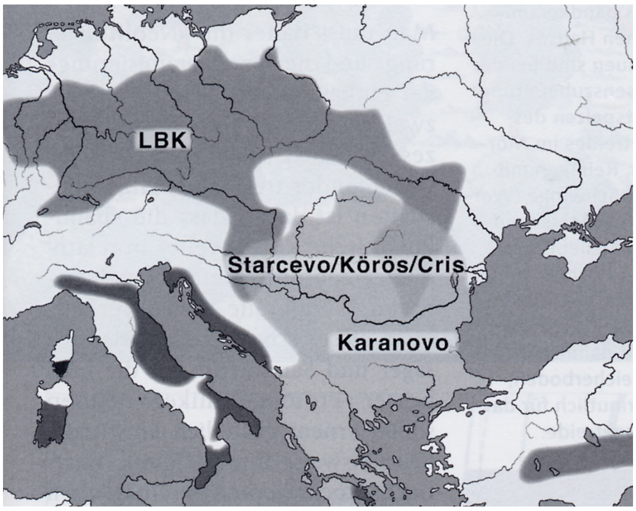


Figure 1: Geographic distribution of the Starčevo-Körös-Criş and LBK culture (Kreuz 2006, 27).

Figure 2: Necklace and typical vessel of the Starčevo culture from Lepinski-Vir (Brukner 1979, 111).

cultures, ca. 5,300 B.C., and rapidly expanded outwards from these previously inhabited areas. The people of the Vinča culture settled in "strategic" areas, exploiting the best resources and landscapes. In contrast to the preceding culture, wild plants and animals were heavily exploited. A characteristic of the Vinča culture was the use of a rich variety of materials from local sources as well as sources located farther away (TRINGHAM 2000; 51ff.).

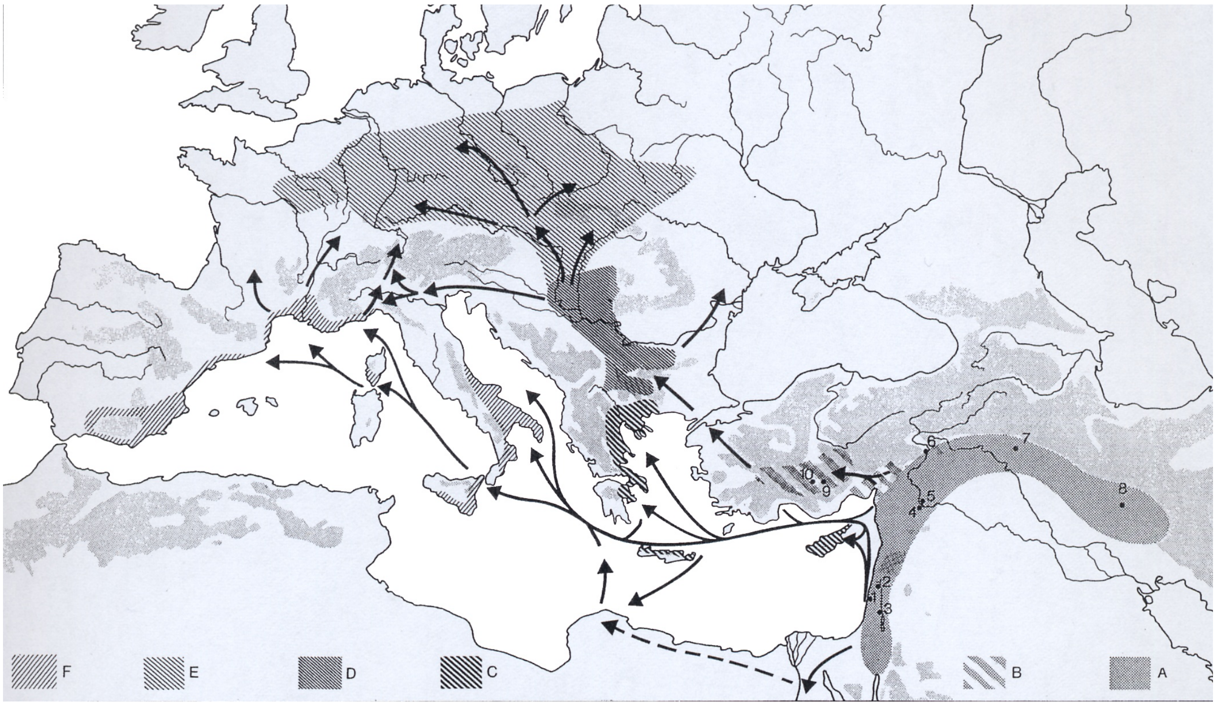


Figure 3: Origins and distribution of agricultural way of life: A. Origins in the core area, the fertile crescent, ~7000 B.C. and B. Anatolia; C. Distribution into southeastern Europe, until 6000 B.C.; D and F. Starčevo-Körös culture and Cardial cultures along the Mediterranean, 6th century B.C.; E. Area settled by the LBK, 5th century B.C. (Lüning 1988, 30 Fig. 1).

The LBK spread rapidly along the primary rivers and quickly colonized most of Central Europe. The culture is separated into an older and a younger period based on two primary waves of expansion. The first expansion, the older or early LBK, dated from 5,800 to 5,300/5,200 B.C., spread along the Danube River to the Rhine River covering most of southern Germany (BREUNIG 1987, 46ff; LÜNING 1988). The earliest known radiocarbon date for Central Europe originates from the right femur of a 30 year old man from the settlement site of Schwanfeld, in Bavaria. The date 5,521-5,444 B.C. (6,580 ± 20 B.P.) contradicts the 5,800 B.C. date which was determined from wood charcoal (STAEUBLE 1995). Based on the 60 dates, taken from 15 samples in Central Europe, STAEUBLE (1995) dates the early phase of the LBK from 5,500 to 5200 B.C.. The second expansion, the younger LBK, dated to 5,300-4,900/4,800 B.C., spread across the Rhine River as far west as the Paris River Basin. In the east, LBK settlements and cemeteries have been found in Hungary, the Czech Republic and Poland. At its maximum expansion, the LBK occupied a 2,000 kilometer east-to-west stretch of Central Europe and reached as far north as the Netherlands and south into Austria.

The neolithic Starčevo-Körös culture bordered the LBK in the east. When they reached the Rhine River in the west, the LBK people met with the people of the La Hoguette culture (see B.2), a culture that had its origins in the Cardial culture, early neolithic farmers and herders who migrated into Europe along the Mediterranean Coast (Breunig 1987, 46ff; Lüning 1988; - 2005; Lüning et al. 1989; Gronenborn 1999; - 2006).

1 Interaction with the Neighbors.

When the neolithic LBK people came to Central Europe they did not enter an unoccupied land. Indigenous Mesolithic groups such as the Ertebølle culture from Denmark and very early neolithic cultures such as the La Hoguette and Limburg cultures can be associated with the LBK.

1.1 Mesolithic Populations and the LBK

The Mesolithic dates between 8,400 and 3,200 B.C (Grünberg 2000). The later Mesolithic in Central Europe begins around 6,000 B.C (7,800 B.P) and continues until circa 4,800 B.C. (6,700 to 6,500 B.P.). It is known from rock shelters and cave sites, very few open air sites and is defined by the presence of trapezoidal microlithic forms and antler working (Jochim 2000, 183). 1,608 individual burials are known from 125 Mesolithic sites (Table 1[1]).

	sex									
	♀		♂		**children**		**undet.**		**total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
single burial	35	2	36	2	15	1	22	1	108	7
head/skull burials	11	1	7	0	20	1	1	0	39	2
burials in cemetery	270	17	371	23	266	17	554	34	1461	91
total unburned	316		414		301		577		1608	
cremations	5	**19**	9	**35**	4	**15**	9	**31**	**27**	**100**
total	321	20	423	26	305	19	586	36	1635	100

Table 1: Mesolithic burials: Distribution of age and sex across different burial types (redrawn after Grünberg *2000, Fig. 35;* Schunke *2004, 57). The percentage of the single, head/skull and cemetery burials is based on the total number of unburned individuals, n=1608. The percentage of cremations refers to the percent of the total number of cremations, n=27.*

The primary burial form was body burials (89%) either from individual graves in and near settlements or caves or from cemeteries. Twenty-seven cremations (2%) from 11 sites have also been recorded (Table 2). Single burials make up 7% and head or skull burials 2% of the remaining burials. Head and skull burials, such as the ones from the Hohlenstein-Stadel or Grossen Ofnethöhle were often found directly under or near the entrance of the cave. At

1 Percentages in all tables are rounded to the nearest percent, therefore, values may not exactly add up to 100.

another site, Eisernen Tor, the skulls were found throughout the settlement and it has been suggested that they were positioned throughout so that they were visible to everyone (GRÜNBERG 2000).

	♀		♂		undet.		total	
	n	**%**	**n**	**%**	**n**	**%**	n	%
infant I	-	-	-	-	2	7	2	7
infant II	-	-	-	-	2	7	2	7
juvenile	-	-	-	-	1	4	1	4
adult	2	7	3	11	1	4	6	22
mature	1	4	1	4	-	-	2	7
senile	-	-	1	4	-	-	1	4
undet.	-	-	-	-	13	48	13	48
total	3	11	5	19	19	70	27	100

Table 2: Mesolithic cremations: Distribution of age and sex (*after* GRÜNBERG *2000, 51ff;* SCHUNKE *2004, 57*).

The dead were found in open air sites, caves and abris. The burials show evidence of hierarchical structures. Individuals of the same age and sex were treated differently within the same burial site. There were differences in the orientation and positioning of the body, the types and number of burial goods as well as the structure of the grave (GRÜNBERG 2000, 199). The burial goods such as tools, weapons, jewelry, animal bones and shells as evidence for food and the furnishing of the grave with red pigments and rocks are evidence for some sort of belief in life after death or a spirit (GRÜNBERG 2000, 20ff.). GRÜNBERG (2000) suggests that the heterogeneous burial rites at the Mesolithic sites were used for social differentiation, dependent on the age, sex, social status or manner of death of the deceased individual. The burial form could be characteristic for a specific group and may indicate that the burial site was used by different groups. The different burial forms occurring at one site may also illustrate changing burial practices through time. GRÜNBERG does not present specific reasons for cremations among the Mesolithic burials, but lists ethnographic interpretations that could be applied to cremations from any time period (2000, 51ff).

Cremations were found in sites all over Europe (Table 3): one adult ♀, one adult ♂ from Franchthi Cave in Greece; three adult ♀, five adult ♂, one child and one unidentified individual from Vlasac, Serbia; two unidentified individuals from Wieliszew XI, Poland; two adult ♂ and one unidentified individual from Skateholm I + II, Sweden; one adult ♂, one child and one unidentified individual from Vedbaek, Denmark; one unidentified individual from Vedbaek Boldbaner, Denmark; one adult ♀ and one unidentified individual from Dalfsen, Netherlands; one child from Oirschot, Netherlands; one unidentified individual from Rochereil Cave, France and one cremation from Buroer Feld by Coswig in Germany (total:

five ♀, nine ♂, four children, nine undetermined age or sex) (Grünberg 2000, 52ff.; Schunke 2004, 57).

The majority of the burials in Scandinavia probably belong to the Ertebølle culture, the cremations from Vedbaek, Vedbaek Boldbaner and Skateholm I + II were people from the Ertebølle culture. There is a hiatus of over 600 years between these and the burial sites that definitely belong to the following Mesolithic traditions (Grünberg 2000, 17ff.). The three individuals, two adults and one older child, from Vedbaek were cremated while the remaining five newborn children found at the site were buried as primary burials. A stone knife without any markings from fire was found together with the burned bones of the male individual. The other adult and the child were buried together, the burial goods included a small piece of ocher and pierced animal teeth. Two of the 62 individuals (3%) from Skateholm I were cremated, the cremation of the male individual was found inside a set of post holes, the remains of a wooden construction that was probably burned with the individual inside it. The other individual was found further away, lying between the burials of two dogs. The cremation from Skateholm II belongs to one of the oldest individuals among the 21 total burials from this site. The *senile* man's bones were only partially burned and scattered over the paved surface of the grave. Eleven of the 124 individuals (9%) from Vlasac I were cremated. These date to the earliest phase of the cemetery. The cremated remains of the child were discovered inside the hearth of a house, the others were recovered from four pits in the cemetery. The cremations were not consistently burned, some only charred, others partially burned and grey in color. Eight of the cremations were found deposited together with body burials. The male and female cremations from the Franchthi cave were two (33%) of a total of six adult burials and one child burial found near the mouth of the cave. The color of the cremated bones suggests that temperatures over 800°C were reached. The cremation from Vedbaek-Boldbaner was found together with the single grave of a *mature* male. The grave had been covered with a small sand hill. The two cremations from Dalfsen were found in a pit surrounded by small hearths, arranged in a semi-circular form around the pit. The pit was 1 among over 20 pits, the others contained charcoal and flint flakes. The bones from the settlement Oirschot V were found concentrated in a small pit, the remaining bones were spread across the remaining surface. The cremated remains from Rochereil show traces of having been de-fleshed prior to being burned at very high temperatures. They were found in a small pit, close to a wall. The settlement Wieliszew XI included four concentrations of over 8,000 stone tools. The cremations were found in small, shallow pits between the concentrations (Grünberg 2000, 52ff). An additional cremation from the Bronze Age site Buroer Feld by Coswig in Germany was identified because of its "non-Bronze Age" like character. Radiocarbon dating confirmed that the cremation had Mesolithic origins, making it the first and oldest Mesolithic cremation in Germany (Schunke 2004, 57).

	sex				
	♀	♂	**children**	**undet.**	**total**
	n	**n**	**n**	**n**	**n**
Franchthi Cave	1	1	-	-	2
Vlasac	3	5	1	2	11
Wiesliszew XI	-	-	-	2	2
Skateholm I + II	-	2	-	1	3
Vadbaek-Boldbaner	-	-	-	2	2
Vadbaek	-	1	1	-	2
Dalfsen	1	-	1	-	2
Oirschot V	-	-	1	-	1
Rochereil	-	-	-	1	1
Buroer Feld, Coswig	-	-	-	1	1
total	5	9	4	9	27

Table 3: Mesolithic cremations: Distribution of age and sex across the find sites (*after* GRÜNBERG 2000, 52ff; SCHUNKE 2004, 57).

The Ertebølle culture from northern Germany and Denmark dates from 5,400 to 3,900 B.C. (PRICE 2000a, 266). The stone tool inventory includes an elaborate blade technology, projectile points and axes as well as some ground artifacts in the form of axes and celts. Projectile points were also made out of organic materials such as bone, wood or antler. The people lived along the coast, therefore it is no wonder that a wide array of fishing gear such as nets, hooks and harpoons were also found. Isotopic studies and the remains of bones from fish, coastal animals and birds and marine shells show that marine foods were important in the diet. Pointed ceramic vessels, similar to those from the earlier La Hoguette ceramic tradition, and shallow oval bowls were found in the later period of the Ertebølle culture, after 4,600 B.C. (PRICE 2000a, 268). Pottery, bone combs such as the ones found in southern Germany and shoe-last adzes are evidence for interaction between the Mesolithic people from the Ertebølle culture and the LBK. It seems that this Mesolithic fishing tradition was very successful and continued to exist alongside the LBK (PRICE 2000a). The first evidence for the exchange of agricultural food stuffs does not appear until much later, 4,300 B.C. when the early Neolithic actually reached Scandinavia (HARTZ AND SCHMÖLKE 2006, 37).

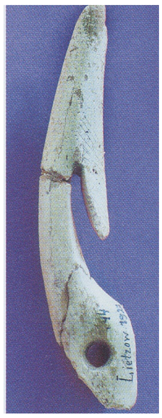


Figure 4: Ertebølle harpoon from the island Rügen, Germany (LÜBKE and TERBERGER 2006, 38).

In fact, some authors believe that acculturation by Mesolithic populations was more common than colonization along the borders of the LBK and in the later Neolithic. Agriculture and the neolithic way of life are probably the result of indigenous adaptation in Scandinavia, Portugal and the British Isles. There is a continuation in the lithic and ceramic traditions. This hypothesis is also supported by the biological information provided by skeletal material. Anthropologically, the people of the LBK did not represent a homogeneous population. The variation among regional groups within the LBK was greater than the differences to neighboring cultures. Comparative studies of the cranium showed that there are significant differences between the people of the Mesolithic and the following LBK, the facial skeleton was wider and shorter. However, there is a continuous development from the Mesolithic to the LBK that cannot simply be attributed to gradual mixing of the two populations. The breadth of the face continuously decreases while the height of the facial skeleton increases. BERNHARD (1978) states that, this evidence cannot rule out that autochthonal development of the LBK people, and therefore an indigenous adaption of the neolithic way of life, was possible. The neolithic population, primarily the people of the LBK, developed out of Mesolithic populations under circumstances that led to a continual gracilization of the population. What these circumstances were, was not stated. BERNHARD describes the people of the LBK as an overall gracile population with a number of archaic features such as the ratio of cranial length and breadth to cranial height and the significant thickness of the cranial vault walls (BERNHARD 1978). The general trend at the end of the Upper Palaeolithic in the decrease in stature and tooth size continues in the early Neolithic (PRICE 2000b, 302ff.). Modern mtDNA (mitochondrial DNA, see section B 4 for more information) studies go even further: They also support the idea that the Mesolithic populations did not die out, but continued into the Neolithic and live in us today. mtDNA analysis of modern populations suggest that more than 85% of modern European genes date to the Upper Palaeolithic and not the Neolithic. Therefore only 10 to 15% of todays mtDNA lineages in Europe are the result of the colonization of Europe from the Near East (RICHARDS et al. 1997; HAAK et al. 2005).

Figure 5: Ertebølle ceramic vessel. (Spitzbodengefäß) 40 cm high (HARTZ and SCHMÖLKE 2006, 36).

2 La Hoguette and Limburg Cultures

The La Hoguette and Limburg cultures are very early neolithic cultures that produced ceramics, which closely resemble the style of the Cardial cultures of the Mediterranean, and can also be associated with some domestic animals, sheep and goat. The cultures predate the LBK in Central Europe and probably represent the northernmost branches of the development in the early Neolithic along the Mediterranean coast (JOCHIM 2000). Both have distinct ceramic inventories and areas of circulation. To the east of the Rhine, the cultures are associated with sites of the oldest LBK, in the Elsass with LBK sites from the younger Flomborn period. The Limburg culture can only be associated with the younger LBK (Lüning et al. 1989).

The La Hoguette was named for the site "La Hoguette" in Normandy by the French archaeologist Jeunesse in 1983. The ceramic sherds were found underneath a much younger megalithic burial mound, which is why they were preserved. The ceramics of the La Hoguette culture are characterized by conical bowls with pointed bottoms and wide-spaced linear grooves. A special characteristic of the clay is that it was tempered with crushed bones in order to harden it. The relationship to the Cardial culture is verified by a cup with an eyelet for a string, a detail typical for Mediterranean ceramics (Lüning et al. 1989; Strien 2000, 75). It was found in sites along the Rhine Valley in the Elsass, the Netherlands, Luxembourg and in south-western Germany predominantly in the Neckar Valley. Other archaeological evidence from this culture includes animal bones and poppy seeds. It is probable that the people from the La Hoguette culture imported the poppy seeds from the Mediterranean into the LBK where they are only found in the western dispersion. No burials or graves from the La Hoguette are known to date. The stone tool inventory associated with the La Hoguette culture is late Mesolithic and contains geometrical forms such as asymmetrical arrowheads and microliths. Very few 'pure' La Hoguette sites, such as Stuttgart-Wilhelma, are known (La Hoguette: 6 out of 30 sites; Limburg 5 to 6 out of 55 sites) (Lüning et al. 1989, 387; Schütz et al. 1991; - 1992; Jochim 2000, 193).

Figure 6: Multi chambered burial mound in the village of Fontenay-le-Marmion, in Calvados near La Hoguette (source: The Megalithic Portal www.megalithic.co.uk/article.php?sid=8558)

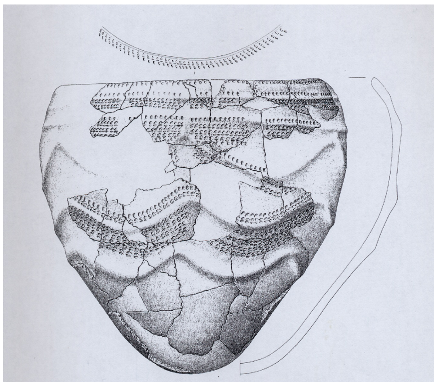


Figure 7: La Hoguette vessel (Lüning 1988, 39 Fig. 10)

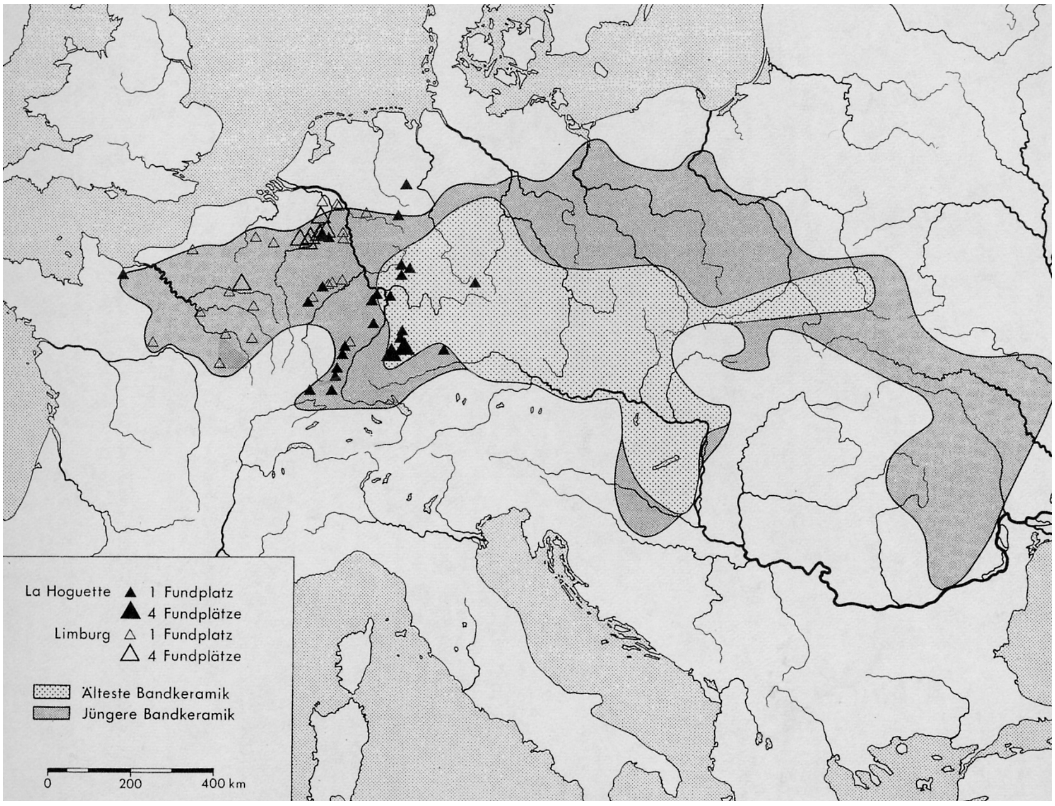


Figure 8: Geographic distribution of the early and late LBK. Filled triangles represent La Hoguette sites, empty triangles represent Limburg sites (LÜNING 1988, 32 Fig. 4).

The same late Mesolithic forms could also be associated with the Limburg culture, which was identified by MODDERMAN (1972) in the 1970s. However, there are no inventories that can definitely be assigned to the Limburg ceramics. Yet the distribution of lithic inventories and Limburg ceramics in the same area of circulation are probably not coincidental. It is possible that a number of late Mesolithic lithic inventories from this period and region could be attributed to either the Limburg or La Hoguette cultures. The area of circulation for this culture spreads across north-eastern France, Belgium and into North-Rhine Westphalia. The ceramic is bowl shaped with tightly-spaced groves and herringbone decorations. Earlier finds from the Limburg culture resemble the style found in the La Hoguette culture, later finds show distinctly different decorating techniques (LÜNING et al. 1989).

One interpretation of these cultures is that they are simply special groups within the LBK who developed their ceramics into a new direction. The presence of the late Mesolithic lithics in the La Hoguette culture speaks against such an interpretation. Another theory states that they were Mesolithic groups who adopted ceramics and domestic animals from the Cardial cultures (JOCHIM 2000, 193). The La Hoguette and Limburg cultures were independent of the LBK even if they have predominantly been found in connection with LBK sites in the past. The La Hoguette and Limburg cultures probably formed small, mobile groups which preferred the sandy plains outside of the areas typically inhabited by the LBK. They used the 'gaps' left by the LBK settlers who preferred the fertile loess regions. There is no evidence for more permanent settlements (LÜNING et al. 1989). The LBK spread westward and encountered the La Hoguette culture near the Rhine Valley. After a while, the culture spread further west into the Alsace where the La Hoguette and Limburg cultures are both associated with the younger phases of the LBK. It is not clear when the La Hoguette and Limburg cultures actually ended. The distinctive pointed ceramic form did not show up in LBK inventories, it disappears. A similar form appeared in the later phase of the LBK when ceramics begin to appear in the Mesolithic Ertebølle culture. But it is later replaced by the newer ceramic forms from Central Europe. It is not known whether there is a connection between the early Neolithic, pre-LBK cultures and the Mesolithic ones of northern Germany and Denmark.

3 Agricultural Colonization vs. Adaptation

Two primary theories compete today to explain the origin of the LBK culture: the theory of agricultural colonization and the theory of acculturation, adaptation and interaction. The first theory contends that the LBK spread into Europe as a fully established culture that brought its technology and way of life with it as it spread north and westward. The rapid and uniform spread of the LBK culture, the types of plants and animals that were domesticated, the traditional house form and, most noticeably, settlements on the loess-rich soils and the ceramic styles and forms, speak for this theory. The presence of non-native plants and animals characteristic to the Neolithic and the LBK are another argument for the agricultural colonization theory (JOCHIM 2000,187). The second theory relies on evidence for interaction between the local Mesolithic inhabitants of Central Europe and the neolithic people further east. According to the acculturation and interaction theory, the local population met up with and adopted the culture from the immigrating farmers and herders. The continuity of Mesolithic lithic traditions in early LBK assemblages is an argument for this theory. In the north, the Ertebølle (see section B.1.1) culture coexisted with the LBK until 5,100 B.C. (LÜBKE 2002). Evidence for interaction between the two populations was found in Mecklenburg-Western Pomerania, where pottery was found at the Ertebølle site of Timmerndorf-Nordmole. The technique had been adopted from the LBK farmers in the south and developed to fit their needs (LÜBKE 2002). It is probable that the LBK farmers traded with the Ertebølle people for mollusks and other seafood.

The most likely scenario however is a combination of these two theories. Neolithic settlers, moving along the primary water ways into Central Europe encountered local Mesolithic hunters and gatherers and traded ideas and items. Evidence for the coexistence of the two traditions, and probably for the interaction as well, has been found in abundance. Mitochondrial DNA evidence supports the interaction and intermixing of the traditions.

4 mtDNA Evidence for Migration and Interaction

Mitochondrial DNA can be recovered and decoded from archaeological specimens that are over 40,000 years old as the spectacular results from the recent genetic studies on Neandertal mtDNA have shown (for example: Krings et al. 1997, Schmitz et al. 2002). Genetic studies from Lake Mungo 3 in Australia have even provided successful mtDNA sequences from ancient modern human remains that are older than 60,000 years (Adcock et al. 2001). Studies of the mtDNA from the first European farmers in the Neolithic of Central Europe 7,500 years ago also shed light on the question of our modern human descent. Researchers have questioned whether the remarkably fast spread of the LBK was orchestrated by neolithic farmers, spreading rapidly across Central Europe, or whether farming and herding were adopted by local Mesolithic populations. mtDNA is found in the mitochondria, the energy producing organelles, of every cell in the body. In contrast to nuclear DNA, of which only one pair is present in the nucleus of the cell, the mitochondria contain 500 to 10,000 copies of mtDNA. mtDNA is exclusively inherited through the mother's egg cell, therefore it represents a female lineage. In general, the mtDNA of children is identical with the mother's mtDNA. Mutations can change individual base pairs, resulting in variations in mtDNA through time. These changes and the rate of mutation can be measured and used as a “molecular clock”. However, the rate of these mutations is based on estimated values.

4.1 Paleolithic Survival vs. Neolithic Replacement

A study of 57 individuals from 16 sites of the LBK and neighboring AVK (Alföldi Vonaldiszes Kerámia) from Germany, Austria and Hungary (including Flomborn, Schwetzingen, Eilsleben, Asparn-Schletz, Halberstadt and Derenburg Meerenstieg II) returned very interesting results (Haak et al. 2005, Burger et al. 2006). The authors wanted to investigate the extent to which neolithic females contributed to the genetic pool of present European populations. Haak et al. (2005) were able to successfully amplify mtDNA sequenced from 24 of the 57 analyzed individuals. Eighteen of the sequences belong to typical Eurasian DNA branches, which are common and widespread in modern Europeans, Near Eastern and Central Asian populations. These sequences “lack the detailed temporal or geographic discrimination required to test the hypothesis” (Haak et al. 2005, 1017). The mtDNA sequences of the remaining six individuals contained a rare and distinctive N1a pattern, a suite of characteristic mutations of the mtDNA sequence. This distinct pattern was the evidence that these sequences were not contaminated with modern material. This pattern only occurs in 0.2% (5 in 2300) of all modern populations. In the studied population, it occurs in 25% of the cases, 150-times more frequently. The high frequency of this N1a pattern occurred at sites across all of Central Europe, in Germany and over 800 km away in Hungary. The authors calculated that the actual frequency in the neolithic LBK populations would have been between 8 and 42%. Haak et al. (2005) were able to show that the loss of the N1a pattern was not simply a result of genetic drift over the past 7,500 years and that it could also not be the result of minor genetic migrations between the LBK farmers and the local Mesolithic population. They rejected their hypothesis that modern Europeans are the direct descendants of the first neolithic farmers. So who do modern Europeans descend from? One explanation is that the LBK culture itself spread without the people, that it was adopted by indigenous Mesolithic people. The explanation supported by the authors is that male and female hunter-gatherers were significantly integrated into LBK communities. These Mesolithic people would have had to have a low frequency of N1a, an assumption that is supported of the world-wide low frequency of this pattern. The research by Haak et al. (2005) shows that the maternal mtDNA lineages of the LBK people have been significantly diluted over the past 7,500 years, that the maternal mtDNA did not exclusively come from LBK farmers. Their evidence supports the idea of a Paleolithic origin of modern Europeans and, thereby provides evidence for significant interaction between the LBK immigrants and the local Mesolithic populations (Haak et al. 2005; Burger et al. 2006).

4.2 Origins of European Cattle

The origin of wild sheep and goats and, by default, their domesticated relatives, was limited to Anatolia and the fertile crescent. This is evidence that, at the very least, these characteristic neolithic elements had to be imported into Central Europe from the Near East. Wild aurochs (*Bos primigenius*) however, were spread much more widely across Europe and could have been domesticated locally in more than one location. The analysis of the mtDNA of 39 domesticated cattle (*B. taurus*), 33 from the Neolithic and 6 from the Bronze Age, compared with the mtDNA sequences from 392 modern animals from Europe, Africa and the Near East showed a. that modern domestic cattle have a neolithic origin and b. that one single genetic group, T3, predominates in Europe today (Troy et al. 2001; Bollongino et al. 2006).

T3 is one of four haplotype groups (T, T1, T2 and T3) that originate from one root haplotype group. Haplogroups are made up of a number of different haplotypes and can be used to define genetic populations that are frequently separated geographically. Haplotypes[2] are common genetic variants that occur within a species. Haplogroups T, T2 and T3 are found in Anatolia and the Near East, the center of domestication. Haplogroup T1 is rare in these regions but more prominent in Africa. Members from this group have been found in southern Portugal (probably North African influence) and in the Americas (consequence of the slave trade) (Troy et al. 2001; Bollongino et al. 2006). The absence of this group suggests a separate African domestication of cattle.

Thirty-eight of the 39 analyzed cattle (*B. taurus*) from the Neolithic and the Bronze Age show sequences similar to modern European cattle, they contain the T3 haplogroup. In comparison, the genetic data from four extinct wild aurochs from Britain (*Bos primigenius*) is distinct from modern cattle and, in consequence, from the neolithic specimens. It does not look as though local domestication played a significant role in the Neolithic or Bronze Age.

2 http://www.hapmap.org/whatishapmap.html.en

However, mtDNA analyses only take the maternal side into consideration. They do not show whether or not imported domesticated cows were bred with local wild bulls. Evidence for possible breeding with local wild cattle was found in the 39th mtDNA sequence from the late neolithic site of Svodin in Slovakia. The mtDNA sequence from one sample was identical to two of the six *B. primigenius* from Britain - The product of local interbreeding between a female aurochs and a male domestic bull? (Bollongino et al. 2006) The predominance of the T3 haplogroup in Europe and the variation of the British aurochs suggest that European domesticated cattle were also imported from the Near East, just as the sheep and goats were imported. In addition, the majority of today's cattle mtDNA derives from these neolithic cattle, which were imported from the Near East.

4.3 DNA of Cremations

DNA analyses have been used to determine the sex of an individual. Recently, it has even been possible to identify certain proteins and, through them, diseases such as tuberculosis. Specific concentrations of proteins can also be associated with pregnancies and menopause. DNA analyses could be ideal for determining the sex of highly fragmented materials such as cremations. However, DNA and mtDNA do not always survive in ancient bone and are not preserved in bone that has been exposed to high temperatures, above 450°C (Brown 2001, Grosskopf 2005, 42f). Experiments with pig bones have shown that mtDNA is preserved at temperatures between 100 and 450°C. Cremations frequently reach temperatures above 800 to 1000°C and experimental cremations have shown that DNA is not longer preserved (Cattaneo et al. 1999). Pusch et al. (2000) also examined human cremations for DNA. They were not able to identify human DNA, however, they did identify DNA from four animal species. The presence of animal DNA was used as an argument for the authenticity of the evaluation. The laboratory in which the analysis was carried out had previously only been used to identify primate DNA and could therefore not have been contaminated with the DNA of other species. If it was possible to identify animal DNA in cremated material, then it should also be possible to identify human DNA. However, the authors did not specify at which temperatures the cremated material had been burned. Also, it is possible that the animal burial goods were treated differently and burned at lower temperatures than the human remains. At this point in time, DNA analyses are not possible for cremated materials burned at temperatures above 450°C. This is the case for the vast majority of the cremations in this study.

5 Strontium Isotopes and Migration

Today, we can only trace the migration of artifacts and clues that were left behind. We cannot say for certain whether it was the actual artifacts that spread through migration or trade or whether an idea was passed along, adopted and spread. Measuring strontium isotopes in human bones and teeth makes it possible to examine human migration in the past.

5.1 The Strontium Isotope Method

Rubidium and strontium are found in all types of rocks and soil. Strontium isotopes are expressed as the ratio of ^{87}Sr to ^{86}Sr. ^{87}Sr is the product of the radioactive decay of ^{87}Rb, which has a half-life of $48,8x10^9$ years (Faure and Mensing 2005, 77). The strontium isotope ratios vary in rocks of different ages. For old granitic rocks (> 100 million years old) the ratios are greater than 0,710 and can reach values of 0,740. Younger basalts (< 1 to 10 million years old) have ^{87}Sr/^{86}Sr ratios of 0,703 to 0,704 (Price et al. 2003, 34; - 2004, 13). The ^{87}Sr/^{86}Sr ratio for loess soils, typical for the LBK, in south-western Germany is 0,709 to 0,710; the surrounding highlands, the Black Forest and the Vosges Mountains in France, have significantly higher values ranging from 0,710 to 0,722 (Price et al. 2003, 39; Knipper 2004, 598; Bentley and Knipper 2005). These values are reflected in the surrounding soils and plants. Dietary strontium enters the human food chain through plants and animals that eat them. Because strontium and calcium ions are very similar, the strontium can substitute for calcium in the hydroxyl apatite of the skeletal tissue during formation of bones and teeth. The strontium to calcium ratio decreases along the food chain, an animal that eats plants will have a higher Sr/Ca ratio than a carnivore. This phenomenon has been used to reconstruct the diet of past populations by calculating the amount of plant and animal food in the diet. The strontium isotope ratio of tooth enamel will reflect the geochemical signature of the place of residence during the time when the teeth were formed. Permanent teeth form in the early years of life and the strontium signature in the enamel remains inert throughout life. Sampling tooth dentin is a little more problematic. Although dentin does not remodel like bone, secondary and tertiary dentin form later in life to repair a damaged tooth, and can influence the ^{87}Sr/^{86}Sr ratio if the individual has moved around. On average, bone is remodeled every 10 years (pelvis crista ilica 10 years, vertebrae 12 years, ribs 20-30 years, femur over 30 years (Knipper 2004, 615; Price et al. 2004, 13)), therefore, the strontium isotope ratio of the skeletal material will reflect the geochemical signature of the place of residence during the last years of life. This is ideal for analyzing bone from an individual that moved around a lot. However, archaeological bone is also very susceptible to post burial or diagenetic contaminations. Secondary strontium from the soil and groundwater fills in the pores in the bone and an exchange of minerals between the bone and the surrounding materials can occur. Different pretreatment methods with weak acid solutions were applied to separate diagenetic from biogenic strontium in the bone. Slight differences in the solubility of diagenetic and biogenic strontium have been measured, however, it is not possible to clearly tell the two apart. The same applies to tooth dentin. Studies investigating the degree of contamination show that it is nearly impossible to separate the diagenetic and biogenic strontium in the dentin. Even if it were possible to separate the two, the strontium signature of the dentin would likely return a local value because dentin, like bone, is partially remodeled during life (Budd et al. 2000; Price et al. 2001; - 2002; Bentley et al. 2002; Trickett et al. 2003). Another problem with bone is that, with age, bone is resorbed and the calcium, as well as the strontium, may be reused in other bones, resulting in a distorted $^{87}Sr/^{86}Sr$ ratio. Although there are a number of factors that influence the $^{87}Sr/^{86}Sr$ ratio, if the teeth and bones of an individual show different strontium signatures, then that person spent the last few years of his life in a different place from where the person grew up.

The information about mobility that can be gained from analyzing the $^{87}Sr/^{86}Sr$ ratios in teeth and bones from humans and comparing them to the local strontium values is manifold. Different values within the teeth of one individual, i.e. variation from the M1 to the M3, show that this individual relocated during childhood. Different values between the teeth and bones show that an individual moved, at the very least, to a new location in the later phases of life. Looking at the strontium values within a population may provide information about possible immigrants into the population. Comparing the strontium values between different populations can provide information about possible interactions, such as marriage, between the populations. Maybe an immigrant can be traced back to his or her original home. However, the same sediment type from different locations will have identical strontium signatures. It will not be possible to tell these locations apart. Therefore, it may not be possible to differentiate between two people from different villages if these villages were built on identical sediments. Strontium isotope analysis is not limited to identifying migratory patterns for humans. Analyzing the strontium ratios in animal teeth and bones can also provide information about their migratory and grazing habits. Balasse et al. (2002) and Knipper (2004, 657-669) suggest that animals were sent to graze in pastures located some distance from the villages. Because bovine teeth grow continually, it may be possible to identify this short-term migration between pasture and the village by using strontium as well as oxygen and carbon isotopes.

5.2 Current Investigations and Results

A study by Price et al. (2001) uses strontium analysis to demonstrate migration among the LBK people in south-western Germany (Bentley et al. 2002; Knipper 2004, 652f.; Price and Bentley 2005; Bentley and Knipper 2005). The study included 36 individuals from Schwetzingen (younger LBK), 11 individuals from Flomborn (middle LBK) and 17 individuals from Dillingen (middle to younger LBK).

The study identified non-local isotope ratios in the tooth samples from 26 of the 64 individuals (40% of the total individuals). Nine out of 36 (24%) of the individuals examined from Schwetzingen were identified as having non-local origins. The majority of these “immigrants” were female and the strontium signature of their teeth was higher than that of the local sample. The signatures were not high enough to suggest that these individuals were originally from the surrounding granitic uplands. Instead, basing their interpretation on the optimal foraging theory by Gregg (1989), which estimates that the optimal diet for foragers consists of 80% wild game and 20% wild plants, Bentley et al. (2002, 802) calculated that the strontium values from the tooth enamel can be attributed to a forager-like diet. It seems possible that some indigenous Mesolithic foragers, who coexisted with the LBK for some time, lived together with the newly arrived neolithic farmers (Price et al. 2003, 50; - 2001; Bentley et al. 2002). The evidence, though not conclusive, supports the interpretation of some indigenous adaptation of the LBK in Central Europe.

Another study, also by Price et al. (2003) looks at the migratory behavior of the LBK individuals from the 'Viesenhäuser Hof' near Stuttgart Mühlhausen (Kurz 1991; - 1992; - 1993; - in prep.). The cemetery is separated into a section from the younger LBK (I), excavated until 1982, and a section from the older LBK (II), excavated from 1991 to 1993. Tooth enamel from the first molar, from 28 individuals from section I and 25 individuals from section II was analyzed. Samples from the bones of five individuals from section II were used to ascertain the local strontium signature. Thirteen females and 15 males were analyzed from section I, 12 females and 13 males from section II. All were adult. The average $^{87}Sr/^{86}Sr$ ratio for the individuals from section II was 0,709415 (0,7091 to 0,7116). This average value falls within the range for loess soils. Eight individuals, four females and four males, have values greater than two standard deviations from the average (0,7103 to 0,7116) and are interpreted as immigrants. The high values suggest that these individuals grew up in the highlands of the mountains but not in the nearby Swabian Alb. Also, the variability of the values suggests that they came from different locations. The remaining individuals with strontium values below 0,710 are either local or came from regions with a similar strontium ratio. The variability within the 'local' population can be explained by the individuals' diet, which seems to have been highly variable in the older LBK. The results for the individuals from section I, the younger LBK, were less variable with $^{87}Sr/^{86}Sr$ ratios of 0,7087 to 0,7098. All but two individuals fall within the range of variation and are defined as 'locals'. The majority of the individuals grouped around the value of 0,7094 and suggest that the diet was different and less variable than in the earlier phase. A preliminary analysis of the animal bones from 'Viesenhäuser Hof' shows that the use of wild animals in the LBK diet changes significantly from the older to the younger period. In the earlier LBK, 68% of the animal bones came from wild animals, in the later LBK this was reduced to 15% (Stephan pers. comm. in Price et al. 2003, 48f, Bentley et al. 2004; Bentley and Knipper 2005). Instead, local cattle bones predominate. Wild animals will roam farther and their teeth produce a different $^{87}Sr/^{86}Sr$ ratio than local animals, a change which would be reflected in the teeth of the animal and thereby also in the teeth of the people who ate them. However, since the strontium concentration is significantly higher in plants than in animals, the difference between the contribution of wild and domestic animals to the strontium in human teeth may not be significant enough to show up in the isotopic record. The strontium analysis from Stuttgart Mühlhausen 'Viesenhäuser Hof' suggests that there was significantly more mobility and variability in the diet in the older phase of the LBK than in the younger phase. The values show that there were only very few immigrants in the later phases. It was a closed society with a smaller and more homogeneous dietary spectrum. Price et al. (2003) suggest that the mobility in the older phase could be a result of the continuous spread of the LBK way of life in the early stages. The study by Price et al. (2001) and Bentley et al. (2002) also looked at 11 individuals, 7 females and four males, from the middle LBK cemetery of Flomborn. Seven migrants (64%) were identified among these 11 individuals. It is likely that these immigrants came from further east as the LBK continued to spread further west in the later phases.

Reflecting on these three examples, the strontium isotope method seems ideal for identifying migratory patterns in the LBK. These seem to have changed throughout the LBK. In the earlier phases, the LBK population was very mobile, either moving from one settlement to another or setting out to populate new areas. The people of the LBK settled on loess soils throughout Central Europe. These soils all have similar strontium ratio values and it is nearly impossible to recognize whether an individual moved from one settlement to another if both were situated on loess sediments. Therefore, the non-local values show that an individual probably did not come from a typical LBK settlement but from the highlands. Since no LBK settlements are known from the highlands, only from the loess sediments, it is likely that these individuals were of a 'local' or indigenous population, not from the LBK. However, strontium samples from Mesolithic sites do not place these people into the highland areas (Knipper pers. comm.). Therefore, it is still completely open as to who these people were. In the later phases, mobility decreased. The strontium values remain within the range of 'local' variation, signaling that, at most, there may have been mobility between the LBK settlements but rarely between the LBK and 'foreigners'. The immigrants that can be recognized are predominantly female. The strontium signatures show that these individuals originated from the highlands and mountains and could suggest that there was interaction and, possibly, intermarriage between the indigenous people and the 'local' LBK settlers.

5.3 Strontium Isotope Analysis and Cremations

If the strontium isotope method could also be applied to cremated teeth, the results could shed some light on the origin of the cremated individuals. Had the cremated individuals migrated into the community? Where did they come from? During cremation, the tooth enamel is cracked; the enamel layer is separated from the tooth and shatters into tiny pieces. At temperatures above 600 to 700°C these pieces are commonly not preserved. Frequently, only dentin can be recovered from cremations. Can cremated teeth provide reliable strontium values for investigating mobility in the LBK?

Due to the limited amount of research this question is hard to answer at the moment. Not only the possible formation of secondary and tertiary dentin during life, but also potential contamination of the porous material during burial may result in a different strontium isotope ratio than that of the strontium which was originally deposited during tooth formation. Being aware of these difficulties but facing the lack of other reference material, dentin of supposedly non-migrant cremations was used to estimate the local strontium isotope ratios in a study on Iron Age burials from Northern Germany (Knipper pers. comm.).

Cremations were the rule from the late Bronze Age and into the Roman Empire in Northern Germany, for example, in the Nienburg Culture (ca. 550 B.C.) from the early Iron Age (BÉRENGER 2001). The dead were cremated and the remains were deposited in an urn, which may have been covered with a smaller bowl. To obtain a local strontium signature, samples were taken from the teeth of cremations from the nearby and contemporaneous cemetery of Windheim-Döhren in North-Rhine Westphalia, which is situated on well comparable geological substrate and represents the common burial practices. Knipper and Taubald (Tübingen) performed the analysis (KNIPPER pers. comm.). They sampled five teeth from cremations. The strontium values for three of the five women from Iron Age site Ilse were significantly higher than the local signature, as defined through the cremated teeth. The significant result for this thesis however, is the result of the strontium analysis for the cremated teeth. The preservation of bone was very poor in the sandy soil. Animal bones, which are usually used to determine a local signature, were not preserved. Knipper and Taubald decided to attempt to determine the local signature from the cremated teeth. The enamel is usually not preserved, leaving the dentin, which is very susceptible to contamination through the soil and groundwater. Because the teeth are likely to be contaminated with strontium from the local soil and groundwater, it can be expected that the teeth would deliver a strontium signature that is very close to the local signature. Using contaminated material to determine a reference signal is questionable, however the goal of the investigation was not to determine the origin of the cremated individuals (believed to be local residents) but to confirm that the unburned women were foreigners. KNIPPER (pers. comm.) expected the strontium values for the cremated teeth to be very close together and to resemble the local signature in the ground. However, there was a significant difference in the minimum and maximum strontium values, 0.0013. A difference in the third position after the decimal point already suggests a different place of origin. KNIPPER (pers. comm.) stipulates that the variation among the cremated teeth cannot only be attributed to differences in contamination, but that it is possible that biogenic strontium actually survived in the cremated teeth. Experimental studies on animal teeth show that the physical as well as the chemical structure of teeth changes during the cremation process. The crystalline structure breaks up and reforms (see section D.1). KNIPPER (pers. comm.) hypothesized, that the restructuring of the crystals may help preserve some biogenic strontium in the dentin cavities of the teeth. To find out how the dentin cavities are affected, KNIPPER (pers. comm.) is looking at the structure of the cremated teeth under an electron microscope. The current project is still running and will show whether the values recovered from the Iron Age cremation truly represent biogenic strontium ratios or if the variation in values can be attributed to some form of contamination. Biogenic strontium ratios from cremated teeth would be a tremendous advancement for identifying the origins of the cremated individuals in the LBK cemeteries.

6 Archaeological Record

The transition from the Palaeolithic to the Neolithic is characterized by the Younger Dryas cold period, the end of which dates to about 9,600 B.C.. This period is followed by a warmer and wetter post glacial climate known as the 'Atlantikum' (Altithermum). Conditions in Europe were similar to those in present-day south-eastern Europe, the temperatures were about two degrees Celsius higher than today. The vegetation consisted of mixed oak forests with oak, linden and elm trees and hazelnut bushes on the rich loess soils inhabited by the LBK settlers, oak and pine forest in the drier soils and poplar, elm and oak forests in the floodplains (Behre 2002). The LBK preferred to set up their communities on the fertile loess soils in the valleys along the smaller branches of the rivers (Sielmann 1972). The rich loess soils offered a nutrient rich environment for the crops grown by the LBK farmers: einkorn wheat (*Triticum monococcum L.*), emmer (*Triticum dicoccum*), barley (*Hordeum* sp.), peas (*Pisum* sp.), flax (*Linum* sp.) and poppy seeds (*Papaver* sp.) probably imported from the Cardial culture of the Mediterranean. Wild plants also complemented the LBK diet (Gregg 1989; Bogucki 2000; Behre 2002).

Figure 9: Einkorn, emmer, pea, lentil and flax seeds (Kreuz 2006, 27).

The LBK herders kept cattle (*Bos taurus*), sheep (*Capra hircus*), goats (*Ovis aries*) and pigs (*Sus scrofa domesticus*) (Keeley 1992). There is evidence that cattle and pigs were imported as well as domesticated from the local aurochs and wild boars. Sheep and goat were first domesticated in the Near East and must have been brought to Central Europe. The animals were a source of food in the form of meat and dairy products as well as a source of other raw materials such as hides and wool for clothing and antlers and bones for making tools. 90% of the animal bones recovered from LBK sites stem from domesticated animals. The remaining 10% come from local wild animals such as deer (*Cervus* sp.), elk (*Alces alces*), chamois (*Rupicapra rupicapra*), alpine ibex (*Capra ibex*), wild boar (*Sus scrofa ferus*) and aurochs (*Bos primigenius*) (Benecke 2002; Bogucki 2000) (see also section B.4).

6.1 Ceramics and Stone Tool Traditions

The archaeological record for the LBK is very good due to the volume of excavated sites and material. The earliest pottery of the LBK is almost invariable in the ceramic style and decorating techniques. In the later phases, regional differentiation of style and design increases as local adaptations influence the techniques in each region. The oldest phase of LBK pottery shows a strong resemblance to the ceramic styles of the Starčevo Körös cultures and was probably developed out of a combination of the ceramics from the two cultures (LICHARDUS 1972). The *Kumpf*, a ¾-spherical bowl with a flat bottom ranging in size from miniature bowls to vessels with 60 cm in diameter, represents the most common form of LBK ceramics (BOGUCKI 2000). Other frequently recovered ceramic forms include shallow bowls, conical pots and bottles. The chronology within the LBK is constructed using the variations in ceramic style and decoration (QUITTA 1960). LICHARDUS (1972) divided the LBK into four ceramic periods, each split up into a number of additional developmental phases: the oldest, the middle, the youngest and the latest LBK. The oldest LBK was thus decorated with bands in the form of spirals or simple meanders, these developed into sharp hook forms, followed by the music note motif and ending with the forms of the Stroke Ornamented Potter culture (SBK), bands made up of regular dots rather than drawn lines (BUTTLER 1938; QUITTA 1960; BOGUCKI 2000).

Figure 10: LBK Kumpf, decorated with bands (GRONENBORN 2006, 22).

The LBK were selective about the quality of raw materials used to make their stone tools. Stones were imported from sites up to 200 km (GRONENBORN 1994) away in order to construct the most well known artifact of the LBK, the *Schuhleistenkeil* (shoe-last adze) as well as other stone tools. Radiolarit was imported from the Carpathian Mountains in the Czech Republic and Slovenia to the Bakony Mountains in Hungary, over 300 km away. Chert from Wittlingen on the Swiss border was discovered in Esslingen on the Swabian Alb, a distance of 175 km. Maas flint from the Limburg area was 'only' transported a distance of 50 km to the area around Aachen (GRONENBORN 1994, 138). Material for flint tools was chosen to have the best quality available by the people at a given site. Local raw materials of good quality were used at sites that were too far away from high quality flint mines. This is an indication for the interaction of LBK groups throughout the settled area. (GRONENBORN 1994; BOGUCKI 2000).

Figure 11: Typical LBK shoe-last adze (Schuhleistenkeil) (GRONENBORN 2006, 20).

The shoe-last adze, a ground and polished tool, is perhaps the best known tool of the LBK assemblage. It varied in size from 3 to 40 cm in length. One side is flat while the upper side is arched. In the middle it has a rectangular cross section. One end of the shoe-last adze falls off abruptly while the edge, which is dull, is rounded off at the tip and arches upwards. The opposite end was sharpened by grinding it. The adze was probably shafted with a knee-shaft ('*Knieschäftung*'). It was most probably used to scrape and plane wood. The flat ax is very similar to the shoe-last adze, only flatter (Buttler 1938; Pittioni 1949). Other tools include the adze, used in farming and clearing forests, a wedge-like tool used when felling trees and the ax, a perforated stone disk. Grinding and polishing stones of the same high quality raw materials were also found (Pittioni 1949; Bogucki 2000). Aside from their definition as woodworking tools, evidence from various cemeteries implies that the shoe-last adze, adze and ax were male status symbols and were also used as weapons (Richter 1969; Pavúk 1972).

Figure 12: Shoe-last adze shafted with a knee-shaft (source Blumammu -Gute Alte Steinzeit http://www.feuer-steinzeit.de/programm/faellen.php)

The flint assemblage consists of flakes and blades. The assemblage of the LBK is centered on blade based technology and consists of tools for cutting, scraping and drilling. The blades were also worked into arrowheads. The use of arrowheads as hunting weapons has been put into question due to the low frequency of remains from wild game in the LBK assemblages. In the cemetery from Schwetzingen, arrowheads had been found in the graves. Arrowheads like these have also been identified in conjunction with the massacres of Talheim and Asparn (Wahl and König 1987; Windl 1999) as well as certain Mesolithic assemblages, and have been interpreted as weapons of war by Keeley (1997).

6.2 Longhouses

Another characteristic element of the LBK was the longhouse. The settlements were usually built on loess rich soils, on slight slopes close to running water such as larger rivers. These houses were built out of local wood and walls consisting of clay and plant fibers. They were large rectangular structures which could measure up to 40 meters in length and 6 to 8 meters in width (Modderman 1972; Kind 1998).

Figure 13: Reconstruction of an LBK longhouse. (*Source: http://www.landschaftsmuseum.de/Bilder/Kronach/Haus-2.jpg*)

The longhouses formed one unit together with the rubbish pits. The typical longhouse was constructed using five rows of posts creating a tripartite house. The roof was a construction of straw and reeds which lay on top of the poles. The trenches along the long side of the houses were created as the clay was dug up to fortify the walls. The pits later served as rubbish pits (GREGG 1989). The function of each of the sections in a typical tripartite longhouse has been a matter of much discussion (MODDERMAN 1972). It is now commonly believed that the northern element made up the living area for one family. The middle section is generally interpreted as a work area and the southern element as a storage area. The middle and southern sections have also been interpreted as stalls for animals (GREGG 1989). It is estimated that such a house had a lifespan of about 30 years (MODDERMAN 1972).

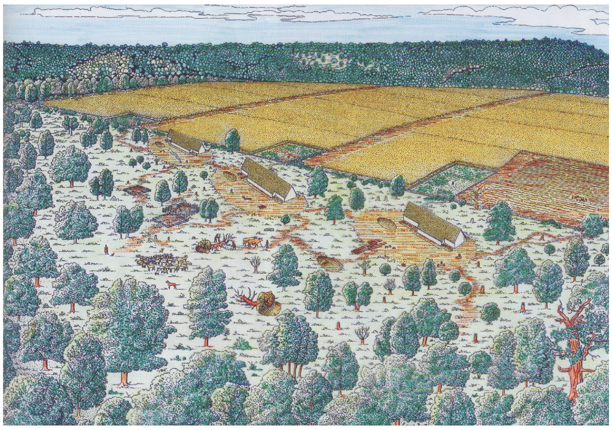


Figure 14: Illustration of an LBK settlement from 5500 B.C.. The 3 houses, large fields and 200m² house garden represents the early LBK settlement from Schwanfeld (LÜNING 2006, 29).

Two theories compete to explain the appearance of multiple interlocking house outlines at LBK sites. The first assumes a continuous settlement at one site. When a house had to be abandoned a new house was built in the near vicinity. A third house could then be constructed on or near the site of the first house, leaving behind the impression that multiple houses existed here at the same time. According to this theory, it would be possible to determine the length of occupation at a site. The settlement at Ulm-Eggingen has been determined to have existed for 200 to 250 years, calculated from the total of 8 overlapping house-phases found at the site, each with an estimated lifespan of 30 years (STRIEN 1990). The second explanation suggests a non-continuous occupation of the sites. According to this theory the settlements were mobile and entire villages would move to a new location when the longhouses were no longer inhabitable. Generations later the villagers moved back to the original location where they built new longhouses on top of the old ones. Another version of this theory suggests an accidental overlapping of villages, either by the original population or by another roaming village.

6.3 Earthworks, Trenches and Wells

Earthworks and trench systems have been identified throughout the LBK. These earthwork systems were usually circular in shape and consisted of a combination of trenches, ramparts and wooden palisades. Some surrounded a settlement, others were empty and are interpreted either as pens in which animals were kept or may have had ritual character (PETRASCH 2002). Few were as large and deep as the trenches at Asparn an der Zaya and can be considered defensive. Trench systems appear more frequently in the younger periods (WINDL 1999) and are viewed as evidence for increased violence between the neolithic populations toward the end of the LBK (Orschiedt et al. 2003). More and more have been discovered in the past 15 years due to aerial photography and scans with the magnetometer. Alone in Bavaria, over 3,000 earthworks dating throughout the Neolithic have been discovered (Lüning 2002).

In 1990, the first LBK well was found in Erkelenz-Kückhoven in the Rhineland. Seven meters of the originally 13 m deep wooden well shaft were recovered (Figure 15). It was constructed out of oak planks and provided the first dendrochronological date for the LBK, 5,090 B.C.. About 30 years later, a portion of the well shaft was destroyed and repaired with new planks, which were dated between 5,062 and 5,052 B.C.. In the sedimentation layers inside the well, organic artifacts such as leather bags, shovels and hoes, a wooden bow and vessels, laces and ropes made out of linen bast fibers and a number of plant fibers and seeds could be recovered, a sensational discovery (Lüning 2002). Before this discovery, organic materials were rarely recovered in the LBK, because they did not survive in the dry loess soils. In the following years, a number of other wells, such as the two smaller ones from the early neolithic site Eythra near Leipzig, were discovered and recovered throughout the LBK and later neolithic communities. Another such well was discovered and reconstructed in Asparn in Austria. The eight meter deep well, like the one from Erkelenz-Kückhoven, was identified within the boundaries of the settlement. Both were found in settlements that were located near local water sources, the Weiße Elster River and the Zaya River, respectively. This suggests that the quality of water was important to the people of the LBK. Wells provided a higher quality of water and also served as a source of water if the settlement was besieged and the people could no longer reach the nearby springs or rivers (Windl 1999; Lüning 2002; Staeuble 2002).

Figure 15: Eight meter deep well from Erkelenz-Kückhoven (North-Rhine Westfalia), dated to 5090 B.C. (Staeuble 2002, Fig. 1).

C. Burial Practices of the LBK

The LBK is known as the first culture with large cemeteries and more or less regular burial practices. Fifty-seven cemeteries are known throughout Central Europe. Body burials and cremations predominate the burial record. Other burial practice included burying the deceased within the settlement, i.e. burying newborn children within the longhouse or disposing of the bodies in the settlement pits. The practice of burying the dead within the settlement was intensively researched by VEIT (1996) and NIESZERY (1995) in their respective theses. Table 4 lists the different types of mortuary practices identified by NIESZERY (1995) in the early Neolithic. The table does not include the column for burial forms that are not preserved in the archaeological record such as corpses that were laid out, possibly on high rises, and left to decay, corpses buried in water or cremations that were scattered instead of buried. According to NIESZERY (1995, 43ff.) only 20% of the population of the LBK is represented in the cemeteries. It is possible that the 80% missing individuals from the LBK can be explained by the category of burial forms that were not preserved in the archaeological record. Another theory is that cremations actually make up the primary burial form in the LBK, however, they were not preserved. This theory suggests that the body burials are the special burial form and not, as suggested at the beginning of this thesis, the cremations.

Circa 2,440 burials from 57 cemeteries and 460 burials from 177 settlements have been identified for the LBK, these figures average to only 17 burials per settlement with settlement burials. In addition, 2 mass graves with a total of 134 individuals and a collection of 447 skulls from Herxheim were identified. These increase the number of known LBK burials and skeletal deposits to 3,481 (WAHL and KÖNIG 1987; PESCHEL 1992; NIESZERY 1995; VEIT 1996; WINDL 1996; - 1999; ORSCHIEDT et al. 2003). It is very probable that a large number of the "missing" individuals were cremated and these cremations were destroyed throughout the course of time (LÜNING 1988; HOFFMANN 1978). In the LBK, cremations were not commonly placed into ceramic vessels, which would have helped preserve them similarly to cremations recovered from cultures. The burial pits were usually very shallow and still within the humus layers. Many were destroyed by erosion or modern agricultural activities. In some cases, the cremation were not recognized or not recovered during excavation of the cemetery and destroyed when the top layer was removed for easier access to the body burials (HOFFMANN 1978; DOHRN-IHMIG 1983). However, the same arguments apply to body burials. Excavations at the Bavarian cemetery Stephansposching lend weight to the theory that cremations may have been the primary burial form in the LBK. SCHMOTZ manually excavated the top layer and found that the vast majority (75% n=31) of the burials from this site were cremations (SCHMOTZ 1985; - 1992).

The body burials from the LBK were buried in oval to rectangular graves, 1.40 to 1.45 m long and 0.60 m wide. They were buried between 0.60 and 1 m below the present day surface. The most characteristic trait for LBK burials was the placement of the deceased in a crouched position, predominantly lying on the left side. The body was slightly bent forward with the arms flexed and the hands underneath the chin or head. The legs were flexed, ranging from a relaxed, nearly extended position to a very tight and unnatural contracted position (Pavúk 1972, Nieszery 1995, Kurz in prep.). The position has been interpreted as a fetal position resembling the position of a sleeping baby. Another interpretation was that the individuals were tied up to prevent them from rising from the grave. Today, the general interpretation is that the position resembles the typical position of a sleeping individual. Death was the long sleep from which an individual never woke up again. Other positions of the body are also known: The crouched position on the right was more frequent than than the crouched burial lying on its back. Whether the position on the back was intentional or the result of the body settling in the grave cannot be reconstructed. Stretched burials either on the stomach or on the back have also been recorded.

Cemetery	**Settlement**	**Cave/Ritual place**	**Mass grave**
- body burials	- body burial in pit	- desecrated corpses	- burial of crime or murder victims
- cremations	- skeleton in a settlement pit	- human sacrifices	
- empty graves/pits	- skeleton in a house	- ritual cannibalism	
- double burials	- skeleton in a trench		
- bi-ritual double burials	- multiple or collective burials		
- partial burials	- partial burials		
- delayed burials	- bone or cranial deposits		
- secondary burials	- secondary or delayed burials		
- cremations with body burials	- cremations - partial cremations		

Table 4: Mortuary practices in the LBK (*redrawn after* Nieszery 1995, 20 Fig. 5).

In following, this chapter gives a brief overview of all the burials and cremations in LBK cemeteries, LBK settlements and the two mass graves, Talheim and Asparn-Schletz.

1 LBK Cemeteries and Burials

The majority of LBK cemeteries date to the middle to younger LBK. None are known from the earliest LBK. The cemeteries were in use for a period up to 100 and a maximum of 400 years and included between 5 and over 300 body burials and cremations. It is not yet clear whether each settlement included its own cemetery (i.e. Stuttgart-Mühlhausen, Rixheim, Butzbach, Sondershausen, Bruchstedt, Mlynarce, Nitra etc.) or whether one cemetery was cumulatively used by a number of regional settlements (i.e. Elsloo, Niedermerz, Herxheim). Cemeteries were found in the immediate vicinity of settlements, set apart from the settlement by 100 to 500 m, or not associated with a settlement at all. It is possible that corresponding settlements have not been found yet or were previously completely destroyed through erosion or modern farming or construction. At the same time, there are a large number of settlements that cannot be associated with a nearby cemetery (see section C.2). Map 1 in the appendix shows the location of the cemeteries. The numbers correspond to the numbers in List 1 on page 218 in the appendix. For easier identification, the cremation-bearing cemeteries from this study are color coded: Elsloo is green, Schwetzingen, red, Fellbach-Oeffingen, blue, Aiterhofen-Ödmühle, pink, Stephansposching, orange, Wandersleben, yellow and Arnstadt, turquoise.

1.1 The Netherlands

*Elsloo**[3]

Literature: MODDERMAN 1970, 45ff; HOFFMANN 1973, 71ff; VAN DE VELDE 1979a; - 1979b, 84ff

The cemetery dates to the **younger LBK** and contained a total of 113 graves, 66 unburned body burials and 47 cremations (Map 2 and 3). It was discovered circa 50 meters north-northwest of the settlement of Elsloo. The ten hectare settlement in the province Limburg was excavated from 1958 to 1966 by the R.O.B. (Rijksdienst voor het Oudheidkundig Bodemonderzoek, the Dutch National Service for Archaeological Heritage) and the Institute for Prehistory of the University of Leiden. The cemetery was discovered and excavated in 1959 and 1966. One third of the area was excavated and the outlines of 95 buildings were uncovered. Twenty-four could be dated to the early LBK and 51 to the later LBK, the remaining 20 could not be positively dated to either period.

The cemetery dates to phases 2c and 2d of the Dutch LBK, the younger LBK. It can be roughly divided into an eastern and western portion. The tool and ceramic grave goods date the eastern portion of the cemetery to the later half of the younger LBK. It contained fewer cremations, the graves were dug deeper and contained traces of hematite powder. The majority of the cremations was located in the western portion of the cemetery which dates to the early half of the younger LBK. The graves for the unburned individuals were less deep and did not contain hematite powder.

The skeletons from the body burials did not survive in the burial record and were therefore not available for study (VAN DE VELDE 1979b, 84). The following information comes from the excavation notes and relies on the shadows preserved in the soil of the graves. Nothing is known about the age or sex of the body burials although some smaller grave pits might suggest younger individuals. Eighteen of the body graves did not contain skeletal remains but were identified, based on size and shape of the pit, due to the body shadow. The body burials primarily were buried in the common LBK tradition, in the crouched position, lying on their left side. Only one individual was lying stretched on his back. In eight graves,

3 The asterix, “ * ”, marks cemeteries that also include cremations.

the head was lying in the NW and the body oriented towards SE, in 13 graves SE to NW. Three had their head in the NE and their body oriented SW. Different decorated ceramic types in the graves established a slight chronology within the cemetery. Twenty-one body burials were accompanied by an adze, arrowheads were recovered from 14 graves, blades and reductions were found in 12 graves. Stones on which hematite was ground were recovered from ten graves.

Calcinated bones were also recovered from some of the western graves, those body graves closest to the accumulation of cremation bearing graves. This suggests that some mixing may have occurred. The cremations were buried to a maximum depth of 40 cm from the current surface. Twenty cremations included burial goods such as ceramic sherds, 12 contained adzes and a few also contained traces of hematite. Only one included a bone point.

1.2 Belgium

*Hollogne-aux-Pierres**

Literature: Thisse-Derouette and Thisse 1952; Tomballe and Thisse-Derouette 1956, 391ff; Veit 1996, 87

Twenty-three so called “depots” from the **younger LBK** were recovered. The depots included shoe-last adzes but no ceramics. One of the deposits, number 24, was identified as a cremation. The material was very fragmentary, yet three cranial fragments and one fragment from the pelvis, scapula, right clavicle, tibia and radius were recovered. It is interesting that only fragments from the right side of the body were recovered. Since a large amount of burned wood was also found in the grave, Thisse-Derouette and Thisse (1952) suggest that the individual was burned in situ. A significant amount of burned wood but no burned bones was also recovered from depot number 23.

1.3 France

Champcueil (Île de France)

Literature: Veit 1996, 89

A dozen destroyed graves were reported.

Charmoy (Bourgogne)

Literature: Veit 1996, 88

The cemetery of the **late LBK** was made up of seven graves, one unsure. It was separated from the nearby settlement by a 25 m long fence.

Chichery (Bourgogne)

Literature: Veit 1996, 88

The cemetery stems from the **younger LBK** and contained seven body burials.

Dormans (Champagne-Ardenne)

Literature: Veit 1996, 89

The cemetery consists of one large pit with one or more skeletons and burial goods. It was dated to the **younger LBK**.

Ensisheim (Haut-Rhin)

Literature: Peschel 1992, 120ff

A small group of four graves, plus two burials from a nearby settlement, recovered in 1977, date to the **younger LBK**. Three of the graves contained burials of children. They were oriented east to west and southeast to northwest and were crouched on their left side. Two of the children's burials included ceramic burial goods and an animal bone. The fourth grave belonged to an adult individual buried in the crouched position. The burial was oriented northeast to southwest.

In 1984, the traces of an **early LBK** settlement and 21 graves were discovered 500 m south of this grouping. The burials are striking due to the amount of jewelry made out of mollusk and snail shells. The graves were simple pits arranged in rows. Red pigment was found in all of the burials. Nineteen of the burials were oriented northeast to southwest, one west to east and one east to west. Again, 19 burials were crouched, lying on their left side. One individual was crouched on the right side and one was lying on the back with the legs crouched towards the left. Half of the burials also included burial goods such as adzes, jewelry, stone scrapers, arrowheads, bone awls and grinding stones. There were no ceramic burial goods. One burial of a three to four year old child also contained a figurine, an idol, made out of the metacarpal of a sheep or goat. There is no anthropological information about the burials. The presence of typical male burial goods such as the adze and arrowheads suggest that there are at least five males among the buried.

Entzheim (Haut-Rhin)

Literature: Weigt 1909-1912, 5ff; Schaefer 1931-1934, 3ff; Peschel 1992, 120; Veit 1996, 87

The group of nine graves was located within a settlement and was excavated in 1908. Most of the original graves were destroyed, the eight intact graves were found during later excavations. The individuals were buried in the crouched position, primarily lying on the left, or on their back. They were oriented from northwest to southeast as well as in the reverse direction. Burial goods included a grinding stone with the remains of red pigments, stone tools and ceramic sherds.

Hoenheim-Souffelweyersheim (Bas-Rhin)

Literature: FORRER and JÄNGER 1918-1921, 875ff; ULRICH 1939-1946, 9ff; - 1952, 41f; PESCHEL 1992, 125ff

Fifty-two graves were recovered over a period of 30 years. The cemetery was located about 250 m from the nearby settlement. The graves seemed to be arranged into four groups. The majority of the identifiable burials were crouched with their legs on the left and a significant number were found lying stretched on their backs, a tradition more common in the younger LBK. Fourteen burials were oriented southeast to northwest, nine east to west, five northwest to southeast and five west to east, two northeast to southwest and one each from southwest to northeast and from south to north. For the remaining graves, the orientation could not be reconstructed. The anthropological analysis identified 15 male individuals, 5 females and 5 children. Four of the identified females were found in the northern half of the cemetery. Half the burials included burial goods such as ceramics, stone tools, arrowheads, jewelry, colored minerals, bone awls and grinding stones. The ceramics date the cemetery to the **younger LBK**. Six unidentified burials included shoe-last adzes and can probably also be considered male increasing the total number of male burials to 21.

Lazicourt (Champagne-Ardenne)

Literature: VEIT 1996, 88

Five graves with six individuals were found grouped northwest of an LBK longhouse.

Lingolsheim (Elsaß)

Literature: SCHAEFER 1931-1934, 3ff; FORRER 1935-1938, 191ff; VEIT 1996, 87

A small cemetery with eight graves from the **younger LBK** was found adjacent to a cemetery belonging to the Roessen culture. A settlement from the same time period was located nearby.

Maizy (Picardie)

Literature: VEIT 1996, 89

Three isolated graves were found alongside early neolithic pits and Bronze Age burials. They were dated to the LBK. Two adults were given ceramic burial goods, the third burial was destroyed.

Marainville-sur Madon

Literature: Nieszery 1995

Six burials were recovered from this site. Further information about the site has not been published to date.

Menneville (Picardie)

Literature: Veit 1996, 89

The cemetery was located directly outside the LBK settlement and consisted of seven graves (four adults, three children). The burial of one female was probably disturbed after interment.

Quatzheim (Bas-Rhin)

Literature: Stieber 1947-1950; Peschel 1992, 139ff

The small group of graves was discovered in 1938 among the remains of an LBK settlement. Originally, nine graves were recovered. In 1948, 4 additional graves were discovered, making it a total of 13. Eight burials were oriented northwest to southeast, one southwest to northeast, three graves were destroyed so that there is no more information available about them. The eight remaining burials were stretched out on their back. One *juvenile* individual was on the back with legs crouched to the left. All burials contained a rich amount of burial goods including ceramics, shoe-last adzes, a stone ax, grinding stones, arrowheads, stone tools, jewelry made out of snail shells or ocher, colored minerals and bones. The ceramics date the cemetery to the **younger LBK**. Based on the burial goods, it is possible that the eight individuals with shoe-last adzes and stone tools were male. Two of the individuals were *juvenile*.

Rixheim (Haut-Rhin)

Literature: Peschel 1992, 143ff

The cemetery was excavated from 1964 to 1972. A settlement was located 400 m to the north. A total of 44 graves were identified but because 20 were destroyed, only 27 individuals (10 ♀, 7 ♂, 6 children, 4 undet.), 1 double burial, were available for study. The graves were dug in sand and the individuals were covered with it. Sherds of ceramics mixed in with the filling suggest that the vessels were intentionally broken and then scattered into the grave fill. Small, dark discolorations in the soil around the individuals are evidence for possible post holes for a burial hut in five graves. Eight other graves may also have had such post holes. Half the burials were found with their legs crouched toward the left, however, the majority of those were lying on their back, not their side. The same is true for the six individuals whose legs were crouched towards the right. Fourteen burials were oriented northeast to southwest, three north to south and one east to west and southeast to northeast. Two-thirds of the burials included burial goods such as ceramics, stone tools, arrowheads and jewelry. The burials were richer in the northern half of the cemetery, the individuals included multiple types of burial goods.

Vinneuf (Bourgogne)

Literature: Carre 1967, 439-458; Veit 1996, 89

The remains of an LBK settlement and two groupings of graves, all destroyed, were identified. The cemetery with 16 graves, 11 containing skeletal remains, was located 500 m further away.

Wettolsheim (Haut-Rhin)

Literature: Peschel 1992, 120

The site was excavated in 1938/1939 and seven graves were recovered. It is possible that more graves would have been recovered, but further excavations were not possible due to the start of the war. Three males and two females were identified. The burial goods included ceramics, stone tools and spondylus jewelry. Interestingly, it was the burial of a female, Grave 1, that had the richest burial goods including a necklace made of spondylus shells, stone tools and ceramic vessels.

1.4 Germany

*Aiterhofen-Ödmühle (Bavaria)**

Literature: Lantermann 1980; Osterhaus 1980, 58f; Baum 1990; Peschel 1992, 65ff; Nieszery 1995; Carli-Thiele 1996

The cemetery was discovered in 1975 and excavated until 1980. Eight burials were recovered during the rescue excavation in a clay pit in the administrative district of Regensburg. The following campaigns brought to light a cemetery 110 by 100 m large and a total of 160 skeletons and 68 cremations. The decoration on the ceramics (phase II-IV according to Meier-Arendt 1966) dates the cemetery to the **middle** to **younger LBK**. The LBK settlement of Aiterhofen was located 300 m to the south. The cremations were located in the central and northwestern portion of the cemetery. Calcinated bone was found in eight graves of body burials and cremation was probably practiced throughout the use of the cemetery. The unburned individuals were buried according to the typical LBK fashion, predominantly in the crouched position, lying on the left side with the head in the east. The preservation of the bones was not good and the bones were very heavily fragmented. Only 42 of the skulls could be used to take measurements for age and sex determination. The 160 body burials were recovered from 153 graves, 20 did not contain enough material to be analyzed. There were 40 females and 36 males among the remaining 140 skeletons. The age distribution shows 22 children, 8 juveniles and 110 adults. The burials were rich and included burial goods such as adzes, axes, arrowheads and jewelry made from imported snail shells for the men and jewelry made from local snail shells for women. Both sexes were also buried with a “make-up set”, a stone tablet with red chalk and flint nodules and a small bone spatula (PESCHEL 1992, 67). Other burial goods include ceramic sherds, stone tools, traces of food and combs made out of bone. The numerous richly furnished burials, both for male and female individuals, are a contrast to the numerous burials that were not given any, or very few burial goods. They seem to be a clear indication for different social status within the community. Whether or to what extent the cremations were given burial goods is not known. Regrettably, it is not possible to present any significant information about the cremations because they could not be located for study. Lantermann, from the University of Frankfurt, examined the body burials from Aiterhofen in her Master's thesis, published in 1980 (LANTERMANN 1980; BAUM 1990, 158). NIESZERY (1995, 91) has published data on the cremations, which he received in a letter in 1990. According to this letter, the graves of the 69 cremations contained the remains of 79 individuals (15 adult ♀, 15 adult ♂, 22 unidentified adults and 27 sub-adults).

*Arnstadt (Thuringia)**

Literature: NEUMANN and WIEGAND 1940, 9ff; KAHLKE 1954, 90ff; HOFFMANN 1973, 71ff

Emergency excavations at the gravel pit Geßler brought to light 25 graves from the LBK, the Stroke Ornamented Ceramic culture and early Bronze Age culture. The majority of the graves was destroyed and could only be identified due to the ceramic burial goods. Six body burials and six cremations from the LBK were identified. The cremations were recovered either inside or underneath overturned ceramic bowls. The classic LBK vessel, the *Kumpf* was also recovered in the burials. The finds were stored at the Institute for Pre- and Protohistory at the University of Jena and in the archives of the museum in Arnstadt. For this investigation, three body burials and three cremations were identified. The remaining graves only contained bones and antlers from animals.

Bischleben (Thuringia)

Literature: KAHLKE 1954, 88; - 1955, 52ff; PESCHEL 1992, 98f

In 1926, an LBK settlement and six graves (including one child and two adult ♀, three undet.) were recovered from a loam pit. Five other graves were destroyed prior to the excavation. The burials were crouched, predominantly on their left side and oriented east to west and west to east. The burial goods include ceramics, stone tools and jewelry. The ceramics date the burials to the **early LBK**.

Bischoffingen (Baden-Württemberg)

Literature: Peschel 1992, 7f

In 1903, a total of six graves were discovered in a field. Four of the burials were buried in 60 cm deep graves, lying on their left side, their arms folded in front of their face and oriented east to west. The ceramic burial goods with these four burials date them to the **younger LBK**. The other two burials, one stretched out on its back and one crouched on the left side oriented southeast to northwest, were located perpendicular to the other four and were not buried as deeply. The only burial goods, a stone knife and another stone artifact, do not indicate a time period. It is assumed that the two individuals were buried later than the LBK.

Bruchstedt (Thuringia)

Literature: Peschel 1992, 99ff; Kahlke 2004

A rescue excavation from 1958 to 1960 led to the recovery of 55 burials (16 children, 5 juvenile ♀, 16 adult ♀, 11 adult ♂, 7 undet.). At least two others were destroyed when the cemetery was first discovered in 1933. The younger portion of the neighboring settlement overlays a part of the cemetery. The graves were buried 50 cm to 100 cm deep. Almost all the burials were found in a crouched position, lying on the left side. Only two burials were on the right side and two were stretched on the stomach. All but five (one north-south, three southwest to northeast, one northwest to southeast) of the burials were oriented northeast to southwest. The burial goods include ceramics, axes, bone and stone tools, red chalk, manganese soft resin ('*Manganweichharz*'), grinding and make-up stones, animal teeth and jewelry made from teeth, bone and shells. The ceramics date to a **younger phase of the LBK**.

Butzbach (Hesse)

Literature: Jorns 1962; Preuschoft 1962; Ankel 1963; Mandera 1963; Peschel 1992, 55ff

In 1936, an LBK settlement was discovered during the construction of the Autobahn; 21 years later, in 1957, the cemetery with 18 body burials (7 ♂, 6 ♀, 2 juveniles and 1 child, 2 undet.) was discovered and excavated. Two of the burials are younger than the LBK, for the remaining 16 the classification is only partially sure. It is more likely that the graves belong to the later Stroke Ornamented Ceramic Culture. The graves were buried 50 to 100 cm, the majority 60 cm deep. Eight burials were oriented east to west, one west to east and one northeast to southwest. The orientation for the remaining burials could not be reconstructed. The burials contained few burial goods. Only the shoe-last adzes and the few ceramic sherds are evidence for dating the cemetery into the earlier Neolithic and the LBK. The remaining graves could also be attributed to later neolithic cultural groups.

Dillingen-Steinheim (Bavaria)

Literature: Peschel 1992, 9f;

The cemetery was discovered while excavations for an Alemannic cemetery were underway. Twenty-five graves containing body burials were recovered in 1987. Four graves were destroyed because they were merely located 10 to 25 cm underground. Twelve burials were buried in the traditional crouched position, nine stretched out on their back. The tradition to place the deceased on their backs occurs more frequently in the **younger LBK** and might be an indication for the dating of this site. Half the burials were oriented southeast to northwest, the other half east-northeast to west-southwest. Shoe-last adzes were recovered from eight burials, two burials contained a ceramic vessel, one burial a stone blade and one a stone spindle.

Dresden-Nickern (Saxony)

Literature: Veit 1996, 79

A group of five body burials from the **younger LBK**. Settlement pits from a settlement of the Stroke Ornamented culture partially overlapped the graves.

Essenbach-Ammersbreite (Bavaria)

Literature: Peschel 1992, 79ff

The cemetery was discovered together with an LBK settlement in 1983 and excavated from 1984 to 1986. A total of 29 body burials (9 children, 3 juveniles, 7 adult ♀, 6 adult ♂, 4 undet.) were recovered, 11 were intact, 9 slightly damaged and 9 almost completely destroyed. The destroyed graves were all buried less than 50 cm deep, the remaining graves were buried up to 1,10m deep. Another grave was found halfway between the settlement and the cemetery, located 40m away. Half the individuals were buried in the crouched position, lying on the left side. More than half, 18 burials, included burial goods such as ceramics, stone tools, arrowheads, jewelry, minerals, animal bones, combs, awls, grinding stones and fossils. The decorations on the ceramics date to the second half of the **younger LBK.**

*Fellbach-Oeffingen (Baden-Württemberg)**

Literature: Biel 1987

The first graves from Fellbach-Oeffingen were unearthed in 1936 when a new field was being ploughed outside of the settlement (Map 5). More graves where found in 1986 when the region came under construction once again. A 50 by 40 m area was excavated from December 1986 to May 1987 in order to preserve further graves before the properties were built upon. The excavation was undertaken by students from the Universities of Tübingen and Mainz. According to Biel (1987), a total of 110 burials were identified many of which had been damaged or completely destroyed by agricultural activities. Eight of the burials were cremations and cremated remains were strewn over 15 more of the body burials. They represent 28% of the total burials. In all cases, the cremation remains are very sparse. The graves were not dug very deeply into the loess soil. This perhaps explains the poor condition of the majority of the burials. The cremations were all found near the surface and were probably also subject to destruction through erosion or ploughing. It is not clear whether the cremated remains from the 15 body burials were complete cremations or whether they are secondary deposits brought in with the soil unintentionally.

A preliminary anthropological evaluation of the unburned bones was undertaken by Matthias Seitz. A catalog of the cemetery was put together, but never published. A total of 116 burials were identified including 8 cremations. Fragments from cremated material were also found in 27 body burials. Forty-eight percent of the burials were oriented southeast to northwest, 25% from northwest to southeast. Except for three burials, two stretched out on the back, one on the stomach, all of the body burials were placed in the flexed crouched position. Over half of the burials were accompanied by burial goods, which were dated to the **younger LBK**.

Flomborn (Rhineland-Palatinate)

Literature: Richter 1969, 158ff; Peschel 1992, 39ff

The cemetery dates to the **earliest phase of the LBK**, when the ceramic style was very homogeneous. This ceramic type is called Flomborn type throughout the LBK. The results from the excavation in 1900 and the following three years were first published at the beginning of the 20th century by Koehl and later, by Richter (1969). Eighty-five body burials (11 ♀, 10 ♂, 4 unidentified adults, 7 children, 8 undet., 45 graves destroyed or no skeletal material available) were recovered, however, the extent of the original cemetery is not known and may have encompassed many more graves. Two children were found together with adult females. Sixteen individuals were buried in the crouched position, lying on their left side; three individuals were found lying on their backs, the legs slightly crouched on the left side. The majority of the burials were oriented east to west and west to east, three burials were oriented southeast to northwest, three northwest to southeast, two northeast to southwest and one from southwest to northeast. Thirty-six of the burials included burial goods such as ceramics, adzes, stone tools, arrowheads, red chalk, grinding stones and jewelry made out of shells, animal bones and antlers and other shells. All adzes, except one, and arrowheads were found in the burials of male individuals. The presence of adzes and more than one category of burial goods, for females, the presence of ceramics and red chalk, are an indication for social differentiation in the community (Peschel 1992, 52). Ten burials (four ♂, three ♀ and three children), were especially rich in burial goods.

Grossörner

Literature: Bach 1978; Nieszery 1995

Five burials were recovered from the site (4 late adult to *mature* ♂, 1 early adult ♀).

Halle-Trotha (Saxony-Anhalt)

Literature: Hoffmann 1973, 71ff; Bach 1978; Peschel 1992, 10

The cemetery is located near a settlement with the same name. Five LBK graves were recovered. Three LBK *Kumpf* and a bowl were discovered together with a stone ax and a broken stone disk. Ashes were found in the bowl and were identified as a possible cremation.

Königschaffhausen (Baden-Württemberg)

Literature: Peschel 1992, 58ff

A small group of seven graves (three adults, one possibly ♂) was unearthed in 1934 by workers digging a ditch. The graves were all buried between 1 and 2 m deep in the ground. The majority of the graves was destroyed by workers. The individual from one grave is interesting because of the orientation and positioning of the body on the right instead of the left side. The head was turned around so that the individual looked towards the southwest. The legs were placed very close to the body. Peschel suggests that the position was intentional and the individual may have been tied up to create the unnaturally sharp angle of the knees.

Mangoldingen (Bavaria)

Literature: Peschel 1992, 70ff; Nieszery 1995

The first grave in the cemetery was discovered in 1966 while ploughing a field. In the following year, three more graves were discovered. Currently, a total of 12 graves of the **earlier LBK** are known. The remains of an LBK settlement were discovered close by. The cemetery was located 5 km from Sengkofen and 30 km northwest of Aiterhofen. The burial goods include jewelry, ceramics, stone and bone tools and weapons such as arrowheads. Grave 3 included the richest inventory of burial goods.

Mannheim-Seckenheim (Baden-Württemberg)

Literature: Gropengiesser 1933-1936, 308ff; Kimmig 1951; Dauber et al. 1967; Veit 1996, 86

During the construction of the 'Reichsautobahn' a number of cremations from the **younger LBK** were reported. However, there is no further information on these finds.

Naumburg (Saxony-Anhalt)

Literature: Hoffmann 1973, 71ff; Bach 1978; Peschel 1992, 10;

Nine LBK ceramic vessels, a shoe-last adze and a flat axe were recovered from the vineyard in 1913. A small pile of ashes was found next to the ceramic vessels. The ashes turned out to be from animals. The finds were sold to the former Museum für Völkerkunde in Berlin. Two vessels were cataloged as containing cremated materials. Only a few pieces of the original collection still remain. However, the cremations were lost.

Niederdorla (Thuringia)

Literature: Nieszery 1995

Ten burials and three possible cremations were recovered. It is not clear whether the cremations belong to the LBK period or stem from a later population.

*Niedermerz (North-Rhine Westphalia)**

Literature: Ihmig 1971, 175ff; Dohrn-Ihmig 1983, 47ff; Peschel 1992, 18ff; Frirdich 1994, 330ff

The cemetery was excavated from 1969 to 1975 after the first grave was unearthed during construction of a main water pipeline. The cemetery remains the only burial site in the vicinity of the numerous LBK settlements in the Merzbachtal. It has not been possible to determine a connection between any of the settlements and the cemetery. Eleven cremations and 102 body burials were excavated on the 5,600 m^2. The majority of the burials was oriented northeast to southwest with variations slightly more toward the north or east. Using the burial goods to determine the sex of the burials, Peschel (1992) identified 63 female body burials, 6 female cremations, 42 male body burials and 5 male cremations (62% ♀, 38% ♂). Twelve juveniles and two children were identified. The cremations were identified on the basis of particles of burned wood and bone and the presence of burial goods. There were no remains to examine. Grave 10 was found 30 cm under the surface. A grinding stone, an adze and a stone blade were found with the calcinated bones and burned wood. The burial goods do not show traces of having been burned. Grave 20 was partially destroyed and only contained a few pieces of burned bone and wood. It was identified as a grave due to three sherds of unburned ceramics. Grave 36 was identified due to the grey coloring of the soil and some burned bone and wood. It did not contain any burial goods. A small amount of burned wood and a few burned pieces of bone were found in the body burial in Grave 37. The cremation did not disturb the body burial as it was located 50 cm above the burial level. Grave 38 could only be identified as a large dark spot and a few burned bone and wood fragments. Grave 50 and 56 were first identified as small body burials 80 cm under the surface. But only small fragments of burned bone were recovered. Grave 83 contained a few calcinated bones and was overlapped by the body burial in Grave 84. Ceramic sherds and burned bone at the foot of that grave probably belong to the cremated remains in Grave 83. Grave76 and 89 are body burials that also included a few pieces of calcinated bone. Burned bone and wood were found underneath three ceramic vessels in Grave 114. Grave 115 also contained two ceramic vessels, which were placed with their opening facing downwards. No calcinated bones were recovered. The cremations were all only identified due to the remains of burial goods that accompanied them.

The majority of the burials included burial goods (63 body burials, 5 cremations) such as ceramics (44 burials), adzes (32 burials, 1 cremation), arrowheads (23 burials), other stone tools (18 burials, 1 cremation), used hematite stones (16 burials), grinding stones (10 burials, 1 cremation), and clumps of pyrite (6 burials). The adzes and arrowheads are typical for male burials while female burials usually only include ceramics and possibly grinding stones. Burials rich with burial goods were dug deeper than those with less burial goods, i.e. 1.10 m and 1.40m. An analysis of the ceramic burial goods show that the southern half of the cemetery also appears to be younger than the northern half.

Seven settlements were located in close proximity to this cemetery. The size and extent of the cemetery is not large enough to represent all the inhabitants of these settlements. Dohrn-Ihmig (1983) suggests that the cemetery was either only used by one settlement, probably Langweiler 9, over a long period of time, or by all communities, but for only a short period of time. An attempt was made to shed light on this question using stylistic methods of investigating the ceramics given as burial goods, but the burial goods could not be brought into connection with a specific settlement.

Oberweimar (Hesse)

Literature: Peschel 1992, 10

The findings from this cemetery have not yet been published. The only available information indicated that the graves are grouped together in small clusters spread up to 110 m apart. The cemetery contains an extraordinary number of burials in extreme crouched positions and individuals lying on their back. There are also a number of burials that have been covered or weighed down with stones.

Roßleben (Saxony-Anhalt)

Literature: Kahlke 1954; Bach 1978; Peschel 1992, 10; Veit 1996, 81

The cemetery is made up of a small group of five graves together with LBK burial goods. Remains of a settlement, including three burials (one child), were located in the vicinity.

*Schwetzingen (Baden-Württemberg)**

Literature: Behrends 1989

The LBK cemetery at Schwetzingen was first discovered in 1988 during construction work for a new neighborhood (Map 4). Human remains and ceramic sherds were unearthed during the construction of a ditch for the sewage system. The ceramic sherds were dated into the early neolithic period. It soon became clear that at least six other burials had been damaged and the finds confirmed that they date to the LBK period. The first archaeological excavations began in January of 1989. A cemetery with an area of about 40 by 100 meters was excavated. Previous construction work had destroyed around 25 graves and many more were probably destroyed by the continuous ploughing and farm work which had taken place prior to the development of the new neighborhood. Behrends (1989) reported 202 graves including 8 cremations. The cremations were found near the surface. It is probable that other cremations were destroyed by the prior farming activities.

Using the ceramics which accompanied almost all of the burials, the cemetery at Schwetzingen was chronologically dated to the **later phases of the LBK** in Central Europe. In total the author identified 214 body burials and 9 cremations. Seven body burials were accompanied by fragments of cremated bone. The cremated remains make up 7% of the total buried individuals. The graves were oval in shape and only as large as necessary in order to accommodate a body in the flexed crouching position. The majority of the bodies were placed on their left side and the predominant orientation of the bodies in the graves was with the head in northeast, the body toward the southwest although all other positions and orientations were present as well. The anthropological appraisal of the remains was performed by Wahl and has not yet been published. Compared to other LBK cemeteries in Europe, the cemetery of Schwetzingen contained relatively few burial goods, most frequently ceramics and stone tools. It has not been possible to find settlement remains in the area which could be associated with the cemetery. Behrends (1989) believes that it is improbable to find an intact settlement in this region.

Seehausen (Saxony-Anhalt)

Literature: Bach 1978; Veit 1996, 81

The cemetery from the **younger LBK** was made up of four body burials. Another grave was found further north in the remains of a settlement located in the vicinity.

Sengkofen (Bavaria)

Literature: Peschel 1992, 74ff

The cemetery was excavated in 1973 after numerous bones were recovered during farming. A settlement was found a few hundred meters away. It dates to the **earlier LBK**. Excavators believe that about a third of the graves were destroyed. 29 graves with 31 burials were recovered. The only information about age and sex comes from the two double burials; one burial contained two juveniles, another a woman with a child. A number of empty pits whose size and coloring were identical to the burials were discovered around the central collection of burials. Two pits also contained ceramic sherds. The majority of the burials were oriented east to west, only three burials were oriented west to east. Nearly all the individuals were buried in the crouched position lying on their left side. Three individuals were lying on their right side. The majority of the burials included burial goods such as ceramics, adzes, arrowheads, spondylus jewelry, animal teeth and bones and bone combs.

Sondershausen (Thuringia)

Literature: Kahlke 1954; - 2004; Bach 1978; Peschel 1992, 101ff; Veit 1996, 80; Nordholz in print

The first graves were discovered and destroyed in 1949. Excavations in 1951, 1952 and 1955 recovered 47 LBK body burials (2 juvenile ♀, 15 adult ♀, 16 adult ♂, 11 children and 3 undetermined individuals). The majority of the individuals were lying on their left side in the crouched position with the burials oriented northeast to southwest. The graves were buried 0.50 to 1.20 m deep. The majority of the burials included burial goods such as ceramics, stone tools, grinding stones, spondylus jewelry, animal bones, shells and pieces of antler, red clay and manganese soft resin. The decoration on the ceramic burial goods is typical for the **older phases of the LBK**.

*Stephansposching (Bavaria)**

Literature: Schmotz 1985, 31ff; - 1992, 35ff; Peschel 1992, 77f

A cemetery with 41 graves (31 cremations, 10 body burials) was discovered in the town in 1981. It was dated to the **middle to later LBK**. The excavated area of 900 m^2 only represents a portion of the entire cemetery. The remaining portion was probably destroyed during the construction of the surrounding streets and sport field. The graves were located very close to the surface and were partially only identified due to the burial goods, predominantly stone tools such as shoe-last adzes or flat axes. Cremated material did not survive. The body burials were oriented east to west (five with their head to the east, two to the west), lying in the crouched position. The burial goods include stone tools and ceramic pots. One burial included jewelry.

*Stuttgart-Mühlhausen (Baden-Württemberg)**

Literature: Biel 1987; Peschel 1992, 63ff; Price et al. 2003; Burger-Heinrich in prep; Kurz in prep

The LBK settlement and cemetery of Stuttgart-Mühlhausen “Viesenhäuser Hof” was discovered, excavated and investigated from 1931 to 1993. It is situated only three kilometers away from Fellbach-Oeffingen. Both sites existed during the **younger LBK** time period. A total of 247 burials and 1 possible cremation were recovered, 177 were dated to the LBK. The cemetery is split into 2 halves; 84 burials to the south of the 'Hofsträßle' were excavated from 1977 to 1982 and date to the younger LBK. The 93 burials to the north were excavated from 1991 to 1993 and date to the older LBK. The cemetery was in use for a long time, six chronological phases were differentiated. The earlier phase lasted 100 to 150 years, the younger phase for about 135 years.

The earlier burials were predominantly oriented west to east and northwest to southeast. The younger burials oriented east to west and west to east. The individuals were primarily buried crouched on their left side. Alternate orientations are more frequent in the younger phases. Seventy-three of the individuals in the northern section and 70 of the 84 individuals in the south could be sexed. There were significantly more males than females among the population. Sub-adults are under-represented. Only 26 burials (21 ♂, 1 ♀ and 4 children) included burial goods such as ceramic sherds, adzes, stone tools, arrowheads, bone and antler tools and animal bones. Three burials included shell jewelry. The burials are predominantly oriented southeast to northwest. It is questionable whether the cremation belongs to the LBK because of its position within an area that was disturbed through younger intrusions into the LBK layers. Due to the questionable cultural affiliation of the cremation it will only be partially incorporated in the discussions; however it is included in the catalog for the sake of completeness.

Vaihingen Enz (Baden-Württemberg)

Literature: Krause 1994; - 1995; - 1996; - 1997; - 1999, Krause et al. 1999; Bentley et al. 2003

In 1994, excavation of a previously known small LBK site began in an area that was soon to become an industrial park north of the city of Vaihingen. In the following 6 years, a complete LBK settlement, which extended over a total area of 20 to 25 acres (8 to 10 ha) and includes a substantial trench system and cemetery, was excavated. The ground plans of more than 100 longhouses were very well preserved. An oval trench, 1.0 to 1.3 m deep and 2 to 2.5 m wide, surrounds the settlement. At its wides points, the trench extends 200 m from east to west and 150 m from north to south and encloses 5 acre. The settlement existed throughout the LBK and at least three settlement phases can be inferred alone from the construction of the trench. In some places the trench cuts across preexisting structures, at others, the ground plan of a longhouse cuts across the filled in trench. The ceramics found in the trench indicate that it was only used as a fortification or boundary for a short time before it was filled in and then utilized as a cemetery. The ceramic style dates the trench and the structures enclosed inside it to the **early to middle LBK period**. In total, 120 LBK graves were found either in the trenches or adjacent to it. 80 burials were found inside the trench. The majority of these were buried in the typical crouched position, lying on the left side with the knees pulled in toward the body. Only a few skeletal remains give the impression of having been dumped into the trench. There are very few burial goods associated with the skeletal remains. Another 40 burials were found in smaller trenches, contemporaneous with the large surrounding trench and in the rubbish pits and trenches parallel to the longhouses. Some of these burials could also be considered as settlement burials, however, they will be treated as cemetery burials in this thesis. The skeletal material was very well preserved in the clayey loess. The skeletal material is being evaluated by Dr. B. Kaufmann from the Anthropologisches Forschungsinstitut in Aesch, Switzerland. Information about the age and sex of 47 individuals from 46 of the burials, both from the trench and the settlement pits, are available in the literature (Welge in Krause et al. 1999, 93ff; Bentley et al. 2003, 478 Tab. 2). Of these individuals 10 were female (1 juvenile, 9 adults), 12 male (2 juveniles, 10 adults), 18 were children. Three juveniles and two adults of undetermined sex as well as two individuals of undetermined age and sex were also included in this evaluation. A third category of remains was recorded, individual bones found in rubbish pits throughout the settlement. These are worth mentioning because the bones are much more robust than the bones from the burials in the surrounding trench. They may represent individuals from another group within the population or from the indigenous Mesolithic population. The analysis of the skeletal material from this cemetery and settlement are not yet complete.

Wachenheim (Rhineland-Palatinate)

Literature: Peschel 1992, 7

Twenty graves were recovered in 1897. The graves had been disturbed. The individuals were buried in the crouched position, their remains oriented northwest to southeast. Only very few burial goods such as ceramic sherds and two shoe-last adzes were recovered.

Waiblingen (Baden-Württemberg)

Literature: Veit 1996, 85

A small group with five body burials was discovered. Traces of settlement pits were found in the near vicinity.

*Wandersleben (Thuringia)**

Literature: Bach 1986, 111ff; Carli-Thiele 1996; personal communication with Birkenbeil 2005/2006

The cemetery was excavated in 1981 and 1982. In total, 169 graves with body burials with 222 individuals (78 children, 22 juveniles, 49 ♂ and 73 ♀) and over 100 complexes with cremations were recovered. The cremations were exclusively located in the southern and southeastern portion of the cemetery. The remaining data on the body burials and the burial goods are still being studied and await publication.

One interesting factor that is also significant for the analysis of the cremated remains is the robustness of many of the females from this cemetery. Especially the bones of the skull are significantly thicker than has been noted from other cemeteries. Measurements were taken on A. Os frontale 5-10 mm in front of the bregma, on B. Os occipitale 5-10 mm behind the lambda suture and C. at the thickest area near the torus. The median measured value for the females from Wandersleben was higher in comparison with the values from the early neolithic cemeteries at Ehringsdorf and Bilzingsleben for all three measurements. For measurement A. the average value for females was 8.1 mm, for males 8.7 mm. An additional measurement 10 mm behind the bregma on the saggital suture resulted in average measurements of 7.6 mm for females and 8.6 mm for males. For measurement B. the average value for females was 9.8 mm, for males 10.8 mm. For measurement C. the average value for females was 14.2 mm, for males 15.4 mm.

Wiesbaden-Biebrich (Hesse)

Literature: MANDERA 1963, 32ff; PESCHEL 1992, 7

At the beginning of the 20th century, LBK graves were discovered in a sand pit. Ritterlings reported 15 to 18 graves containing body burials; the individuals were all buried in the crouched position, lying on their left side. They were all oriented east to west. The burial goods include ceramic sherds of the flomborn typology, shoe-last adzes, pieces of red chalk and necklaces made from shells and bones. The ceramics date the cemetery into the **older LBK.**

Wittmar (Lower Saxony)

Literature: RÖTTING 1983; PESCHEL 1992, 11ff

The 300 m^2 cemetery was excavated from 1976 to 1978. Sixteen LBK graves (3 children, 3 juveniles, 3 young *adult* and 7 *mature* to *senile* adults; among these were 7 ♀, 3 ♂), 1 grave from the Stroke Ornamented culture and 34 graves from the Roessner culture were recovered. The LBK graves were found between 28 and 63 cm in the ground and seem to have been placed in 2 parallel lines running east to west. Nine burials were oriented east to west, one east-southeast to west-northwest and four burials were oriented west to east. The remaining two graves were destroyed. Thirteen individuals were found in the crouched position, 11 of them lying on their left, 2 on their right side. One individual lay on its back. The orientation of the remaining burials could not be reconstructed. Nine burials contained ceramic burial goods whose decorations place this cemetery in the **middle of the LBK**.

1.5 Austria

Kleinhadersdorf

Literature: NEUGEBAUER and NEUGEBAUER 1987, 194; - 1988, 265; - 1989, 167; - 1990, 182; - 1991, 237; PESCHEL 1992, 157ff; VEIT 1996, 78

The cemetery was first discovered in 1936 and excavated by Josef Bayer and Viktor Lebzelter. In 1986, the Bundesdenkmalamt resumed the excavations at the site when a vineyard that had lain dormant was activated again and ceramics and a burial were uncovered. The cemetery dates to the **younger LBK**. Over 5 years, a total of 70 possible graves were identified, however, anthropological data is only available for 20 individuals (2 ♀, 3 ♂, 5 unidentified adults, possibly male, 1 juvenile, 9 children, 4 cremations). The body burials were buried in the traditional crouched position, the majority lying on their left side oriented southeast to northwest. The majority of the graves no longer contained skeletal material (49 “Verfärbungen”), only ceramic sherds. A settlement was located to the west of the cemetery. The burials without burial goods were buried in shallow graves less than 60 cm deep. The burials with burial goods (jewelry made from shells and teeth, stone and bone tools, ceramics, grinding stones and red chalk around the head) were buried in deeper graves more than 70 cm under the current surface.

Rutzing/Haid

Literature: PESCHEL 1992, 164ff; VEIT 1996, 78

The cemetery was discovered in 1960, 250 m northeast of the matching settlement. Twenty-four graves were identified, a number of them were destroyed before they could be excavated. The cemetery dates to the **younger LBK**. It is likely that the cemetery extended further towards the west and originally contained more than the 24 burials (1 possible juvenile ♀, 1 juvenile ♂; 2 adult ♀, 6 possible adult ♀, 8 adult ♂, 6 children). Fourteen burials included burial goods such as ceramics, shoe-last adzes, stone and bone tools, arrowheads and jewelry. Shoe-last adzes, stone tools and jewelry made out of animal teeth are typical burial goods for male burials.

1.6 Czech Republic

Mlynárce

Literature: VEIT 1996, 79

The cemetery contained 20 graves. The matching settlement was located 300 m away.

*Nitra**

Literature: Pavúk 1971; Peschel 1992, 174ff; Veit 1996, 79

The cemetery from the **younger LBK** was first discovered in 1964 and then excavated in the following year. It contained 75 LBK body burials (22 ♀, 24 ♂, 22 children, 7 undet.). The matching settlement was located east and southeast of the cemetery. This direction is echoed by the orientation of the burials. The graves were relatively deep, on average 1.00 to 1.20 m. Eight groupings with burned human bones and ceramics from the younger LBK were uncovered while removing the top layer with a bulldozer. These probably belonged to cremations. Pavúk (1971) does not consider them graves because there were no clear grave markings or burial goods. Regrettably, these finds were destroyed. Eleven overlapping graves were observed. The younger graves overlapped graves from the early LBK. An overwhelming number of individuals, 85%, lay on their left side in the crouched position. Half the individuals were oriented southeast to northwest. Over half of the burials, 62%, predominantly males burials, included burial goods such as ceramics, jewelry, stone tools, pieces of a red mineral and graphite, bone tools and grinding stones. Typical for the male burials are spondylus jewelry and stone tools. The ceramic decorations date the cemetery to the younger LBK and the following Zeliezovce culture.

Vedrovice

Literature: Veit 1996, 79

The cemetery directly borders the settlement. Since the end of the 19th century, graves have been repeatedly discovered. The literature cites 22 burials, plus 5 burials of children that were probably intentionally buried within the borders of the settlement.

1.7 Poland

Giebultowie

Literature: Veit 1996, 79

A small group of graves and a settlement from the **earliest LBK.** Only two graves with skeletal material were recovered. Five empty graves and six pits with ceramics and other artifacts were also found.

1.8 Summary of the Cemeteries

Fifty-seven cemeteries including 2,090 body burials and 350 cremations are cited in the literature. The cemetery burials make up 70% of the known burials and skeletal depositions in the LBK. The cremations make up 15% of the burials in LBK cemeteries. The majority of the individuals were buried in the crouched position, lying on their left side. The predominant orientation of the body burials was with the head lying in the east and the body pointing towards the west (Figure 16). If we take into consideration that the majority of the burials was also positioned on the left side, then the dead faced east and south. However, the orientation of the body burial within the grave was only mentioned for a quarter of the burials. It is possible that this apparent trend could change if the orientation for all of the graves were known.

The age distribution among the cremations shows that, compared to the body burials, children are under-represented whereas juveniles and adults are over-represented (Table 5). Eighteen percent of the body burials were identified as children. Only 7% of the cremations were classified as children. It is possible that children were not cremated as frequently as adult or juvenile individuals. Another possible explanation is that the more fragile and gracile bones of children simply were not preserved. The surplus of juvenile individuals among the cremations, is probably the result of how the age was determined for the cremated individuals (see section E.2). In short, in some cases it was only possible to determine an age span such as "*juvenile* or older" because the juvenile age category could not be ruled out with confidence. Therefore this age category may be over-represented among the cremations. A similar over-representation was recorded for the *senile* individuals for the same reason.

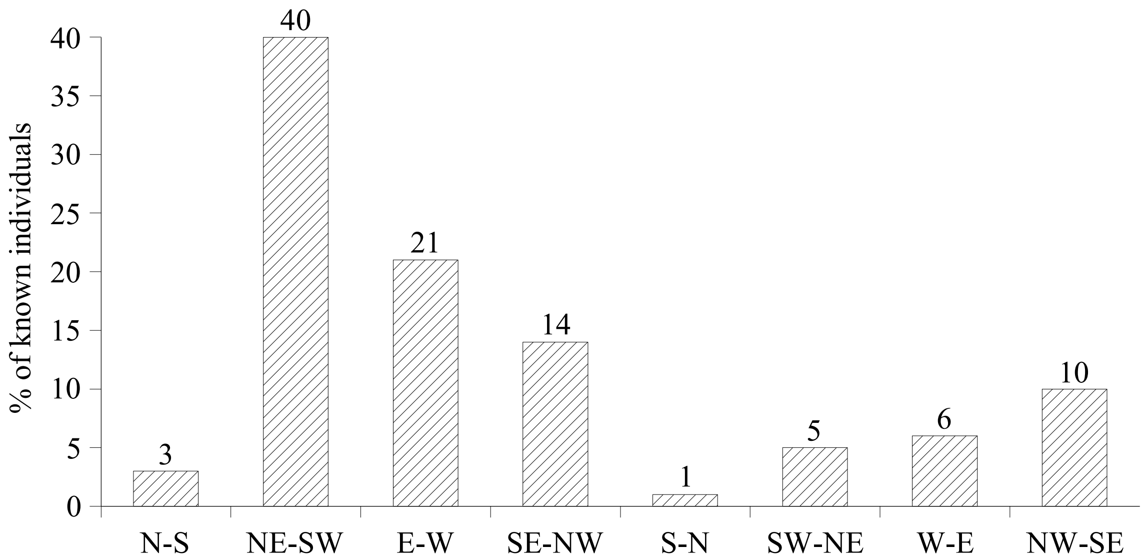


Figure 16: Orientation of bodies. The first coordinate represents the location of the head, the second the direction in which the body is lying.

The ratio of females to males shows that there were slightly more females (21%) among the identified body burials than males (20%). These percentages include individuals from all age categories since the age of these individuals was not always specified in the literature. The females also predominate among the cremated individuals (13% ♀/ 10% ♂). Among the cremations from Schwetzingen, Fellbach-Oeffingen and Wandersleben, twice as many females were identified as males. The percentage of females and males is based on the number of identified individuals listed in the cited literature. It was not always clear whether the sex determination was based on anthropological evaluations or on archaeological evidence in the form of burial goods. The 775 undetermined body burials are not necessarily unidentifiable. Either an anthropological evaluation was not carried out or the results have not

	Body Burials		Cremations		Total	
	n	**%**	**n**	**%**	**n**	**%**
children	370	18	26	7	396	16
juveniles	91	4	52	15	143	6
adults	854	41	201	57	1055	43
undet.	775	37	71	20	846	34
total	2090	100	350	100	2440	100
♀/♂	446/412	21/20	46/34	13/10	492/446	20/18

Table 5: Summary of the age distribution for body burials and cremations from 57 LBK cemeteries. Bottom row illustrates the total number and the respective percentages of sex determined individuals from these burials.

been published. An evaluation of these individuals could significantly influence the statistic.

Burial goods were identified in 68% of the graves (Veit 1996, 95), however, the distribution of burial goods is not the same for every cemetery. Female graves generally did not contain very many burial goods, primarily ceramics and some jewelry made out of local material. Very few also included grinding stones or pigments. The spectrum of burial goods was much larger for the male graves. These often included multiple and varied burial goods such as ceramics, stone tools, weapons and flint tools. The shoe-last-adze was the most common stone tool form found in the graves and was exclusively associate with males and, in very few cases, with older females. Pavúk (1972) states that the presence of a shoe-last-adze in a burial is sufficient to justify labeling the burial as male. The male burials also included jewelry, bone and antler tools, pigments and grinding or polishing stones. The graves of children also included a varied spectrum of burial goods such as ceramics and jewelry. Stone tools, flint tools, pigments, grinding stones and weapons were also found. It is probable that these rich burial goods were reserved for male children (Peschel 1992, 189). Ceramics are the most common burial good. Sherds are included in almost all burials, whether male, female or child. The sherd probably belonged to vessels, now broken, that contained food and other organic substances to accompany the dead. In the cemeteries Wandersleben and Arnstadt, some cremations were found either inside or covered by ceramic bowls and *Kumpf* (Neumann and Wiegand 1940; Birkenbeil pers. comm.). The cremations from the other cemeteries are only accompanied by ceramic sherds.

2 LBK Settlement Burials – A Short Summary

Burials or skeletal deposits within the confines of a settlement have been identified throughout the LBK. In total, 360 burials and 100 deposits of isolated skeletal remains, predominantly skullcaps, from 176 sites are cited in the literature (Table 6, Veit 1992; - 1996; Orschiedt 1998). These make up 15% of the burials in the LBK. Veit (1996) differentiated between burials that could be directly associated with and considered contemporaneous with the settlement (the same burial goods were found in the grave and in the settlement) and burials without clear association (no clear archaeological evidence and the grave does not resemble the graves in the first category). The later usually referred to small groups of graves found within the boundaries of the settlement but without an archaeological connection. More than half of the burials were directly associated with the settlement within which they were found. The majority of these burials date to the late LBK.

	Settlement Burials		Isolated Skeletal Remains		Total	
	n	%	n	%	n	%
children	97	27	18	18	115	25
juveniles	10	3	3	3	13	3
adults	86	24	14	14	100	22
undet.	167	46	65	65	232	50
total	360	100	100	100	460	100
♀/♂	38/35	11/10	-	-	38/35	8/8

Table 6: Age distribution for settlement burials and isolated skeletal remains. Bottom row illustrates the total number and the respective percentages of sex determined individuals from these settlement burials.

Settlement burials were found in association with specific buildings or deposited either individually or in small groups in open spaces near the periphery of the settlement[4]. In most cases, the burials were deposited in settlement pits. It is not clear whether an additional burial pit was dug or if the deceased was simply deposited in the preexisting pit. Ten percent of the burials were found in material pits[5] running parallel to the houses. Only seven burials were found near the ground plan of a longhouse. Of these, only two, one child from Zauschwitz and one adult from Frankfurt-Praunheim, were actually found inside the ground plan. In both cases, the ground underneath was burned, the skeletons were covered with charcoal. The individuals were lying on their stomach, the extremities splayed. A burned beam covered the lower legs of the adult from Frankfurt-Praunheim. The finds were interpreted as accidental

4 The burials from Vaihingen Enz are not included among the settlement burials. The burials were deposited in the pits surrounding the settlement, however, they are interpreted as a cemetery.

5 The loam used to construct the walls of the longhouses was taken from pits directly adjacent to the site where the houses were built. The resulting pits and trenches were then used as storage and rubbish pits.

deaths resulting from a house fire. Classic cremations were not recovered from within any settlement. One individual from Nezvisko in the Ukraine was deposited in a grave and a wooden structure was burned down over him burning the majority of the body, only the skull and some of the extremities remained intact. The individual was accompanied by extraordinarily rich burial goods that also showed signs of burning. The burial was found directly next to a longhouse that had also burned down. The remaining settlement burials were found either grouped in larger pits, in individual pits throughout the settlement or in the surrounding trenches.

Two-thirds of the settlement burials were buried in a crouched position, half of these lying on their left side, the other half lying on the right side or the back. Only ten individuals were found lying on their stomach and eight on their back. For the remaining burials, the position could not be reconstructed or was not recorded. The head was primarily oriented towards the east, followed by orientation toward the north. Less than half of the burials were accompanied by burial goods. Those that did contain burial goods included the same spectrum as found in the cemeteries. In some cases, it is difficult to differentiate between burial goods and the ceramic fragments and artifacts that were originally in the settlement pit.

It is interesting to see that children (50%), and sub-adults in general (55%), make up over half of the age determined individuals from the settlement burials (Table 6). However, the number of adult individuals will probably increase if it is possible to age and sex the undetermined individuals. It is probable that this category will include more adult individuals than sub-adults because the bones of sub-adults would have been easier to identify due to their small size and are already included in that category. The number of identified children and sub-adults does not significantly decrease the child deficit already identified among the cemeteries. The total percentage of children's burials found in settlements and cemeteries increases from 16 to 18%, the percentage of sub-adults increases from 22 to 23%.

The sex of an individual was only determined in 20% of the settlement burials. Thirty-eight females (8.5%) and 35 males (7.8%) were identified. The superior number of females is echoed in the ratio of females in the cemeteries (21% ♀/ 20% ♂) and among the cremations (13% ♀/ 10% ♂).

Settlement burials do have a special status within the LBK. However, it is not clear what that status is. The individuals cannot be assigned either a higher or lower status in the settlement. Except for three cases, there is no evidence for a traumatic death for individuals buried within the confines of a settlement. Among the identifiable individuals, children and younger females predominate. However, the number of undetermined individuals can easily balance out this predominance. It is interesting to note that cemeteries and settlements with settlement burials do not occur together. Settlement burials and cemeteries cannot be confidently distinguished from one another. Some of the cemeteries described above only included a handful of burials. Small groupings of burials were also recovered from within settlement boundaries. Another interpretation of these grouping could be that these are also small cemeteries located near a settlement. Small cemeteries could grow into larger ones similarly to Vaihingen Enz. Those burials found in the immediate vicinity of settlement structures could have been placed there before the trench of building was constructed. Later settlement phases could have cut across older cemeteries. Burial goods were rarely associated with the settlement burials, therefore only direct dating of the skeletons and the associated structures can determine whether or not the two are contemporaneous.

2.1 Isolated Skeletal Remains

Isolated skeletal remains were identified from 45 locations. Twelve of these sites also contained regular settlement burials. Cranial fragments were identified at 26 sites, only 5 sites included only postcranial remains, the rest contained both cranial fragments and postcranial skeletal remains (Veit 1996, 194ff). These isolated skeletal remains have been interpreted as the remains of a sacrificial meal, traces of cannibalistic practices in the LBK. Whether this interpretation is accurate remains to be seen. It is clear that these remains are not the result of disturbed burials. The majority of the skeletal remains carry definite traces of intentional manipulation. The epiphyses of the long bones were cut or broken off, the skull intentionally manipulated to form "skull cups". In other cases the bones were simply shattered or crushed into very small pieces that could not be put together again. These fragmented bones were often found in association with animal bones. Eighteen of the identified skeletal remains were children, three juveniles and 14 from adult individuals (Veit 1996).

In this context, it is important to mention the 447 skullcaps that were retrieved from the inner trench surrounding the settlement at Herxheim in Southwestern Germany[6] (Orschiedt et al. 2003; Zeeb-Lanz and Haack 2006; Orschiedt and Haidle in press). The southern half of the settlement was excavated from 1996 to 2005 by the Landesamt für Denkmalpflege in Rhineland-Palatinate. A 100 by 250 m area was excavated. The settlement was surrounded by two parallel trenches. The structures within the settlement area were largely destroyed by erosion and because the settlement was used by later populations up until the Roman period. The orientation of the longhouses could be reconstructed through the remains of pits and post holes filled with ceramic sherd. The ceramics show that the settlement was inhabited throughout the LBK. The majority of the skeletal material, 65%, was recovered from the inner ditch, 32% from the outer ditch and the remaining material from settlement pits inside the enclosure. Only nine articulated skeletons were identified, the remaining skeletal material was highly fragmented. The bone fractures show that the bone was still relatively fresh when it was broken, but the individual was no longer alive. The lack of fracture lines and concentric

6 The skeletal material from Herxheim is very heavily fragmented and complete skeletons are not available for evaluation. Haidle and Orschiedt are attempting to determine a minimum number of individuals (MNI) for males, females and sub-*adult*s based on preserved skeletal element. This evaluation is still in progress. Haidle suggests that the resulting MNI will grossly under-represent the actual number of individuals represented at Herxheim. It is probable that the skeletal elements were deposited *pars pro toto*, only one fragment to represent the whole. In this case, every fragment from Herxheim could represent a separate individual (Haidle pers. comm.)

fractures around the blow marks show that the bone had already lost a lot of its elasticity by the time the damage was inflicted (Orschiedt et al. 2003, Zeeb-Lanz and Haack 2006; Orschiedt and Haidle in press). There was no evidence for traumatic death on the skeletal material from Herxheim. Two skulls showed evidence of healed blows to the head. These showed evidence of healing and did not lead to the immediate death of the individuals. Cut marks were identified on 10% of the skulls. They are not typical butcher markings. Their position on the cranial vault and the facial skeleton shows that the cuts were positioned so the skin could be removed from the skull. The same applied to the cut marks identified on 3% of the postcranial bones. The flesh was removed for ritual purposes.

*Figure 17: A classic deposition of skull calottes, facial skeletons, human ribs and smashed human long bones alongside ceramics and animal bones from Herxheim (*Zeeb-Lanz and Haack 2006, 11).

Initially, Herxheim was interpreted as a site where a battle must have taken place. This interpretation was dismissed. There are no traumatic injuries on the bones that would lead to immediate death. The sheer number of individuals (at least 1,350 individuals, extrapolated for the area yet to be excavated), the standardized manipulation of the skeletal elements and the lack of bite marks from animals do not support the theory of a mass grave resulting from warfare. Instead, the findings suggest some sort of ritual deposition (Haidle and Orschiedt 2005, http://www.projekt-herxheim.de/menschen.htm; - in press; Zeeb-Lanz and Haack 2006). The skeletal material was deposited at Herxheim over a period of fifty years. The excavators postulated that Herxheim was some sort of central ritual place. Individuals who died were buried locally, and then, maybe once a year, were exhumed and taken to Herxheim where the bones were crushed and redeposited in the trenches surrounding the settlement. Burial goods such as ceramics and grinding stones were also smashed and deposited in the trenches. Analysis of the ceramic styles showed that at least eight regional styles could be identified, the furthest region being from the Elbe River Valley (Zeeb-Lanz and Haack 2006). Recent findings have shown that the parallel trenches are in fact made up of a number of small trenches that had been constructed along a circular route around the settlement. The trenches were filled in and new ones were constructed. Over time, the numerous smaller trenches merged into two large parallel trenches (ZEEB-LANZ and SCHMIDT 2005, http://www.projekt-herxheim.de/index.htm; ZEEB-LANZ and HAACK 2006).

The analyses of the 1996 to 1999 excavations are not yet complete and new excavations took place in 2005 and 2006. What exactly occurred at Herxheim is still unclear, but further research and investigation are sure to have a great impact on the interpretation of the burial practice of the LBK. The remains of over 1,350 individuals will increase the number of known LBK burials and deposits by 50%!

3 LBK Mass Graves - Talheim and Asparn

3.1 Talheim

Literature: WAHL and KÖNIG 1987, ALT et al. 1995

Excavations in Talheim took place in the spring of 1983 and 1984. The site was discovered by the owner of the property while planting a vegetable patch. On discovering pieces of human bones, he reported the find to the local authorities who quickly notified the Landesdenkmalamt in Stuttgart. The first excavation was a rescue excavation measuring 2.5 by 1.5 m and encompassed the vegetable patch. A pit or grave filled with bones was uncovered 35 cm below the surface. The layer of bones was 20 cm thick. The excavation in 1984 only lasted 14 days. The pit in the vegetable patch was the center of a larger oval pit measuring 2.9 by 1.2 to 1.5 m. The surrounding area was also excavated but no further structures were found. The bones were still anatomically connected. Unfortunately, they were jumbled together and difficult to assign to one specific individual. Nine skulls could be identified at first glance in 1983. The skeletons at the bottom of the pit were intact and had probably been laid down on the floor. The other skeletons were not as intact and were probably tossed into the pit haphazardly. The pit did not include any burials goods. A few ceramic sherds, dated to the younger LBK, a few stones and two animal bones were found but were not deposited there intentionally. Radiocarbon dating was carried out for the ceramics, 5,960 ± 60 and 6,045 ± 60 B.P., and two vertebral bones from two individuals, uncalibrated around 7,000 B.P. First estimates calculated that the pit encompassed 20 to 25 individual skeletons.

The position of 29 individuals in the mass grave could be identified by reconstructing which skeletal elements belonged together. Over half of these individuals were lying on their stomach, the extremities angled away from the body. Others were lying on their backs. None of the individuals looked as though they were lovingly placed there, the position of the skeletons gives the impression that the individuals were randomly thrown into the pit. The arms and legs were entangled and it was difficult to determine where one began and the other ended. In total, 34 individuals were identified based on the number of skulls in the mass grave

(7 *infant* I, 6 *infant* II, 3 juveniles, 7 adult ♀ and 9 adult ♂, 2 undetermined adults). The sexual dimorphism is very pronounced, the females are characterized by very gracile and slim yet long bones. At the same time, the muscle relief of the crania was relatively robust. In some cases, the *Protuberantia occipitalis externa* was more pronounced in the females than in the males, the mastoid process could not be used to clearly discriminate between males and females. These features represent the muscle attachment sites on the cranium to which the muscles of the neck attach. These patterns indicate that the muscles were very pronounced, possibly because the women wore headbands that helped support heavy loads being carried on the back. Similar observations of thick cranial bones and distinct muscle attachment sites were made for the females from Schwetzingen and Wandersleben and will be addressed in the final chapter.

Traumatic injuries were identified on at least 20 (59%) of the skulls, the other skulls were heavily fragmented. The majority of these injuries were caused by flat axes, closely followed by unspecific injuries, injuries caused by a shoe-last-adze and injuries caused by stone arrowheads. None of the injuries showed evidence of healing.

The people from Talheim were attacked, killed and dumped into a mass grave. It does not look like anyone survived, otherwise the dead would probably have been given a more proper burial. If anyone survived, they were probably taken away by the attackers. This mass grave, the mass burial from Asparn (see section C.3.2) and the discovery of the remains of circa 500 individuals from the inner trench at Herxheim (Orschiedt et al. 2003) are all evidence for the increasing violence towards the end of the LBK. The mass graves also present an image of a living population of the time period since all of the individuals living in the population were killed at the same time. The distribution of sub-adults (47%) and adults (53%) in Talheim represents a nearly ideal population. Demographic analyses of representative series and modern populations have shown that the percentage of sub-adults in a living population must lie between 45 and 60%.

The living population from Talheim, in contrast to the dead buried in the cemeteries, reflects the actual number of men, women and children that lived at this site. They did not die of natural causes. The cemeteries do not present a picture of the actual living population, they show how many people of a certain age or sex died. How many continued to live can only be determined by calculating life expectancy tables. This difference is important. When looking at the results of the anthropological evaluation in Chapter F and G, the number of children and juveniles is very low, only 23% of all of the cremations were sub-adult. Children are usually under-represented in most archaeological populations. This is either due to the poor preservation of the smaller and more gracile bones or to the special treatment of neonates and infants. Another explanation is that the quality of life in the Neolithic was much better than is assumed today and children really did not die as frequently as can be expected. This would also explain the small number of juvenile individuals. Juvenile individuals are in the prime of life, they are healthy and growing and very resilient. Maybe they really did survive best.

Again, the same argument applies to the senile individuals of the population. Only two were identified among the cremations. It is possible that the people of the LBK did not reach very old age. This implies that life for the adults may have been significantly harder than for the sub-adults. In sum, the individuals from Talheim represents a living population. If these people had had the chance to die of a natural death, the distribution in the cemetery would probably look quite different.

3.2 Asparn an der Zaya

Literature: Windl 1996; - 1999; Teschler-Nicola 1996, 47-64.

Asparn an der Zaya is located in the northeastern corner of Austria. The settlement was inhabited, with some interruptions, throughout the entire LBK. Aerial photographs and scans with a magnetometer present a complete picture of the settlement and the impressive system of trenches that surrounds it. A large trapezoid ditch with 400 m long sides surrounds a system of 2 oval parallel trenches. The trapezoid trench has been dated to the earliest settlement phase in the oldest LBK. The oval trenches and some of the longhouses from this later phase partially cut across these older trenches. The parallel oval trenches were also created at different times and belong to separate settlement phases. An older trench was partially filled in when a new one was constructed. The trenches are up to 3 m wide and up to 2 m deep[7]. The youngest trench is tentatively dated to 5,000 B.C:. Windl (1999) interprets the different trenches as the result of changes in power structures within the community and the resulting long periods of violence.

Windl's (1999) theory is supported by the discovery of over 100 skeletons in the youngest trench (Table 8). The individuals were lying on their stomach, arms and legs spread from the body. Because there are no large cemeteries in the vicinity, these skeletons in the trench were first interpreted as a special burial form at the end of the LBK. However, the anthropological analysis of 67 skeletons demonstrated that these individuals did not die a natural death but were massacred. All skulls display the injuries from multiple deadly blows to the head caused by both clubs and axes. In addition, a number of bones also contain bite marks, probably from dogs. These bite marks indicate that the dead were not immediately buried but were lying out in the open for a period of time. Arms and legs were dragged off up to 5 m and were obviously still in anatomical connection. The dead were tossed into the trenches and left to be scavenged by animals. The age and sex distribution of the 67 individuals represents the distribution one expects to find in a living population. Fifteen females and 28 male individuals were identified. The sub-adults made up 40% (n=12.5 *infant I*, 8.5 *infant II* and 5.5 *juveniles*) of the identified individuals, the adults the remaining 60% (n=22.5 *adult*, 18.0 *mature*). According to Teschler-Nicola et al. (1996) the juveniles and younger women are under-represented. They were probably taken away. It is probable

7 Today, the amount of earth from the excavation of 1 of the oval trenches equals 1000 truck loads.

that this massacre wiped out the entire population and left no one to arrange proper burials. Further analysis of the site has not yet been published.

4 Summary of Burials in the LBK

The individuals from Talheim represent a snapshot of a living population in the LBK. The individuals did not die a natural death, they were murdered. Therefore, a typical living population in the LBK is made up of circa 47% sub-adults and 53% adults, as illustrated through the mass grave at Talheim. In contrast, cemeteries are made up of those individuals of a population that died a natural death or were killed in an accident or an attack. They represent a longer period of time throughout which people died and were buried. The age distribution of cemeteries illustrate the number of people in each age category who died and not how many individuals from each age category actually lived at one time. When analyzing the age and sex distribution of these individuals, anthropologist have to make assumptions in order to derive information about the demographic distribution within this population: the deceased represent one generation and, in sum, represent the living population, all of the individuals from the population were buried in the cemetery, there was no migration to of from the population and the deceased were not buried outside of the cemetery. The population was stable and the rate of birth equals the rate of death. These assumptions are are based upon the data anthropologist have available to them today but without them it is impossible to calculate age distributions or make demographic statements about a population (Acsádi and Nemeskéri 1970; Kölbl 2004).

These percentages equal 20% sub-adults and 34% adults among the total known burials and skeletal deposits from the LBK (Table 8, 15% children, 5 % juveniles and 34% adults).

The undetermined individuals make up almost half of all known burials. However, not all of the burials and skeletal deposits have been evaluated and not all evaluations of burials and skeletal deposits have been thoroughly published. For example, the 447 skull caps from Herxheim and 33 of the 100 burials from the mass grave at Asparn/Schletz are still being evaluated. They are not undetermined individuals, their age and sex just has not yet been published. Without these undetermined burials, the percentages equal 37% sub-adult and 63% adult individuals (Table 7, 28% children, 9% juveniles and 63% adults). Compared with the living population represented by Talheim the sub-adult individuals are slightly under-represented. Whether the sub-adults were not preserved in the burial record or were subjected to some other burial practices not recognizable in the archaeological record still remains to be seen.

	Cemetery Body Burials	Cemetery Cremations	Settlement Burials	Isolated Skeletal Remains	Talheim + Asparn	Total LBK
	%	%	%	%	%	%
children	28	9	50	51	34	28
juveniles	7	19	5	9	8	9
adults	65	72	45	40	58	63
total	100	100	100	100	100	100
♀/♂	34/31	16/12	20/18	-	22/36	29/27

Table 7: Age distribution for all of the burials and skeletal remains from the LBK, excluding the undetermined individuals. Bottom row illustrates the respective percentages of sex determined individuals.

There are slightly more females (552) than males (518) among the total number of individuals for which the sex could be determined. The larger number of females than males is the same for three of the four categories of burials. Females made up 18% and males 17% of the total identified individuals in the LBK, 29% female and 27% male when excluding the undetermined individuals (Table 7). This pattern had previously been observed among the cremated individuals evaluated by this author in the Master's Thesis (2003). Twice as many females than males were identified among the cremated materials. It is possible that these percentages are the result of the small sample size. However, two factors cited in this study suggest that there must be another reason for the predominance of females in the burial record: First, the number of individuals is no longer small, nearly 3,500 individuals compared to the 15 individuals from Schwetzingen and 33 individuals from Fellbach-Oeffingen. Second, the literature did not clearly specify whether the sex determination of the burials was based on anthropological or archaeological analyses based on burial goods. It is easier to identify males based on archaeological evidence because certain items are characterized as classic male burial goods (see sections C.1.8 and F.8). It is not easier to identify females or males based on anthropological methods. If females predominate the burial record, then it is not because the males could not be identified but because there were truly fewer males or the males were subject to different burial rites. Based upon the distribution of females and males from Talheim it is probable that the number of males and females was equal in the LBK. Therefore, the males were not all buried in the cemeteries and settlements. Further evaluation of the large number of undetermined individual could still influence the percentage of female and male individuals.

	Cemetery Body Burials		Cemetery Cremations		Settlement Burials		Isolated Skeletal Remains		Talheim/Asparn/ Herxheim		Total LBK	
	n	%	n	%	n	%	n	%	n	%	n	%
children	370	18	26	7	97	27	18	18	34	6	545	16
juveniles	91	4	52	15	10	3	3	3	9	2	164.5	5
adults	854	41	201	57	86	24	14	14	59	10	1214	35
undet.	775	37	71	20	167	46	65	65	33+447	83	1558	45
total	2090	100	350	100	360	100	100	100	581	100	3481	100
♀/♂	446/412	21/20	45/35	13/10	38/35	11/10	-	-	22/37	22/36*	552/518	18/17*

*Table 8: Age distribution for all of the burials and skeletal remains from the LBK. Bottom row illustrates the total number and the respective percentages of sex determined individuals. *The undetermined remains from Asparn and Herxheim are not included in the calculation for the percentage of sex determined individuals.*

D. Cremations – Methods of Investigation

The work of physical anthropologists resembles the work of detectives; they search for clues that will help to determine the identity of a deceased individual. The difference between the two professions is that, generally, anthropologists do not want to solve a crime. Physical anthropologists carefully examine skeletal remains for clues to the sex and age at death of the individuals. They take measurements and look at muscle markings to determine body height and mass of the individual. The muscle markings also provide insights into the type of physical activity the person performed during life. Pathological features are evidence for a person's diet, the illnesses and injuries a person suffered from and, in some cases, for the cause of death. Epigenetic and odontological traits help identify kinship ties within a population. A well preserved skeleton can provide the anthropologist with a wealth of information about the deceased individuals and the population in which they lived. The reality is, there are rarely perfectly preserved skeletons to work with. Skeletons are frequently highly fragmented. Skeletal elements are missing or have been destroyed. Cremations represent an even higher degree of difficulty for the anthropologist.

The earliest known cremation was discovered at Lake Mungo in Australia and is believed to date to 40,000 B.P. (Bowler et al. 2003). In Europe, the earliest cremations are known from the Mesolithic. Twenty-seven cremations, 2% of the known Mesolithic burials (see Table 3 on page 20) are known from 11 sites (125 sites total) throughout Europe (Grünberg 2000, 43; Schunke 2004, 57). They became more frequent in the Neolithic and with the beginning of the Bronze Age, cremations were the primary funeral practice. The prevalence of cremations as the main funeral practice continued for 1,500 years throughout the reign of the Roman Empire (Wahl 1982; Herrmann 1988). For certain time periods, cremations represent the only source of human remains for anthropological investigations.

The first thorough anthropological investigations of cremations were undertaken in the 1930s by Krumbein and in 1934 by Thieme who performed the first “blind” investigation of cremated materials (Wahl 1982). Other noteworthy researchers include Waller, who developed the first guidelines for the investigation of cremated materials, and Kloiber, who developed the first metrical methods for the identification of cremations. In 1961 Chochol came up with the first five-step identification scheme for burn stages, focusing on the coloring and completeness of the cremation. A second five-step scheme was developed by Malinowski and Porawski in 1969. The latter took into consideration that skeletons do not burn evenly and also emphasized deformation and coloring.

The color and burn stage scheme that is used for the analysis of the cremations in this paper is a combination of the burn stage scale developed by Wahl (1982) during his experimental investigation of modern cremation in the crematorium of Mainz, Germany, in 1980 and the hardness scale defined by Herrmann in 1988 (Figure 18).

Experimental cremations and the study of the cremation process in modern day crematoria are invaluable for understanding what happens to a body when it burns. In modern crematoria, a body normally takes between 60 and 90 minutes to turn to ash, but may also take up to 3 hours. Gas jets produce a temperature within the oven of 700 to 1,000°C. These controlled conditions lead to the full oxidation of the organic materials. The soft tissue burns, thereby raising the temperature inside the oven without outside influence. The skeleton remains more or less intact. However, it is very fragile while it is still hot and breaks up as it falls into the collection pit. The remains are pulverized and collected in an urn for burial. The amount of time it takes for a corpse to burn is a factor of the temperature and the amount of oxygen in the oven. The amount of energy needed for a cremation in a crematorium has been estimated to equal 146 kg of wood (McDonnell 2001; McKinley and Bond 2001). Experimental cremations using a pyre are dependent on environmental conditions, the type of wood and whether the wood is fresh or dry (Grosskopf 2005). Wahl (1981) estimated that circa two cubic meters of wood are required for the complete cremation of an adult individual. The basic construction of a funeral pyre was an accumulation of wooden logs and branches, possibly arranged in the form of a box, on which the corpse and burial goods were arranged. Other models show that the body was placed inside the wood construction, or even underneath it. The important thing is that the logs are arranged in such a way to allow for a natural flow of air, of oxygen, around and through the pyre. The temperature of wooden funeral pyres could reach up to 1000°C, depending on the environmental conditions and the quality of the wood (Wahl and Wahl 1983, McKinley and Bond 2001; Grosskopf 2005). In the past, cremations were probably a two day process. After the pyre collapses, the remains continued to smolder and cool in the ashes. Only after the pyre had cooled off could the remaining ashes be collected and buried (Wahl 1981). Considering the time and effort and the financial burden involved in cremating one individual, it is highly likely that this burial form was reserved for privileged members of a society.

1 Chemical and Physical Heat Induced Changes

Human bone is made up of 60 to 70% inorganic materials such as calcium phosphate, or hydroxy apatite, water and organic collagen. The calcium phosphate, or apatite, is arranged in an uneven crystalline structure. When bone is heated it undergoes chemical and physical changes. At temperatures of 150°C to 300°C, water and organic substances are released from the bone. The bone shrinks slightly due to the loss of collagen. The color of the bone is yellowish-white and resembles that of unburned bone. Temperatures from 300°C to 600°C cause the bone to first expand and then shrink. The bone’s coloring changes from brown and black to bluish-grey. The crystalline structure then begins to change, the hydroxy bonds break apart and the crystalline structure begins to break up and reform into larger crystals. At this point, the bone is very fragile and breaks easily. At 600°C to 800°C, the structure of the bone continues to change as carbon dioxide is released from the bone. At temperatures above 800°C, the calcium and phosphate compounds in the bone, pyrophosphate and hydroxy apatite, combine to form Whitlockit (b-Tricalciumphosphat), which is the characteristic mineral in burned bone (HERRMANN 1972, - 1976a; - 1976b; - 1988). This reorganization of the structure of bone is a sintering process. Cremated bone can withstand the withering effects of aggressive soils better than unburned bones. A cremated bone is white. When buried, the bone will take on the color of the surrounding soil and, at first glance, may look like unburned bone. The melting point of bone is ~ 1,630°C (comparative melting points: silver ~ 950°C, glass 1,300-1,500°C) (DOKLÁDAL 1970; HERRMANN 1972; - 1976a; - 1976b; - 1988; WAHL 1982; HUMMEL and SCHUTKOWSKI 1986; MCKINLEY 2000). Figure 18 is a compilation of the five-step scale developed by WAHL in 1982 and the hardness scale developed by HERRMANN in 1988.

Burn Stages	I		II		III	IV		V			
Temperature	100°	200°	300°	400°	500°	600°	700°	800°	900°	>1000°	(°C)
Colour	yellowish-white, ivory	glassy	brown/dark brown	black	grey, bluish-grey	milky white, slightly chalky		white (surface is beige or grey when bone has been laying in the earth)			
Comments	looks like unburned bone	~1% shrinkage due to loss of water and organic substances	no further shrinkage until ~ 750°C	near complete charring of organic materials	inner compact bone may still be black	chalky surface, bone is light and very fragile, bone continues to shrink		smooth surface, when cool, bone becomes very hard parabolic heat induced tearing and shrinkage of bone (~10-12%)			
Hardness	decreases						transitional phase structure is not defined "chalky"		increases		
Comparative Materials					-glass becomes soft and malleable	-glass becomes a thick liquid			-melting point of silver	-max. temp. achieved by burning wood -melting point of gold -melting point of glass -melting point of bone	

Figure 18: Burn stages: The relationship between temperature, color, texture and hardness of cremated bone (*redrawn and adapted after* WAHL 1982, 21 Tab.1; HERRMANN 1988, 579 Fig. 274).

Experimental cremations on the microscopic level by SHIPMAN and co-workers (1984) and HERRMANN (1972, - 1976a; - 1976b; HERRMANN et al.1990) have provided new insights into the structural changes within burned bone and teeth. SHIPMAN and co-workers (1984) studied dentin, enamel and bone tissues of sheep and goats. They also classified five burn stages. In stage I (20 to <185°C) the microscopic structure of the tissues remains normal. During stage II (185 to <285°C) the surface of the tissues becomes irregular and begins to show increased roughness. In stage III (285 to <440°C) the surface begins to smooth out and appears glassy. In stage IV (440 to <800°C) the surface takes on a fleecy or frothy appearance. In the final stage V (800 to 940°C) the frothy particles melt into larger smooth and nodular shaped structures (SHIPMAN et al. 1984). HERRMANN (1976a) has observed that a sintering process takes place in bone at temperatures above 700 to 800°C. The lamellar structure of the bone smooths out as the minerals and crystals in the bone melt and reform into new and larger crystal structures. After reaching temperatures above 800°C the concentric structure of osteons is formed into a homogeneous surface that lacks the circular rings visible in unburned bone. The sintering process results in the loss of volume and the change in hardness of burned bone. The transitional phase is characterized by extreme brittleness and chalky appearance of the bone (HERRMANN 1976a; WAHL 1982).

1.1 Hardness

Living bone is a very solid and elastic substance. As illustrated in Figure 18, when bone is burned it looses its elasticity and reaches a minimum of solidity and hardness at about 400°C. Continuous heating of the bone from 400°C increases its hardness, which reaches a maximum at about 800°C (HERRMANN 1976a). However, while the bone is still hot it is extremely brittle and can snap like a twig. Only after it has cooled off does it reach its maximum hardness, which is twice that of unburned bone. This is due to the sintering process (localized melting). Temperatures of 700°C to 800°C cause the lamellar structure of bone to “melt” and form a homogeneous mass of crystals. As the crystals in the bone are heated, they expand and combine with other crystals to form larger apatite structures. This loss of the lamellar structure and the expansion and merging of crystals leads to a decrease in volume and shrinkage of the bone (HERRMANN 1976b; WAHL and WAHL 1983; - 1984; HUMMEL and SCHUTKOWSKI 1986; MCKINLEY 2000).

1.2 Shrinkage

The amount of shrinkage depends on the mineral structure of the bone, its location in the skeleton and proximity to the source of heat, as well as on the overall physical status of the cremated individual. As stated above, the first stage of shrinkage takes place at temperatures of up to 300°C, when water and organic compounds are released. The bone’s size remains relatively constant up to 750°C, while the effects of shrinkage reach their maximum at about 800°C, when the mineral structure begins to change through the sintering process. The denser the mineral content of a bone or part of a bone is the less it will shrink. The length may be affected to a different degree than the diameter of a bone. Shrinkage of 25 to 30% is calculated for the cross section of the femur shafts and 5 to 10% for the lengthwise shrinkage of long bones in general, an average of 12% is calculated for the femoral head. The shrinkage factor varies within a single bone; measurements on experimental burned radii indicate shrinkage of 1.9 to 2.5% on the cross section of the shaft and 3.8 to 5.0% on the radius head. The epiphyses are more strongly influenced by shrinkage than the shafts. “These figures imply that there is no reliable overall shrinkage factor; they suggest variability not only between individuals, but also between different skeletal elements [within the same body]” (MCKINLEY 2000, 406). Since it is impossible to reconstruct the original measurements for cremated bone, HERRMANN (1976b) proposed that, for practical purposes, shrinkage of 10% should be assumed for bones which have been completely burned. DOKLÁDAL (1970) experimented with the effects of shrinkage using five modern cadavers from the dissection lab at an anatomical institute. The bodies were cut lengthwise and one half of each body was burned in a crematorium. The flesh was removed from the other half of the bodies and used as a control sample. The burned bones were compared to the unburned bones of the other body halves. A general shrinkage of up to 15% was calculated for the cremated bones (Dokládal 1970). An average factor of 12% has been generally agreed upon (Wahl 1982; Herrmann et al. 1990; McKinley 2000).

1.3 Fissures, Tears and Deformations

The high temperatures necessary to burn bone are characterized by the chemical and physical changes they leave behind. The variations in color and surface structure of the bone have been discussed and are critical for determining how high the temperature for burning was. Other physical changes that identify burned bone are the fissures, tears and deformations which occur with varying frequency and concentration dependent on the height and intensity of the burning as well as on the body mass of the individual being burned. A bone may simply shatter or break apart, either parallel to or straight across the long axis of a bone. Parabolic or "U-shaped" fractures along the shaft of long bones are usually oriented symmetrically along the length axis of the bone. Concentric fractures occur on both sides of the vertebral bodies, polygonal fractures show up on the proximal heads of long bones and cranial vault bones. All tears, either parallel or perpendicular to the bone's long axis tend to be slightly parabolic in shape. Heat fissures, heat fractures and twisting occur only on fresh bones or on bones still covered with organic substance (Herrmann 1972, - 1976a; McKinley 2000). The lack of organic compounds and water in bones prior to being burned do not cause the bone to twist and fissure due to dehydration. Cremation experiments with cadavers freshly stripped of most of their flesh show that freshly macerated bones undergo the same degree of twisting and fracturing as cremated bodies do (McKinley 2000).

2 Weight, Fragmentation and Completeness

Besides testing the techniques for cremating a body, researchers have also performed numerous experiments to find out how the cremation process affects the body. The bone weight after cremation was thoroughly studied by authors such as Malinowski and Porawski (1969), Herrmann (1976a; b) and Trotter and Hixon (1974). Malinowski and Porawski (1969) found that the average weight of bone from the cremation of males was 2,004 g and 1,540 g for females. Experimental cremations range from 1,534 g to 3,605 g for males and from 952 g to 2,302 g for females. The difference in bone weight between males and females was confirmed by experiments carried out by other researchers (Herrmann 1976a; Trotter and Hixon 1974). The weight of the remains of an adult individual can vary between 200 to 2,500 g, depending on how completely and how carefully the bones were collected. Herrmann (1976a) concluded that although there was a difference in the average weight of the cremations of males and females as well as a slight difference in cremation weight dependent on the age of the burned individual, the weight of a cremation could not be used as a diagnostic characteristic for determining the sex of a cremated individual. These weights and the difference in weight between the sexes were determined using cremations from controlled experimental conditions. These findings cannot be applied to archaeological burials because these rarely, if ever, contain complete cremations.

Cremations, and burials in general, are subject to pre-depositional disturbance, suffer damage in the soil due to erosion and are destroyed and scattered by modern day activities such as ploughing and construction. It is highly improbable that the weight of burned bone found in archaeological contexts is significant for the determination of the sex of the deceased individual. At most, it can provide useful information about the preservation of the cremation in relation to others from the same and related sites.

It is commonly required that the weight and fragmentation of a cremation is recorded in order to determine its completeness. There are a number of factors, besides the physical weight and size of the cremated individual, that influence the amount and weight preserved. Depending on how important it was to include all of the burned remains of a cremated individual in the burial influenced the diligence with which the remains were gathered and collected from the funeral pyre. The presence of small bones such as fingers, toes or teeth is a clue as to how carefully the ashes were gathered. The efficiency with which a cremation could be collected and reburied is represented by cases where even the smallest hand and wrist bones have been identified. At times only the remains which could be identified as human were collected, leaving the burned debris behind. A person’s standing within the community may have influenced with how much care their remains were handled. The remains of a highly respected or high ranking individual may have been taken care of more carefully than those of someone with a lesser status. An individual who might have been dangerous to the community after death would have been treated differently, for example by systematically leaving certain parts out of the burial or burying them in a separate location in order to hinder the person’s spirit from returning. Another reason why parts of a cremated individual may be missing is that family members kept parts of the deceased for a separate burial rite. The amount of care with which cremations were collected for further burial varies from site to site and from grave to grave (Wahl 1982; - 1983; - 1988).

Weight is not a reliable factor for determining the overall completeness of a cremation although it is an indicator as to whether one can expect to find remains from a complete individual or not. The amount of fragmentation is dependent on the amount of care with which the cremated remains were treated after cremation. Directly after the burning process has been completed and the bone is still hot, the remains are extremely fragile and brittle (Herrmann 1976a; Wahl 1981). Observations of burnings in crematoria have shown that long bones remain intact until they are dropped into the collection bin beneath the furnace. There they break apart into small fragments circa 10 to 15 cm in length (Wahl 1981). It can be assumed that in prehistoric cremations only about half of the burned material even made it into the burial (Chochol 1961 in Wahl 1982). Cremated remains were usually placed into urns, buried in pits or strewn over designated areas such as cemeteries or possibly ritual spaces (Herrmann et al. 1990). In some cases, the average fragment size of two centimeters for cremated remains in urns gives the impression that the fragments were broken up before they had cooled off prior to being placed into the urn (Gejvall 1963; Wahl 1981). Further loss and damage of the cremated material can occur while it is resting in the ground. In the ground, the cremated remains become subject to the effects of nature and the events occurring above ground. Modern day farming and construction work have damaged many archaeological sites and added to the destruction of buried remains. Grave goods such as urns, pottery or stone tools are often the only clues that indicate the burial site of a cremation. (Wahl 1982).

3 Sex Determination

The morphological method of sex determination is based upon the size, shape and form of a bone. Warping, twisting, fracturing and shrinking can cause these traits to become unreadable for the anthropologist. The skull and pelvis are the most important bones for the identification of sex. On the pelvis, the *Incisura ischiadica major*, the *foramen obturatum* and the *preauricular sulcus* represent the main features used to determine the sex of a skeleton (Acsádi and Nemeskéri 1970; Wahl 1982). However, bones of the pelvis are among those that suffer the most under the influences of heat. The important characteristics are rarely, if ever preserved. The bones of the skull are the most important sex-defining parts (Heussner 1992). The features of the skull which are most useful in identifying the sex of an individual are the supraorbital ridge, the upper edge of the orbits, the mastoid process, the occipital nucal crest, the mandibular condyles and the mandibular angle between the ramus and the body. On the postcranial skeleton, the size of the epiphyses and the robustness of the *linea aspera* are the most useful for determining the sex of a skeleton. The general robustness of the bones of the cremated individual can also help to sex an individual (Acsádi and Nemeskéri 1970; Wahl 1982). Gracile individuals are most likely juveniles or females. Robust individuals are often male. Whether an individual can be considered gracile or robust is relative based on the overall robustness of the original population. An individual, who would be considered robust in a population of small, gracile people, would be termed gracile in a population of strong and robust people. The robustness of a cremated individual is based on the overall impression of all fragments in the cremation compared to the remains of other cremations from the same population.

Each trait, although found within the spectrum of the same body, must be identified and sexed individually and without reference to the other traits. When the features being examined do not point towards one sex, then measurements must be applied in order to identify the individual. The morphological method of determining the sex of cremated material leaves much to be desired when the fragmentation of the material becomes too great or if the bones required for sex identification have been completely destroyed by the burning process. Metrical methods have had great success in determining the sex of a cremated individual. For a very promising method, the thickness of the wall of long bones or of the bones of the cranial vault is measured (GEJVALL 1963; SCHUTKOWSKI and HUMMEL 1987). According to GEJVALL (1963, p. 475) "out of any two individuals of equal size, the walls of the bones of the female will on average be 1/3 –1/4 thinner than those of males." VAN VARK et al. (1997) and RÖSING (1977, 55 Tab. 2) list measurements, which can be taken even from cremated material.

A shrinkage value of 12% was factored into the calculations. These values can only be taken as a guideline, a point of reference, and cannot be applied to the evaluation of a new series of cremations. Since members of two populations can show significant diversity in body shape and size, it is important to establish equivocal values for each individual population. A combination of the mentioned morphological and metrical methods for determining the sex of a cremated individual should allow for 75% of the examined individuals within a series to be sexed correctly (RÖSING 1977; WAHL 1982; - 1996; SCHUTKOWSKI and HUMMEL 1987).

3.1 Determining Sex from the *Pars petrosa*

The angle of the *meatus acusticus internus* of the *Pars petrosa* has recently been accepted as a useful method for determining the sex of cremated materials (WAHL 1982; WAHL and GRAW 2001; GRAW et al. 2005; NORÉN et al. 2005). The *Pars petrosa* is a very durable and compact bone located on the interior surface of the temporal bone. It frequently survives the cremation process intact. WAHL (1982) attributes a shrinkage of 12% to a completely burned *Pars petrosa*. However, this shrinkage does not seem to influence the effectiveness of the method. In general, the *Pars petrosa* of males is broader and lower than that of females. The surface of the posterior facet is more bulging in females than in males. The primary sex defining characteristic is the steepness of the angle of the *meatus acusticus internus*. A cast of the *meatus* was taken using "dentist's modeling cement" which, once mixed, hardens and retains its shape after the cast is removed. The cast represents a negative of the *meatus acusticus internus*.

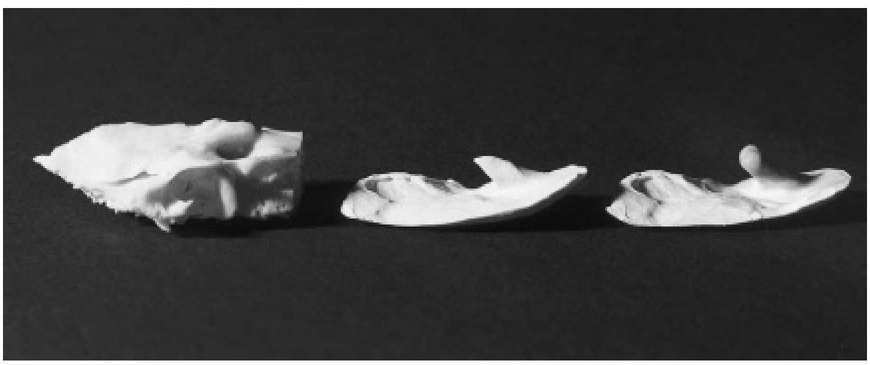


Figure 19: Casting technique for sexing using the Pars petrosa: Pars petrosa (left), casts (middle and right) (GRAW et al. 2005, 114 Fig. 1)

It is now possible to measure the lateral and the medial angle of the cast to the surface posterior facet. A medial angle greater than 45° is characteristic of females, less than 45° is characteristic of males (Wahl 1982; Wahl and Graw 2001; Graw et al. 2005). The study of 410 modern *Pars petrosa* (248 ♀ age 19-94, avg. 47.7 years; 162 ♂ age 21-95, avg. 54.5 years) by Graw et al. (2005) defined the following variances: Lateral angles below 40° or medial angles above 155° speak for male, lateral angles above 65° and medial angles below 133° speak in favor of female *Pars petrosa*. In the study, the lateral angle had greater diagnostic value since it could be used to classify two-thirds of the samples correctly. Including the medial angle did not significantly improve the evaluation.

A preliminary study by Forschner (2001) suggests that the method can also be applied to determine the sex of sub-adult individuals. Eighty-eight percent of the studied males between 0 and 18 years and 86% of the females were correctly sexed using this method. Graw et al. (2005) found no significant age dependencies relating to the usefulness or accuracy of the method. Another characteristic feature is the sharpness of the medial angle. For males, the angle is sharp, in females it is blunt. In addition, a rugged morphology of the posterior surface of the *Par petrosa* is characteristic of females, a smooth surface is characteristic of males. In sum, a steep angle of the *meatus acusticus internus*, a rugged posterior surface and a blunt medial angle are distinguishing features of a female *Pars petrosa.* A flat angle of the *meatus acusticus internus*, a smooth posterior surface and a sharp medial angle are distinguishing features of a male *Pars petrosa.*

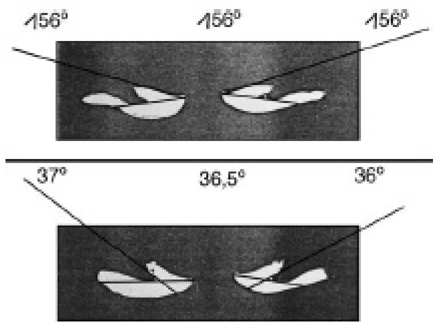


Figure 20: Illustration of the lateral (top) and medial (bottom) angle from the cast of the meatus acustic internus of the Pars petrosa of a male individual (Graw et al. 2005, 115 Fig. 3).

4 Age Determination

The label "age" refers to the biological age of an individual at the time of death and not to the chronological age, the number of years that the individual had actually lived (Rösing 1977, Wahl 1982; Herrmann et al. 1990). The methods of age determination are applied to the characteristics of the body, which grow and change throughout the lifespan of a person. These are influenced by the person's environment and lifestyle, making a chronological age determination highly unlikely. The methods used when investigating the age of a cremated individual again are the same as those utilized when working on unburned material and their effectiveness relies heavily on the fragmentation of the bones.

It is easiest to determine the age of children from cremated materials. Teeth, which are still inside the mandibular or maxillary bone, can survive the cremation intact. Tooth eruption schemes have been worked out by various authors (for example: Rösing 1977; Ubelaker

1978). Once the permanent teeth have all erupted they are no longer a reliable source for determining the age of a cremated individual. Determining the age by using dental attrition, which is an age defining characteristic in unburned bone, is no longer possible when the enamel of teeth has been shattered. The last permanent tooth, the M3, starts coming in by the age of 18 and is fully developed by the age of 35. WAHL (1982) observed that teeth were not as common in his assemblages as had previously been assumed and suggests that other characteristics, such as growth and development of long bones (RÖSING 1977), growth of cranial vault wall or epiphyseal fusion might provide promising results when working with cremated material. In cases in which the teeth and epiphyses are missing, the thickness of the cranial vault bones in the region of the calvarium or of the compact bone of the shaft of the radius and femur have also been cited as important age-defining characteristics in children and adolescents (MÜLLER 1964; WAHL 1982). The end phases of the *infant I* and *infant II* age category are marked by growth spurts both in length and thickness of the bones (WAHL 1983). The latest epiphyses on the postcranial skeleton, the sternal end of the clavicle and proximal end of the humerus, close by the age of 25 in males and 23 in females (see figure 149 in SZILVÁSSY 1988, 424).

The lack of age-defining characteristics that survive the cremation process makes age determination difficult, especially in the adult stages. The typical characteristics such as the morphology of the pubic symphysis, the auricular surface of the ilium, the sternal ends of the ribs or dental attrition are of limited value for determining the age of a cremated individual (RÖSING 1977; MCKINLEY 2000). Certain pathological changes of the skeleton may be of use for age determination of a cremated individual. For example, arthritis of the vertebral column or the ossification of ligaments on vertebra or bones of the extremities are characteristics of skeletons in the age class of *mature* or older.

Most anthropologists depend on the cranial suture fusion for aging since cranial pieces with sutures are recovered fairly frequently. A simplified version of this fusion is the progressive closing of the sutures, the inside sutures before the respective outside ones, beginning with the coronal and sagittal sutures (RÖSING 1977; SZILVÁSSY 1988, 430). The age spectrum applied to these features is relatively broad. This method of age determination is not without its problems either. It is difficult to identify the correct position of a small cranial fragment with traces of a suture. Wormian bones in a cranial suture may also provide false information if they are not identified correctly. In addition, the fusing process is erratic and cannot be pinpointed easily. To top it off, during the cremation process, partially fused sutures may break apart, rendering an age that is too young.

Teeth are also affected by the high temperatures that occur during cremations. According to DOKLÁDAL (1970), the first changes in color take place between 200°C and 250°C. The tooth turns from white to pale yellow; there is no change in the tooth's structure at this point. At temperatures around 350°C, the color changes to a darker reddish-yellow with the dentin turning a dark grey (SHIPMAN et al. 1984). Fractures show up along the enamel and root portions of the tooth at around 400°C. The color changes to black and blue on the inside. The tooth crown bursts off and the roots of the tooth twist and become deformed starting at temperatures greater than 600°C. The color of the outside of the tooth is greyish-white, the inside bluish-grey. At temperatures greater than 800°C the tooth enamel is completely destroyed and only dentin and root fragments remain. Teeth that remained within the alveoli and had not erupted at the time of cremation may survive intact without the loss of a crown (Dokládal 1970).

4.1 Tooth Cementum Annulation (TCA)

Recent experiments on the tooth roots recovered from cremated materials provide a promising but time consuming method for determining the age of an individual by counting the growth lines in the dental cementum (McKinley 2000). While tooth roots are subject to shrinkage due to the cremation process, the internal structure remains unaffected. Ideally, 20 cross-sections of a tooth are required to cover the entire tooth spectrum. The number of counted rings plus the age of tooth eruption allow an estimation of the age at death (Grosskopf and Hummel 1992). When sex of the individual and tooth being analyzed are known, Grosskopf (Grosskopf and Hummel 1992; Grosskopf 2005) add a margin of error of ± 3.23 years. When the tooth being analyzed cannot be identified because the enamel had popped off during the cremation process or the sex is unknown, the margin of error increases and it is not possible to pinpoint a single age at death but rather an age-span during which the individual may have died. Grosskopf herself points out that this method can be a very accurate method for determining the age of a cremated individual, but at this point it should be used in correlation with the morphological and other histological identification methods.

TCA Method

For this thesis, nine single rooted teeth were selected from seven cremations from Schwetzingen (four teeth from Grave 135, Grave 202 and Grave 209) and Fellbach-Oeffingen (five teeth from Grave 38, Grave 47, Grave 77 and Grave 81). For a detailed description of the method see Grosskopf 2005 and Francken 2006.

1 The teeth were embedded in a two component synthetic resin (*Biodur*). It is made up of a resin and a hardener (ratio 100:28). The embedded teeth are then placed into an exicator with -0.8 bar pressure for 24 hours in order to remove any air bubbles trapped in the resin. The resin block was then dried for an additional 24 to 48 hours at 30°C so that the resin could harden completely.

2 The blocks were ground into smaller blocks to ease the following cutting with the inside hole saw (Sägemikrotom or Innenlochsäge). The sharp blade of this saw is located on the inside. A mobile arm slowly presses the resin block against the rotating blade. In a first step, the top third of the tooth was cut. Then the height of the arm was adjusted so that a 70-100 µm thin section could be cut. The mobile arm was set to speed 5. At this speed, a

thin section can be cut in 15 to 20 minutes and the traces left by the rotating saw blade are minimized. Whenever possible, three to five sections were cut. This was not always possible because the saw literally pealed the cut tooth away, leaving a tooth-cross-section-shaped hole in the thin section.

3 The intact sections were clued onto a microscope slide using *Eukitt* and covered with a cover slip. All prepared slides were also placed into an exicator for 24 hours to remove any bubbles in the *Eukitt.*

4 The sections were looked at underneath a transmitted light microscope at 200 to 400 times magnification. A digital camera to transfer the picture to a computer was attached to the microscope. However, the image was much more clear and sharp through the lens of the microscope. The tooth rings were counted starting with the eruption ring (Figure 21). Either the dark or the light rings were counted at a minimum of four different locations on each tooth section. The average number of counted rings was added to the age of eruption of the tooth to determine the age of the individual. A standard deviation of 2.5 years was added.

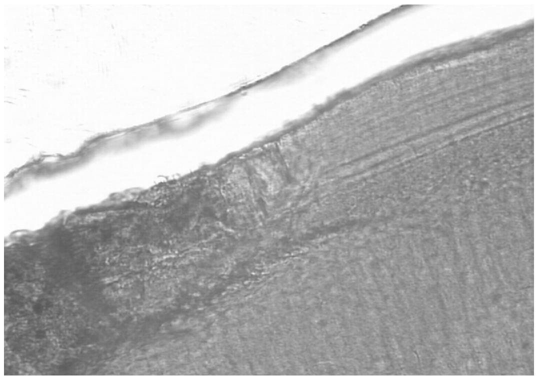


Figure 21: Thin section of an incisor Grave 77, Fellbach-Oeffingen, 200x magnification.

5 Counting the rings was very difficult. The structure of the tooth had changed due to the intense heat affecting the teeth. The structure was cloudy and rounded (Figure 22), the dentin rings were frequently no longer observable. Another difficulty was that the exterior rings of the dentin had splintered off during the cremation process. Therefore, any age determination must be understood as a minimum age since it is not possible to reconstruct how many rings were destroyed.

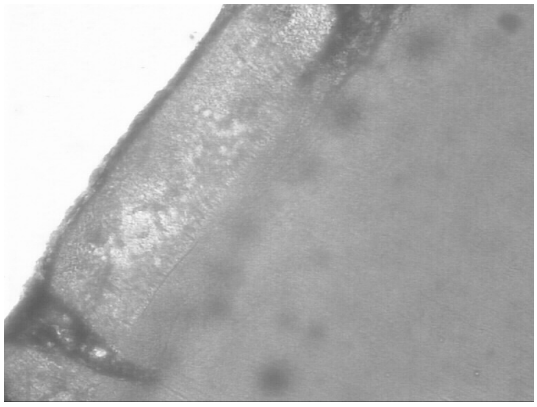


Figure 22: Thin section of an incisor/canine Grave 209_1, Schwetzingen, 200x magnification.

4.2 Histological Age Determination

Bone structure changes throughout the life span of an individual. During childhood and adolescence bone is formed, remodeled and resorbed on a regular basis. In adulthood the bone is continuously remodeled, replacing old or damaged bone. The original trabecular bone is replaced by lamellar bone, which forms around blood vessels. These systems are called osteons. During bone remodeling, the bone is resorbed by cells called osteoclasts. These cause holes in the bone, which can in turn be refilled by lamellar bone and are called secondary osteons or haversian systems. The more remodeling and resorption occurs, the more the original lamellar bone and primary osteons are replaced. Osteons and haversian systems become more regular and may also cut across each other. With age, more bone is resorbed than can be rebuilt, lacunae remain open, weakening the bone. These structural changes can also be observed in cremated bone. This makes an age determination into the age categories *juvenile*, *adult*, *mature* and *senile* possible. Figure 24 illustrates the four histological stages identified and described by Grosskopf (2005) in her unpublished dissertation.

For this thesis, nine femur fragments from the seven cremations from Schwetzingen (six fragments from Grave 135, Grave 202 (Figure 23), Grave 206 and Grave 209) and Fellbach-Oeffingen (three fragments from Grave 63, Grave 103 and Grave 105) were selected for age determination with the histological method. The fragments were embedded in synthetic resin *(Biodur* – see section TCA Method). The resin block was cut in half with an inside hole saw. At first, 200 - 300µm thin sections were cut and looked at underneath a transmitted light microscope. It was very difficult to cut the thin sections because the bone was very soft and the sections did not remain intact. After some discussion, the author decided to look at the cut surface of the resin block underneath a regular microscope. The structures of the femur were clearly visible at the lowest level of magnification. The following analysis was carried out using the cut surface of the resin block.

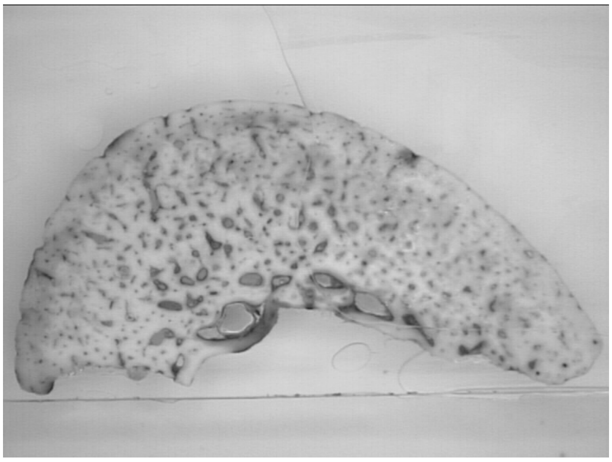
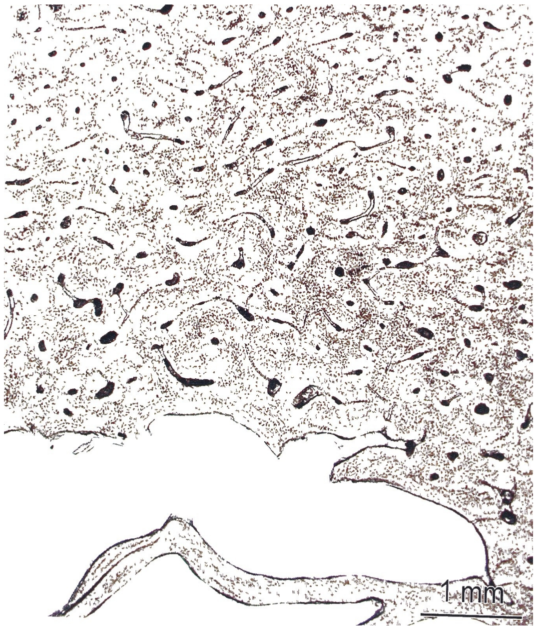
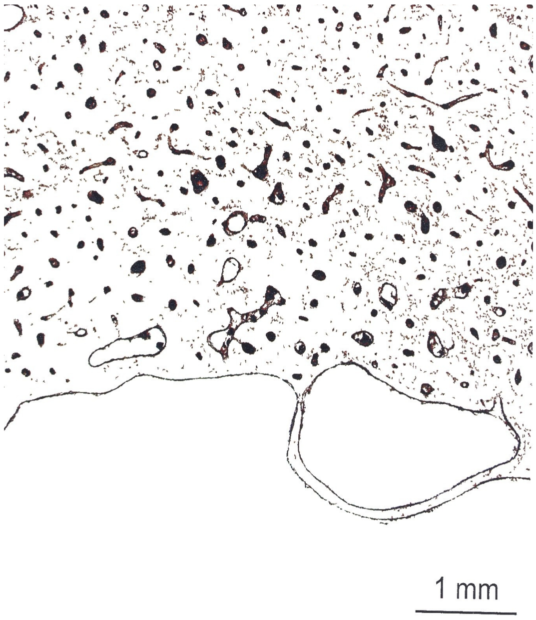


Figure 23: Histological section of a femur from Grave 202, Schwetzingen, size: 12.8 mm

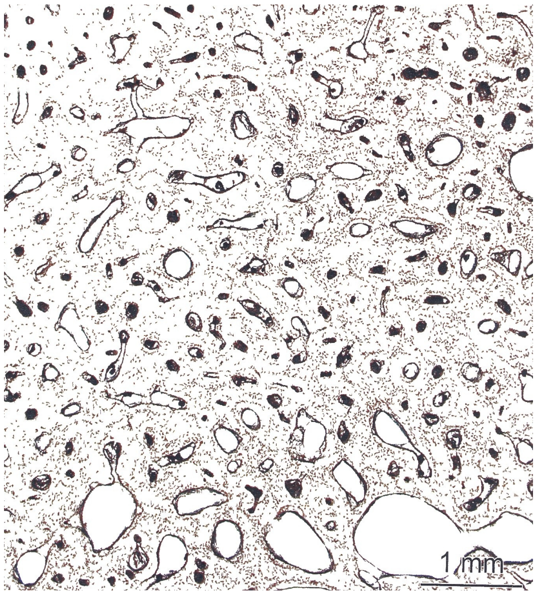
a. *juvenile*: the structure is made up of lamellar bone and irregular shaped osteons. These are often arranged like a row of pearls "perlenschnurartig".



b. *adult*: the amount of lamellar bone decreases. It only occurs in the periosteal region. The osteons are irregular but become more regular in the late *adult* phase.



c. *mature*: the bone structure is homogeneous. The osteons are of similar size and shape. Very few lamellar bone is present. Resorption lacunae begin to occur in the late *mature* phase.



d. *senile*: the number of resorption lacunae increases, they also occur in the periosteal region.

Figure 24: The internal structure of the femur compact bone as a method for age determination described by GROSSKOPF 2005, 55ff*, diagrams adapted from* MAAT et al. 2005.

5 Measurements and How to Take Them

Metric data can be used for age and sex determination and to differentiate between different populations or groups within a population. Metric sex determination relies on the fact that “out of any two individuals of equal size, the walls of the bones of the female will on average be 1/3 – 1/4 thinner than those of the male” (GEJVALL 1963, 475). GEJVALL (1963) proved his theory by taking measurements on 50 male and 49 female modern cremations selected from crematoria in Stockholm. The statistical analysis of his data shows that a sexual difference does exist for the majority of the series. Measurements of the wall thickness of the cranial and long bones were also studied by SCHUTKOWSKI and HUMMEL (1987) and WAHL (1996). SCHUTKOWSKI and HUMMEL (1987) evaluated skeletal material from three cemeteries, two from the pre-Roman Iron Age and one from the migration period, 2nd to 6th century A.D. They found a significant difference in the strength of the cranial vault walls and in the strength of the humerus, radius and femur wall in the middle of the diaphysis (see D.5.1). The cranial vault wall thickness (Ms1) was 5 to 23% thinner for females compared to the males, the humerus wall thickness (Ms28) 11 to 24% thinner, the radius wall thickness (M33) 13 to 21% thinner and the femur wall thickness (Ms44) 4 to 15% thinner. WAHL (1996) built upon the study of the cranial vault wall thickness and looked at cranial vaults from 15 series dating from the late Bronze Age and including material from modern crematoria. The cranial vault wall of females was between 1 and 28% thinner than that of males, on average 9%. Without the measurements from the modern crematoria the range narrows to 9 to 27% thinner, with an average shrinkage value of 12%. In this study, the experimental shrinkage values calculated by WAHL (1988, 105ff) for the cremations from the Roman cemetery at Stettfeld (20% for cranial vault wall thickness, 15% for epiphyses and 10% for long bones) are used.

A similar metrical significant difference exists for children and juvenile cremations (WAHL 1983). The Roman cemetery Süderbrarup contained 763 cremations of 780 individuals, 184 belonged to sub-adults. One third of these sub-adult cremations contained the remains of teeth, which made an age determination possible. WAHL (1983) took measurements of the thickness of the cranial vault wall and the thickness of the wall from radius and femur diaphyses from these sub-adult individuals and plotted the results in a growth curve. The measurements from the remaining 60 sub-adults were compared to this growth curve to help determine these individuals' age. How well these data can be applied to other populations still waits to be seen, but the investigation of large series like these will help advance the method and improve the diagnostic value of cremated materials.

5.1 Definition of Measurements for Cremations

WAHL (1988, 48ff) has defined a set of 59 measurements, some adopted from different authors and others adapted or specifically defined for cremations. Which measurements can be applied to a specific series depends on the overall preservation of the cremated material. If a bone was not preserved in the cremation, it is simply not possible to take any measurements from it. The following measurements were applied to the cremations discussed in this thesis (* defined by Wahl specifically for cremations, WAHL 1988, 48ff):

1. Thickness of the cranial vault wall, take ~ ten measurements from the area above the "hat line" and calculate the average thickness (GEJVALL 1963, Ms1a).

2. Cranial wall thickness between *Protuberantia occipitalis externa* and *Eminentia cruciata* (GEJVALL 1963, Ms1b).

9. *Processus frontalis* of the zygomatic bone: breadth between the *Frontomalare temporale* (fmt) and *Frontomalare orbitale* (fmo) *.

10. *Processus frontalis* of the zygomatic bone: smallest breadth between the *Processus marginalis* and the inner edge of the orbit *.

11. *Processus frontalis* of the zygomatic bone: breadth between the inner lateral edge of the orbit and the *Jugale* (j), parallel to the *Processus frontalis* *.

16. Breadth of the mandibular corpus near the 2nd molar.

17. Transverse thickness of the mandibular condyle (VAN VARK 1997, Ms3).

18. Sagittal thickness of the mandibular condyle (VAN VARK 1997, Ms4).

19. Thickness of the coronoid process of the mandible, 2 mm underneath the apex *.

20. Transverse diameter of the *Dens axis* (HELMUTH/REMPE 1968).

21. Sagittal diameter of the *Dens axis* (HELMUTH/REMPE 1968).

22. Height of the *Dens axis*, from the caudal surface to the apical end of the *Dens* *.

26. Breadth of the glenoid cavity of the scapula (MOLLISON 1938, Scapula Ms8).

27. Average diameter of the proximal epiphysis of the humerus (GEJVALL 1963, Ms3a+b).

28. Thickness of the humerus wall in the middle of the diaphysis (GEJVALL 1963, Ms3c).

32. Average diameter of the proximal epiphysis of the radius (measurement needed to determine body height) (MÜLLER 1958, RÖSING 1977).

33. Thickness of the radius wall in the middle of the diaphysis across from the interosseous crest (GEJVALL 1963, Ms4).

39. Average diameter of the proximal epiphysis of the femur (RÖSING 1977).

43. Breadth of the *Linea aspera* near the middle of the diaphysis, range and average value *.

44. Thickness of the femur wall in the area directly across from the *Linea aspera* (Gejvall 1963, Ms2).

45. Height of the patella (Mollison 1938, Patella Ms1).

46. Transverse breadth of the patella (Mollison 1938, Patella Ms2).

47. Maximal thickness of the patella (Mollison 1938, Patella Ms3).

50. Maximal thickness of the *Margo anterior* of the tibia *.

The measurements were taken with a sliding caliper (1/20 mm) with a digital display. The diameter of the proximal epiphysis of the humerus and femur was determined by holding it against a piece of millimeter paper.

It is possible to determine the age of a cremated individual even if this process is somewhat more difficult than with unburned bone. The same techniques and age defining characteristics can be applied to the cremated bone as long as the bone or portion of the bone necessary for the various methods is available and not too badly fragmented. Morphological, metrical and histological methods should be applied side-by-side in order to achieve the most complete and secure age determination. In the case that one or more of the methods cannot be employed, the remaining methods should be applied with the utmost care.

6 Height Determination

It is only possible to determine the height of a cremated individual if certain pieces such as the proximal epiphyses of the humerus, radius or femur are present. The height determination is calculated by correlating the diameter of the epiphysis with the length of the bone. This length is then used to calculate the body height just as it is calculated with the directly measured length of a bone. There is a great margin of error due to the shrinkage caused by the cremation process. An additional error comes from the double correlation, first from the epiphysis to the bone length and then from the bone length to the body height. There is also an error because each population is unique, which means the correlation factor is different (Wahl 1982; - 1983, 50). Tables for the determination of body height from the proximal epiphyses of the humerus, radius or femur are available from Malinowski and Porawski (1969, Tab. III) and Rösing (1977, Fig. 2). There is a great degree of variation between the two tables. In the studied cremations, differences of up to eight centimeters were recorded between the two methods. The different burn stages and the resulting shrinkage have affected the bones from all of the cemeteries in this study to various degrees. It is possible to make comparisons with a population, but there is doubt whether a comparison across populations can deliver reliable results.

7 Pathology and Epigenetic Characteristics

It is possible to observe the same pathological or epigenetic traits on cremated bone as it would be on unburned bone even though the strong degree of fragmentation, twisting, warping and fissuring of the burned bone make it relatively difficult to do.

The experimental studies helped establish a methodology for the investigation of cremated materials. In general, the methods are no different from the ones applied to unburned skeletal material. The first step is to identify the degree to which the material was burned. This includes identifying heat induced changes, chemical as well as physical, in order to determine burn stage and burn temperature. It includes looking at the color, the hardness and chemical status of the bone. The cremation is further examined for its completeness and weight. It is essential that fragmentation, shrinkage and deformation of the bone due to heat is considered because these factors affect the features to be studied in the next stage of the identification process, age and sex determination. The anthropologist working on cremated material must be familiar with the effects of heat and the influence of burning on all age and sex specific traits available for study on human bone. Morphological and metrical methods are used to determine the age and sex as well as body height, stature and racial background of the deceased. Although it is rare, pathological and epigenetic changes on the bone may survive the burning process. Thin sections of the teeth and the femur may also be helpful in narrowing down the age. An overall discussion of the results should include references to all of the above mentioned points as well as to experimental research methods that can shed more light onto the cremation process.

E. Material and Methods

1 The Cremations

As mentioned above, 12 cemeteries with a total of 350 cremations are cited in the literature (see C.1). The dating of the cremations from four cemeteries (Hollogne-aux-Pierres, Niederdorla, Kleinhadersdorf and Nitra) into the LBK is not clear. The cremations from Nitra were not preserved and would not be available for study even if the dating were more clear. Therefore, these were not included in this study. The 11 cremations from Niedermerz were not recovered and can therefore also not be analyzed. The cremations from Aiterhofen-Ödmühle and Stephansposching were not available for study. The data for the cremations from Aiterhofen and the single cremation from Stuttgart-Mühlhausen "Viesenhäuser Hof" were compiled from the unpublished publications by LANTERMANN (1980) and BURGER-HEINRICH (in prep.) and are incorporated into the demographic analysis. The author was able to analyzed the cremations from the remaining five cemeteries (Elsloo, Schwetzingen, Fellbach-Oeffingen, Wandersleben and Arnstadt). The cremations from Elsloo were evaluated in the archaeological museum of Leiden. The cremations from Wandersleben were evaluated in the satellite station of the Landesamt für Denkmalpflege Weimar in Kromsdorf. The cremations from Arnstadt were made available to the author and evaluated in Tübingen. The cremations from Fellbach-Oeffingen were stored in the osteological repository of the Landesamt für Denkmalpflege Baden-Württemberg in Rottenburg, the cremations from Schwetzingen in the osteological repository of the Osteological Branch Office of the Landesamt für Denkmalpflege Baden-Württemberg in Konstanz and evaluated in Tübingen.

2 Problems with Age Determination

The methods for age determination were described in section D.4. Although this author attempted to determine the age of the cremated individuals as carefully as possible, it was frequently only possible to determine the age as an age range, e.g. as "*juvenile* or older". Adults could rarely be separated into *adult*, *mature* or *senile* categories. Therefore, for the evaluation, the author has chosen to limit the age labels to the terms "children", "juveniles" and "adults". This simplification of the age categories allows a better comparison between the cemeteries. However, it is also an oversimplification, which ignores certain conspicuous features among the age distribution such as the gross over- and under-representation of *juvenile* and *senile* individuals, as described below. Therefore, an age distribution using all six age categories (in italics) is presented first. The simplification to three categories (regular font) is only used when it is necessary to compare the figures. Children include the cremations of the categories *neonatus*, *infant I* and *infant II*. Juveniles include the cremations aged as *juvenile* and a fraction of the individuals defined as "*juvenile* or older" and "*infant II* or older". Adults include *adult*, *mature* and *senile* individuals.

This decision gave rise to the question what to do with the individuals whose age determination spans two or more of the age ranges used in the evaluation. The possibilities both have their advantages and disadvantages. The first option, which is most commonly used and was applied in my master's thesis, divided the individual equally across all age categories in question.

For example:

"*juvenile* or older"

= *juvenile*, *adult*, *mature* or *senile*

= 1/4 *juvenile*, 1/4 *adult*, 1/4 *mature* and 1/4 *senile* = 1/4 juvenile and 3/4 adult.

"*infant II* or older"

= *infant II*, *juvenile*, *adult*, *mature* or *senile*

= 1/5 *infant II*, 1/5 *juvenile*, 1/5 *adult*, 1/5 *mature* and 1/5 *senile*

= 1/5 children, 1/5 juvenile and 3/5 adult

Using this option, the *juvenile* and *senile* individuals, the two ends of the spectrum, will be over-represented in the demographic analysis. Sometimes it was only possible to eliminate the very young *infant I* age category, resulting in the age determination "*juvenile* or older" and thereby in a gross over representation of the actual number of juvenile individuals. This same label is also responsible for the large number of *senile* individuals. However, it was only possible to identify 1 definite *senile* and 1 *mature* to *senile* individual, less than 1%, among the 217 studied cremations. Using this option, 23 additional *senile* individuals could be assumed for the total studied individuals, increasing the total percentage to 12% *senile* individuals.

The second option divides these individuals across the age categories depending on the percentage to which they definitely occur in the studied population (Ubelaker 2001). This option is applied separately to each individual population. To distribute the individuals whose age determination spans more than one age category, it is necessary to look at the actually identified number of individuals in each age category. The individuals whose age determination spans more than one age category are then assigned proportionally to these categories. This option is problematic for a number of reasons: age categories for which no single age determination was possible end up showing zero individuals. The option also assumes that the distribution of identified single age determinations reflects the actual age distribution for the population. However, this author believes that the results from this option are more realistic because *juvenile* and *senile* individuals will not be as grossly over-represented as with the first option. A distribution of the cremations according to the proportions provided by the cemeteries does not make sense because this thesis is trying to discern whether there is a difference between the two burial forms. Using the same proportional distribution would mask possible deviations.

The cremations from Wandersleben are used to illustrate the available options.

Option 1:	Equal distribution across all categories			
	n		**n**	**%**
infant I	**6**		**8**	**6**
infant II	**4**		**7**	**6**
infant I+II	2	2/2 infant I; 2/2 infant II		
infant - juvenile	2	2/3 infant I; 2/3 infant II; 2/3 juvenile		
infant I o.o.	1	1/6 infant I; 1/6 infant II; 1/6 juvenile; 1/6 adult; 1/6 mature; 1/6 senile		
infant II o.o.	4	4/5 infant II; 4/5 juvenile; 4/5 adult; 4/5 mature; 4/5 senile		
infant II – mature	1			
juvenile	**0**		**15**	**12**
juvenile-adult	5	5/2 juvenile; 5/2 adult		
juvenile – mature	5	5/3 juvenile; 5/3 adult; 5/3 mature		
juvenile o.o.	34	35/4 juvenile; 35/4 adult; 35/4 mature; 35/4 senile		
adult	**4**		**26**	**22**
adult – mature	6	6/2 adult; 6/2 mature		
adult o.o.	15	15/3 adult; 15/3 mature; 15/3 senile		
mature	**3**		**23**	**19**
mature-senile	1	1/2 mature; 1/2 senile		
senile	**1**		**16**	**14**
indet.			**26**	**22**
total			**120**	**100**

Table 9: Age analysis Option 1: Equal distribution across all categories.

With option 1, the *juvenile* and *senile* individuals make up 12% and 14% of the cremations from Wandersleben, respectively (Table 9). Using option 2, the percentage of *senile* individuals drops to 8% (Table 10). However, since it was not possible to definitely identify a *juvenile* individual, the percentage of juveniles is zero. Initially, this scenario seems very unlikely. Why should there not be any juvenile individuals among the cremations from Wandersleben? However, since the purpose of this thesis is to identify possible trends among burial rites for the LBK, it must be considered that the juvenile*s* were not cremated in this population. Maybe option 2 does illustrate the realistic scenario, i.e. that juvenile individuals were for some reason not included in the cremation ritual in Wandersleben. Possibly because they represent an “in between” state between childhood and adulthood? Did juveniles partake in certain rituals and were therefore treated different? One definite *juvenile* cremation each was identified among the cremations from Schwetzingen and Fellbach-Oeffingen. These are evidence that juveniles were cremated.

Option 2:		**Proportional distribution based on percentage of directly identified age categories.**		
	n		**n**	**%**
infant I	**6**		**8**	**6**
infant II	**4**		**9**	**7**
infant I+II	2	60% infant I; 40% infant II		
infant II-juvenile	2	100% infant II; 0% juvenile		
infant I o.o.	1	33% infant I; 22% infant II; 0% juvenile; 22% adult; 17% mature; 6% senile		
infant II o.o.	4	33% infant II; 0% juvenile; 33% adult; 25% mature; 8% senile		
infant II – mature	1	36% infant II; 0% juvenile: 36% adult; 27% mature		
juvenile	**0**		**0**	**0**
juvenile-adult	5	0% juvenile; 100% adult		
juvenile – mature	5	0% juvenile; 57% adult; 43% mature		
juvenile o.o.	34	0% juvenile; 50% adult; 38% mature; 12% senile		
adult	**4**		**42**	**35**
adult – mature	6	57% adult; 43% mature		
adult o.o.	15	50% adult; 38% mature; 12% senile		
mature	**3**		**29**	**24**
mature-senile	1	75% mature; 25% senile		
senile	**1**		**8**	**6**
indet.			**26**	**22**
total			**120**	**100**

Table 10: Age analysis Option 2: Proportional distribution based on percentage of directly identified age categories.

A third possibility divides the individuals of the "or older" categories across the age categories depending on the the number of years that make up each age category (Table 11). The *infant I* and *infant II* age categories span six and seven years respectively (see F.1). The *juvenile* category (age 15 to 20) spans 5 years. The adult age categories *adult*, *mature* and *senile* each span 20 years. In reality, the senile age category includes individuals older than 61 years.

For example:

"*juvenile* or older" = 65 years

= *juvenile*, *adult*, *mature* or *senile*

= 8% *juvenile*, 31% *adult*, 31% *mature* and 31% *senile*

= 8% juvenile and 92% adult.

"*infant II* or older" = 72 years

= *infant II*, *juvenile*, *adult*, *mature* or *senile*

= 10% *infant II*, 7% *juvenile*, 28% *adult*, 28% *mature* and 28% *senile*

= 10% children, 7% juvenile and 83% adult

Option 3:	Proportional distribution based on percentage of years per age category.			
	n		**n**	**%**
infant I	**6**		**7**	**6**
infant II	**4**		**7**	**6**
infant I+II	2	43% infant I; 57% infant II		
infant II- juvenile	2	58% infant II; 42% juvenile		
infant I o.o.	1	8% infant I; 9% infant II; 6%juvenile; 26%adult; 26% mature; 26% senile		
infant II o.o.	4	10% infant II; 7% juvenile; 28% adult; 28% mature; 28% senile		
infant II – mature	1	13% infant II; 10% juvenile: 38% adult; 38% mature		
juvenile	**0**		**5**	**5**
juvenile-adult	5	20% juvenile; 80% adult		
juvenile – mature	5	11% juvenile; 44% adult; 44% mature		
juvenile o.o.	34	8% juvenile; 31% adult; 31% mature; 31% senile		
adult	**4**		**30**	**25**
adult – mature	6	50% adult; 50% mature		
adult o.o.	15	33% adult; 33% mature; 33% senile		
mature	**3**		**26**	**22**
mature-senile	1	50% mature; 50% senile		
senile	**1**		**18**	**15**
undet.			**26**	**22**
total			**120**	**100**

Table 11: Age analysis Option 3: Proportional distribution based on percentage of years per age category.

This variation probably represents the most realistic distribution of ages than span multiple age categories. However, this method is very rarely used and it would be difficult to compare values generated with this option to values presented in the literature.

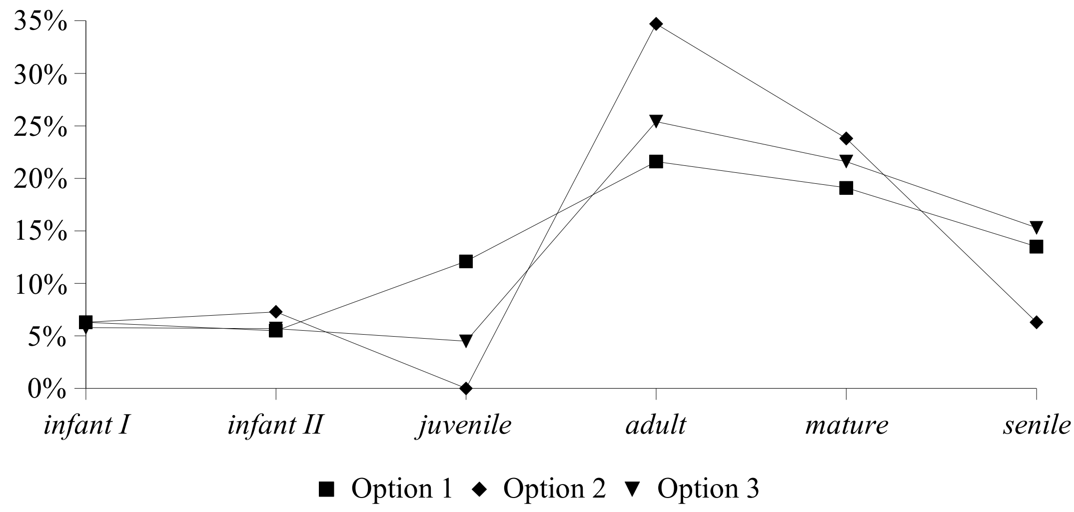


Figure 25: Age analysis: Comparison of the three options.

It is most probable that the lack of definite juvenile individuals among the cremations is due to the difficulty in determining exact ages from cremated materials. In Wandersleben, the average fragment size is very small and the average weight of the cremations is 94 g, ranging from 0.4 to 565 g (see F.6.2). The cremations from Elsloo were very poorly preserved, making identification of individual age categories even more difficult than for the other cemeteries. Using option 2, the demographic analysis would show 0% juveniles throughout. Therefore, in this thesis, the age distribution illustrated by option 1, i.e. the equal distribution of the age ranges across the individual age categories, will be used.

F. Results

This chapter presents the results of the morphological, metrical and histological examination of the cremations from the investigated cemeteries. It is divided into eight sections; the first five present the results from the individual cemeteries this author was able to analyze herself: Elsloo in the Netherlands, Schwetzingen and Fellbach-Oeffingen in Baden-Württemberg and Arnstadt and Wandersleben in Thuringia, all in Germany. The sixth and seventh section present the results taken from the literature for Aiterhofen-Ödmühle and Stefansposching in Bavaria, Germany. The final section combines and compares the results from all cemeteries. The tables include both the number or individuals (n) and percentages (%) to facilitate the comparison between the populations. Decimal numbers are rounded to the nearest tenth, percentages to the nearest whole percentage. Due to the small sample sizes, the percentages appear large and significant. Whenever the sample size allowed, an average value and a range of values are given. Also as a result of the small samples, statistical analysis was only carried out for the measurements that could be taken from five or more individuals within one cemetery.

1 Description of the Catalog of Cremations

0 Grave and find number

The finds from Fellbach-Oeffingen also include an additional complex number which is set in parentheses.

1 Weight of the cremation (D.2)

total bones (tb = cr + pc + gr + ab); cranial (cr); postcranial (pc); grus (gr); animal bones (ab); rest (stones, pottery, charcoal) in grams. The weight of a cremation was taken to the nearest gram. The weight of cremations weighing less than 10g was recorded to the nearest tenth of a gram.

2 Burn stage and color

according to Figure 18. The burn stage depends on the relationship between temperature, color, texture and hardness of the cremated bone. Parabolic and “U”-shaped fractures on long bones and concentric fractures on the vertebral bodies are very characteristic. Twisted or rolled up edges characterize cranial vault bones burned at high temperatures.

The color of cremated bone is slightly distorted due to the long period during which the bones were lying in the ground. They take on the color of the soil and any other colored substances that may be in the vicinity. To determine the actual color of the burned bone, it is sometimes necessary to look at a fresh fracture or scrape away a small portion of the outer layer of the bone. This procedure does not unduly damage or destroy the already heavily fragmented material.

3 Average and maximum fragment size in mm (D.2)

very small	less than 15 mm
small	16 – 25 mm
medium	26 – 35 mm
large	36 – 45 mm
very large	greater than 46 mm

4 Completeness

is dependent on the weight and skeletal elements that are represented. The regions of the body include cranial (bones of the cranium) and postcranial bones (bones of the torso and bones of the extremities). The limiting value of 10 g was chosen based on results from my Master's thesis. The cremations identified as scattered remains were incomplete and usually weighed less than 10 g.

-	less than 10 g
(-)	slightly more than 10 g but not all regions of the body represented
(+)	more than 10 g, at least 2 of the 3 described body regions are significantly represented
+	significantly more than 10 g, all regions of the body are represented

The weight of a cremations was taken to the nearest gram. Cremations weighing less than 10 g were recorded to the nearest tenth of a gram.

5 Description of identifiable elements of bone.

Includes at least the description of “cranial” or “postcranial” fragments. Unless explicitly stated, long bone names refer to the diaphysis of the long bone and vertebra names refer to the corpus. Specific vertebra are abbreviated: cervical (vc), thoracic (vt), lumbar (vl) and sacral (vs) vertebra. The cranial sutures are also abbreviated: coronal (sc), saggital (ss) and lambdoidal (sl) suture. Other skeletal elements are not abbreviated.

6 Age categories

Description of the characteristic age determining features on skeletal elements.

infant I	younger than 6 years
infant II	7 – 14 years
juvenile	15 – 20 years
adult	21 – 40 years
mature	41 – 60 years
senile	older than 61 years

Age could often only be determined as an age range, excluding either the very young or very old age categories. These ranges were recorded with the postfix “or older” (o.o.).

For the evaluation, the age categories of the cremations are reduced to three categories (children, juvenile or adult) instead of using the six categories as defined by MARTIN (1957, age categories in *italics*). Sub-adults include children and juveniles. The children include the cremations aged *neonatus* (no individuals of the category could be identified), *infant I* and *infant II*. The juveniles include the cremations aged as *juveniles* and a fraction of the individuals defined as “*juvenile* or older” and “*infant II* and older”. The adults include *adult*, *mature* and *senile* individuals (see E.2). The resulting 'partial' values for individuals were rounded up to one space after the decimal point. Percentages were rounded to the nearest one percent.

7 Sex

Description of the characteristic skeletal elements: ♀, (♀), undet., (♂), ♂

Including robustness and muscle markings: gracile, gracile-medium, medium, medium-robust, robust

8 Measurements (Ms:)

See D.5. Brackets [] mark the values of measurements where it is not certain whether they were taken at the exact location specified in the list of measurements (see D.5.1). For example: Ms28 described the thickness of the humerus wall in the upper third of the humerus diaphysis, close to the proximal epiphysis. When a piece of humerus is identified it is often very difficult to place it in its exact position on a complete bone. Therefore, the measurement is taken, but noted in brackets.

9 Comments

These include information about any pathologies, multiple burials or burial goods.

A dash (-) is used to mark fields for which no information is available.

A star (*) indicates that teeth were taken for the Tooth Cementum Annulation analysis.

A hash mark (#) indicates that femur fragments were taken for thin section analysis.

2 *Elsloo, The Netherlands*

The cemetery Elsloo was excavated from 1956 to 1966. The cemetery was only in use during the younger LBK while the nearby settlement dates back to the older LBK. Elsloo and Stuttgart-Mühlhausen are the only cemeteries in this study that can be directly linked to a settlement (Map 2 and 3). Of the 113 graves from Elsloo, 66 probably contained body burials. Very few bones and only some teeth and tooth enamel were preserved. The loess soil decalcified and destroyed the material completely. Only shadows from the decomposition of the body and some burial goods were preserved in the soil. The graves had been dug between 50 and 150 cm deep from the present surface. Forty-seven cremations were reported in the literature, but only 45 actually contained cremated skeletal material. Cremated materials survived in the soil because the sintering process during cremation made them more durable. The cremations were found less than 40 cm from the present day surface.

The anthropological evaluation of the cremations from Elsloo was carried out in the summer of 2005 at the National Museum of Antiquities in Leiden. Dr. Verhart made the cremations available to me and provided me with working space at the museum.

2.1 Burn Stage, Color and Degree of Fragmentation

The cremations from Elsloo were all burned to burn stage IV and V. The color of the bone was bright white and the texture very smooth and chalky. The color and texture indicate that the cremations were burned at temperatures between 700 and 900°C. The calcium of the bone had been converted to Tricalciumphosphate during the cremation process, a compound much more resistant to the erosive effects of the soil. Therefore, the cremations and some burial goods survived in the burial record and the body burials did not. The bright white color of the cremation was surprising. Usually, cremated material takes on the color of the soil in which it was deposited. It is possible that the color was bleached out of the bone by the aggressive soil. Washing alone cannot cause the bones to become that white. The cremations from Schwetzingen were washed prior to further analysis. After the soil was washed away the bones still retained the off-white to beige color. In addition to the white color and texture, the cremations are also distinguished by rounded edges and smooth surfaces. In some cases, the broken edges of the bones were rounded off and tapered to such a degree that it was not possible to differentiate between a cranial bone and a fragment from the diaphysis of a long bone, a distinction that is usually made at a glance.

		Fragmentation							
		very small		**small**		**medium**		**total**	
		n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Burn Stage	**I**	-	-	-	-	-	-	-	-
	II	-	-	-	-	-	-	-	-
	III	-	-	-	-	-	-	-	-
	IV	18	40	4	9	-	-	22	49
	IV-V	3	7	1	2	-	-	4	9
	V	7	16	10	22	2	4	19	42
	total	28	63	15	33	2	4	45	100

Table 12: Elsloo: Distribution of burn stages and fragment size

Sixty three percent of the cremations were fragmented "very small", less than 15 mm, 33% were "small", between 16 and 25 mm, and only two cremations contained fragments that were "medium"-sized, 26 to 35 mm (Table 12). The average maximum fragment size for the 45 cremations was 25 cm and the average fragment size was "very small". (Table 13) This degree of fragmentation corresponds well with that from the other cemeteries in this study. The distribution of fragment size across the age and sex categories does not show a clear trend, primarily due to the small number of cremations and the few identifiable individuals. The average maximum fragment size of the female cremations was smaller than that for the males. The *infant* o.o. category was also "very small" with an average maximum fragment size of 30 mm, smaller than the juvenile o.o. and adult age categories. The undetermined age category included the fragments with the smallest average maximum fragment size, which was to be expected. The fragments were difficult to identify due to the small size and poor preservation.

		n	**Ø frag. size (mm)**	**Ø max. frag. size (mm)**
Sex	♀ **(adult)**	1	small	29
	♂ **(adult)**	2	small	36
	undetermined$_s$			
Age	***infant o.o.***	11	very small	30
	juvenile o.o.	7	very small	37
	adult	1	medium	51
	undetermined$_a$	23	very small	17
	total	45		25

Table 13: Elsloo: Distribution of the degree of fragmentation and the average maximum fragment size across age and sex categories.

2.2 Weight, Fragmentation and Preservation

The average weight for the cremations from Elsloo was 77 g (Table 14). Twenty-four cremations (53%) weighed less than 20 g, half of these less than 1 g(!). In some cases, only very small fragments of tooth enamel were recovered. Eleven cremations weighed between 23 and 81 g, and the remaining 10 between 130 and 501 g. The very small amounts of cremated material weighing less than 20 g are almost completely identified as burn stage IV (17 of 24). The fragment size of these cremations was very small and ranged between 2 and 40 mm. The pieces weighing less than 1 g were postcranial but not further identifiable. Such small deposits of skeletal material could be explained by *pars pro toto* deposits, the deposition of one or very few pieces of skeletal remains to symbolize the complete body. At this site, it is more probable that the preservation was extremely poor and it is lucky that the graves and skeletal material were identified at all. Twenty of the graves containing cremations also included burial goods such as ceramics, stone tools and pieces of hematite These made it possible to date the cremations to the LBK.

		Weight					
		total (g)			**average (g)**	**min. weight (g)**	**max. weight (g)**
			n	**%**			
Burn Stage	**I**	-	-	-	-	-	-
	II	-	-	-	-	-	-
	III	-	-	-	-	-	-
	IV	431	22	12	20	1	132
	IV-V	202	4	6	51	1	426
	V	2839	19	82	149	1	501
	total	3472	45	100	77	1	501

Table 14: Elsloo: Distribution of weight across the burn stages.

The identified cranial fragments make up 16% of the total weight of the skeletal elements, the postcranial material 83% (Table 15). The cranial material included small tooth fragments and pieces of the cranial vault and cranial base. In some cases, it was possible to identify cranial sutures but not which suture or whether or not they had been fused. All that remained of the teeth were some enamel splinters. The post cranial bones and the muscle markings were worn down and smoothed out. Although the preservation was not good due to to the aggressive environment during deposition, only 1% of the total weight of the cremated material could not be categorized as either cranial or postcranial. The category 'other' contains the burial goods, predominantly ceramic sherds and burned wood. The ceramics are in the same poor condition as the bones, faded and heavily eroded by the soil.

		Weight Distribution				
		total (g)	**%**	**% all**	**min. weight (g)**	**max. weight (g)**
Skeletal Elements	cranial	560	16	14	1	122
	post cranial	2877	83	73	1	407
	rest	35	1	1	1	22
	total: cremation	3472	100			
	animal bones	2		0	2	2
	other	488		12	1	433
	total: all	3962		100		

Table 15: Elsloo: Distribution of weight across the skeletal elements.

2.3 Sex Determination

One possible female (Grave 66) and two possible males (Grave 51 and Grave 73) were identified among the cremations from Elsloo. The possible female from Grave 66 was identified due to the very gracile bones. The nuchal crest is not pronounced at all. The proximal epiphysis of the metacarpal is fused. These fuse between 16 and 20 years of age, therefore, the gracile nature is not due to the young age of the individual. The male individual from Grave 51 was identified by the strong *linea aspera* of the femur. The muscle markings are robust for this series. The sex of the individual from Grave 73 was determined from the round *Margo supraorbitalis*. Two additional cremations could possibly belong to male individuals (Grave 39 and Grave 57) based on the pronounced muscle marking of the nucal crest. However, this feature is treated with caution because the females in the LBK seem to have had thick cranial vaults (see F.3.5). While robustness cannot be used as an exclusive feature to determine the sex of an individual, it does usually help confirm a predetermined tendency. In the case of the females from Schwetzingen and Wandersleben, the cranial vault in females is sometimes thicker than that of the males. Therefore, it is not clear whether the robustness of this feature can be used to differentiate between the sexes and these two individuals will not be included as possible male individuals.

2.4 Age Distribution

The age distribution reflects the difficulties resulting from the poor preservation of the cremated remains (Table 16). Over half of the material could not be assigned to an age category. As mentioned earlier, these cremations were highly fragmented and the weight ranged between 1 and 20 g. Of the remaining 22 cremations, the majority were either classified as “*infant II* or older” or “*juvenile* or older”.

	total ♀		total ♂		undet.		total	
	n	%	n	%	n	%	n	%
***infant* I**	-	-	-	-	-	-	-	-
***infant* II**	-	-	0.2	0.4	3	6	3	7
juvenile	0.3	1	0.2	0.4	5	11	5	12
adult	0.3	1	0.5	1	4	9	5	11
mature	0.3	1	0.5	1	4	8	4	10
senile	0.3	1	0.5	1	4	8	4	10
undet.	-	-	0.0	-	23	51	23	51
total	1	4	2	4	42	93	45	100.0

Table 16: Elsloo: Age distribution.

The possible female from Grave 66 was classified as "*juvenile* o.o." based on the fused proximal epiphysis of the metacarpal. The proximal epiphyses of the metacarpals fuse between 16 and 20 years of age. The proximal epiphysis of the humerus is also fused. This increases the minimum age of the individual to older than 18 to 20 years of age. A maximum age could not be determined. The possible male individual from Grave 51 was identified as adult. It was not possible to positively identify the cranial suture, however, since it is fused on the inside and almost completely fused on the outside, the individual could be classified as at least *adult*. The possible male individual from Grave 73 could only be assigned the classification "*infant II* o.o.". The cranial suture of this cremation was not yet fused and the tooth fragment in this cremation too badly damaged for an age determination. A more detailed age determination was possible for the individuals from Grave 74 and Grave 85. The epiphyses of a distal phalanges ares not fused, the bones are very gracile, resulting in the classification *infant* to *juvenile*. The individuals from Grave 39 and Grave 40 were classified as "late *juvenile* o.o." because these same epiphyses were already fused. The individuals from Grave 7, Find number 408 and Find number 464 were also classified as "late *juvenile* o.o." because the vertebral body was fused. For the remaining cremations, the youngest age category could be ruled out based on the size of the bone fragments. A closer age determination was not possible.

Children make up 14% of the age determined cremations from Elsloo. Together with the juveniles (23%), the sub-adults represent 36% of the identified individuals, the adults make up 64% (Table 17). This age distribution is very similar to the distribution among the cremations from the other cemeteries and also among the body burials from these cemeteries where the percentage of sub-adults ranges from 13 to 34% and 16 to 45% respectively. However, it is probable that the individuals for which an age could not be determined would fall into the adult age categories. The bones of children are very fragile. The cremations process and the subsequent burial in the erosive soil at the cemetery of Elsloo probably destroyed the cremated remains of children much faster than those of adults.

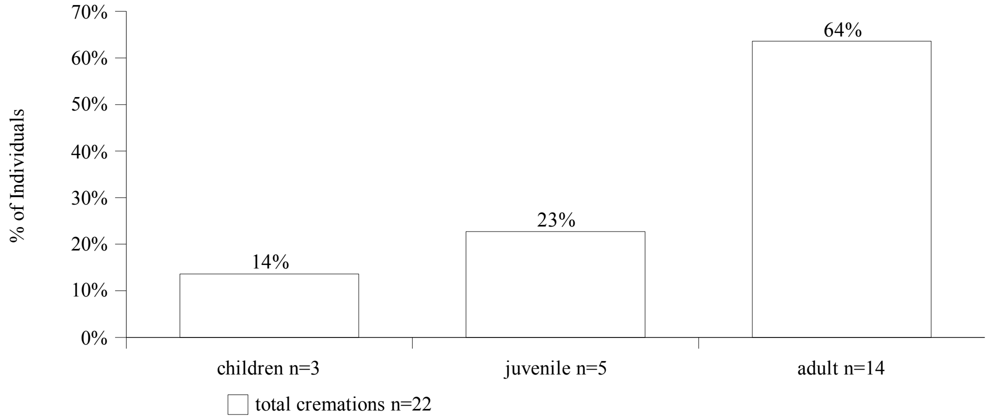


Table 17: Elsloo: Age distribution of the classifiable cremations.

2.5 Metrics

Twelve different measurements were taken from the cremations from Elsloo (Table 18). It is regrettable that only one measurement, Ms43 (thickness of the *linea aspera*) could be measured on one of the sex determined individuals. Therefore, it is not possible to make significant observations about the degree of variation within this population nor compare these measurements to those of the other cremations in this study. Ms43 was measured for the individual from Grave 51. The breadth of the *linea aspera* ranged from 6.6 to 7.0 mm. The height of the *linea aspera* was 5 mm. The pronounced height of this feature was the reason for classifying this individual as a possible male. Ms1 (thickness of the cranial vault wall) was measured in 16 cases. The average thickness was 3.5 mm and it ranged from 2.9 to 4.6 mm.

	burn stage IV-V								
	1	2		3				4	5
								+ shrinkage *	
		♂		undet.				♂	undet.
		Ø (mm)	n	Ø (mm)	n		s(n)	Ø (mm)	Ø (mm)
Measurements	1	-	-	3.5	16	±	0.58	-	4.2
	18	-	-	5.8	1		-	-	6.7
	19	-	-	2.2	2		-	-	2.5
	20	-	-	7.9	2		-	-	13.2
	21	-	-	9.15	2		-	-	10.5
	22	-	-	27.5	1		-	-	30.3
	33		-	2.1	4		-	-	2.3
	43	6.8	1	6.6	3		-	7.8	7.6
	50	-	-	7.8	5	±	1.63	-	7.8

Table 18: Elsloo: Measurements (column 1) from the cremations, defined in E.5.1. Comparison between males (column 2) and undet. individuals (column 3). Columns 4 and 5 show values for the cremations plus the shrinkage value. (+20% cranial, +10% epiphyses, +15% long bones).*

3 Schwetzingen, Baden-Württemberg, Germany

3.1 Burn Stage, Color and Degree of Fragmentation

Two-thirds of the cremations from Schwetzingen (Map 4) were burned at very high temperatures, burn stages IV, IV-V and V (Table 19). The chalky white to creamy white coloring of the bone indicate burning temperatures above 600 to 800°C. The range III-V indicates that these individuals were not burned as thoroughly as the others. However, usually only very few pieces of bone are colored black to grey and were actually identified as burn stage III. Grave 202 was identified as having burn stage III and V and included some black to grey colored bone fragments alongside the majority of bones from burn stage V. One possible interpretation of the dual burn stages in one grave is that they are the result of multiple burials. However, no duplicate skeletal elements were found in this grave, therefore the cremation is still counted as one individual. The grave also contained some unburned rib fragments which may have originated from earlier body burials that were accidentally mixed with the cremation during burial. The more likely interpretation is that cremated fragments of burn stage IV were not preserved because these fragments are especially fragile (see Figure 18). Bones from burn stage IV no longer have the elasticity of bone still containing some organic materials such as those from burn stage III or below. The chemical transition from burn stage IV to V is important. During burn stage IV, the bone is in its most fragile state, after reaching burn stage V it is even more robust than an unburned bone. Nor have they reached the increased level of hardness of cremated bones from burn stage V.

		Fragmentation							
		very small		**small**		**medium**		**total**	
		n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Burn Stages	**I**	-		-		-		-	
	II	-		-		-		-	
	III	-		-		-		-	
	III-V	3	20	2	13	-		5	33
	IV	2	13	-		-		2	13
	IV-V	2	13	-		-		2	13
	V	6	40	-		-		6	40
	total	13	87	2	13			15	~100

Table 19: Schwetzingen: Distribution of burn stages and degree of fragmentation.

There is no apparent correlation between burn stage and the age or sex of the cremated individuals (Table 20). Both males and females were thoroughly burned, two-thirds at temperatures greater than 800°C. The same applies to the individuals of undetermined sex. Half of the males and females were burned at burn stage V, the other half at burn stage III-V. All age categories, "*infant* o.o.", "*juvenile* o.o." and the adult individuals, are represented in burn stage V. The two *infant* individuals were completely burned and highly fragmented. The bones from infants and younger juveniles are smaller and thinner than adult bones. They burn more quickly and usually quickly reach burn stage V. They are usually highly fragmented compared to the bones from adult individuals.

		Burn Stages										
		I		**II**		**III**		**IV**		**V**		**total**
		n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Sex	**♀ (adult)**	-		-		0.7	4	0.7	4	2.7	18	4
	♂ (adult)	-		-		0.3	2	0.3	2	1.3	9	2
	undetermined $_S$											
Age	***infant* o.o.**	-		-		-		-		2.0	13	2
	***juvenile* o.o.**	-		-		0.3	2	1.3	9	0.3	2	2
	adult	-		-		0.3	2	1.3	9	1.3	9	3
	undetermined $_A$	-		-				1.5	10	0.5	3	2
	total	0		0		2	11	5	34	9	54	15

Table 20: Schwetzingen: Distribution of burn stages across age and sex categories.

The average fragment size (Table 21) for all cremations from Schwetzingen is 10 mm. The higher the degree of burning the higher the degree of fragmentation will be. The bones from all individuals from burn stage IV, IV-V and V are highly fragmented (87%), that means less than 15 mm. The individuals with burn stages ranging from III-V are slightly more variable in size, 2 of the 5 (13%) have an average fragment size between 15 and 24 mm and fall into the category small. The average fragment size is larger for those individuals that include burn stage III. The cremations from burn stage IV and V have the smallest degree of fragmentation, 7 mm each. The average maximum fragment size is 26 mm. Table 21 shows that the general trend, the higher the burn stage, the smaller the fragment size, is confirmed for the cremations from Schwetzingen.

			Fragmentation	
			Ø frag. size (mm)	Ø max. frag. size (mm)
		n		
Burn Stage	I	-	-	-
	II	-	-	-
	III	-	-	-
	III-V	5	13	29
	IV	2	7	11
	IV-V	2	27	24
	V	6	7	28
	total	15	10	26

Table 21: Schwetzingen: Distribution of average fragment size and average maximum fragment size across burn stages.

3.2 Weight, Fragmentation and Preservation

The average weight of all cremations from Schwetzingen is 184 g (Table 22). Predictably, the average weight for the cremations in burn stages IV and V is less than the weight for the cremations from burn stage III-V. One possible reason for this difference is that all of the organic substances have not been completely burned from the bone. Yet the cremation with the greatest weight, Grave 209 with 974 g, was identified as belonging to burn stage V. It is more likely that the difference in average weight in the burn stages is not significant at all. The weight range for the cremations spans from 0.2 to 974 g. The cremations in Schwetzingen were deposited directly into the ground. There were no ceramic urns or bowls to protect the bones from the erosive and corrosive effects of the soil. Whether the cremations were placed into organic containers such as baskets or leather bags is not known and cannot be reconstructed for this cemetery. Depending on how carefully a cremation was collected from the pyre and whether the entire cremation was subsequently deposited in the ground or not also influenced the wide range of variation in the average weight of the cremations (see below). Five out of 15 cremations weighed more than 10 g (33%) and only 5 (33%) weighed more than 100 g. The remaining five cremations weighed between 0.2 to 7.5 g.

		Weight					
		total (g)			**average (g)**	**min. weight (g)**	**max. weight (g)**
			n	**%**			
Burn Stage	**I**	-	-	-	-	-	-
	II	-	-	-	-	-	-
	III	-	-	-	-	-	-
	III-V	1247	5	45	249	3	653
	IV	1	2	0	0	0.2	1
	IV-V	230	2	8	115	0.6	229
	V	1290	6	47	215	6.2	974
	total	2767	15	100	184	0.2	974

Table 22: Schwetzingen: Distribution of weight according to burn stages.

The majority of the cremations from Schwetzingen (87%) fall into the fragmentation category "very small". The average fragment size ranges between 10 and 24 mm. Although it is possible to identify individual bones through characteristic features on the bone, the majority of them could only be assigned to groups of skeletal elements: cranial bones, bones of the torso and extremities (see Table 23). Ten of the 15 cremations (67%) from Schwetzingen include both cranial and postcranial elements. With 703 g, the postcranial bones make up the majority of the total weight (25%). Long bones like the femur, tibia and radius predominate. Their cross sections, such as the tear drop shape of the radius or the sharp, thick border of the *Margo anterior* of the tibia, are very characteristic. Therefore they are also among the bones that are easiest to identify, which is the reason why they are the most common bones listed. Vertebra, specifically the vertebral body or, less frequently, the articular surfaces, and fragmented ribs are also easy to identify. However, they are extremely fragile and are only present in very small quantities (0.6% of the total weight). Torso bones were identified in 7 cremations (47%). Next to the vertebral and rib fragments, three pieces of the scapula and one pelvic fragment from the *acetabulum* were recovered (Grave 78, Grave 127 and Grave 198). The cranial bones make up 14% (378 g) of the total weight of bones. Diagnostic bones such as suture fragments, the *Pars petrosa* and facials bones and teeth are especially important to identify as they provide the primary information about the age and sex of the cremated individual. Of the 12 cremations (80%) containing cranial fragments, 5 (63%) included fragments of burned teeth. During cremation, erupted teeth often fall out of the alveolar cavities in the mandible and maxilla. The heat affects them just like the surrounding bone (D.1). Only unerupted teeth have a chance to remain intact. The presence of teeth in these neolithic cremations shows that the cremations were carefully gathered together before interment. Had those responsible for gathering and burying the individuals been less careful, then small pieces such as teeth and finger bones would not have made it into the burial. The sutures are also very valuable for determining the age of cremated individuals from Schwetzingen. Although the accuracy of the method is questioned, it is one of the few methods available to determine the biological age of cremated material. Four cremations (27%) had pieces of cranial bones that included useful cranial sutures. The *Pars petrosa* is a very compact bone. It survives the burning process better than the cancellous bone of the torso. Three *Pars petrosa* were recovered from 2 cremations (13%; Grave 74 and 2x Grave 209). The remaining 61% of the weight of bones comes from the unidentifiable rest, or "*Grus*", fragments of bone that are so highly fragmented that it is only possible to assign them to cranial or postcranial skeletal category. These pieces are generally less than 10 mm in size. The presence of such small fragments of *Grus*, like the teeth, is evidence for the completeness of the cremations from Schwetzingen. Teeth and small bones, such as phalanges and wrist bones, were recovered from a total of 5 graves (33% of the total graves). Teeth were recovered from five graves (two ♂, two ♀, one undet.) and small bones from four graves (two ♂, one ♀, one undet.). It seems that the people of the LBK were very careful when burying the dead, both the cremated and body burials.

		Weight Distribution				
		total (g)			**min. weight (g)**	**max. weight (g)**
			%	**% all**		
Skeletal Elements	cranial	378	14	13	0.6	148
	post cranial	703	25	24	0.6	260
	Grus	1686	61	59	15	568
	total: cremation	2767	100			
	animal bones	31		1	13	18
	other	80		3	8	30
	total: all	2877		100		

Table 23: Schwetzingen: Distribution of weight across the skeletal elements.

Animal bones, rocks, a key and some ceramic sherds make up 4% of the total weight of all of the studied material. These weights were not included in the above calculations.

Table 24 summarizes the distribution of weight and fragment size across the sexes and age categories. The maximum fragment size for the sexed individuals is identical for males and females. The maximum fragment size for the adult individuals of undetermined sex is 10 mm smaller, which is part of the reason why they are undetermined. As can be expected, the maximum fragment size for children is also very small, ranging from 16 to 23 mm. Interestingly, the average weight for the female cremations is 250 g less than that of the males. This could mirror the results of the studies on the correlation of cremation weight and sex as discussed in section D.2. However, the sample size is very small and one heavy cremation influences that average weight and leads to false impressions. The average weight for sub-adults is relatively small. This is understandable for the *infant* categories. However, the cremations representing juveniles or older individuals are most probably not complete. The average weight for the adults of undetermined sex is significantly lower than that of the sexed individuals. The small amount of cremations and their very small fragment size are two of the major reasons why it is not possible to sex these individuals. The individual from Grave 206 is an *adult* individual of undetermined sex. The bones are robust compared to the rest of the cremated individuals which is why this individual could possibly be a male individual. However, the fragments are too small; only 5 g of the 229 total grams are from the cranium. The cranium is under-represented. It is possible that the skull was intentionally not deposited with the remaining skeleton, but it is more likely that the remaining fragments were not preserved. The remaining weight is spread equally between postcranial bones and *Grus*. This is a case where, although the cremation is in relatively good condition (sufficient weight and fragment size to make it possible to identify bones, burn stage IV-V), the skeletal elements needed in order to identify the sex are simply not present.

		n	Ø max. frag. size (mm)	average weight (g)	weight range (g)
Sex	♀ (adult)	4	35	424	4 - 974
	♂ (adult)	2	32	675	191 - 580
	undetermined S				
Age	*infant* o.o.	2	16	13	6 - 19
	juvenile o.o.	2	23	2	0.6 - 3
	adult	3	24	90	8 - 229
	undetermined A	2	16	0.4	0.2 - 0.6
	total	15	26	184	

Table 24: Schwetzingen: Distribution of weight and fragment size for sex and age classes.

It is not possible to identify any significant trends in weight, fragmentation or overall preservation for males or females, sub-adults or adults (Table 24). The difference in fragment size and weight between sub-adults and adults was to be expected. There is no significant difference in fragment size between the sexes. The difference in weight between males and females can also probably be attributed to sample size and not to the normal variation in body weight between the sexes.

3.3 Sex Determination

Of the 15 cremations from Schwetzingen it was possible to clearly identify two females ("♀"; Grave 202 and Grave 209), two possible females ("(♀)"; Grave 74 and Grave 198) and two possible males ("(♂)"; Grave 127 and Grave 135, see Table 25). The *adult* female from Grave 209 was identified due to the steep angle of the M*eatus acusticus internus* of the *Pars petrosa*, the sharp border of the M*argo supraorbitalis* and the overall gracile size of the teeth and mastoid process. The *adult* female from Grave 202 was sexed due to the gracile build of the bones and the less pronounced mastoid process. The possible female from Grave 74 was sexed due to the shape and form of the mastoid process. The gracile form of the bones also supported the identification of this individual and the possible female from Grave 198. The bones of the two possible males are both significantly more robust than the bones from the other cremations in this population. The individual from Grave 135 was also sexed as possibly male due to the round shape of the M*argo supraorbitalis*. No definite males could be identified.

	♀	(♀)	♂	(♂)	**undet.**	**total**
	%	%	%	%	%	n
children	0	0	0	0	6	0.9
juveniles	0	0	0	2	9	1.7
adults	13	7	0	11	38	10.4
undet.	0	7	0	0	7	2.0
total	13	14	0	13	60	15.0

Table 25: Schwetzingen: Distribution of sexes

In sum, the females make up 20% (4) of the sexed individuals, the males 9% (2). It was not possible to identify the sex of the remaining nine individuals due to the high degree of fragmentation and the small sample size. As mentioned above, the one *adult* cremation with a larger sample size did not contain the required skeletal elements to determine the sex. In comparison, the sex distribution of the unburned burials from Schwetzingen shows that 47% (n=61) of the sexed individuals are female and 36% (n=47) male.

A sex determination using burial goods is not possible for Schwetzingen because those cremations that were associated with burial goods were also associated with the burials of unburned individuals. Since the cremations not found together with unburned individuals do not include burial goods, it is likely that these do not belong to the cremated individuals. Grave 117a contained a body burial of a probable *adult* female and was associated with ceramics. An exception may be Grave 54, which contained a *juvenile* or older cremation and a late *mature* female alongside a flint blade that showed signs of having been burned. Flint blades have often been associated with male burials, but not exclusively.

Twice as many females as males could be identified among the cremations from Schwetzingen (Figure 26). There are also 30% more females than males among the body burials. It is possible that the difference in percentages between males and females is due to the small sample size and the low number of sexed individuals among the cremations. This trend is echoed in the body burials. Therefore, the sex of an individual was probably not the decisive factor for why an individual was cremated.

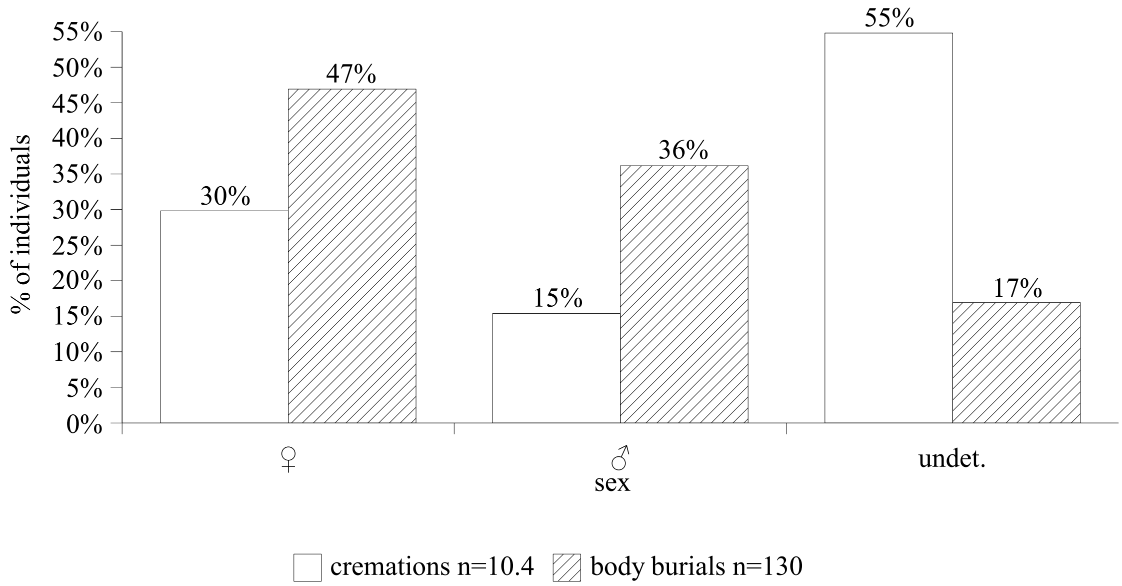


Figure 26: Schwetzingen: Distribution of sex for the adult cremations and body burials

3.4 Age Determination

The high degree of fragmentation of the cremated remains made it necessary to determine age ranges rather than assign a specific age to an individual. For the demographic analysis at the end of this chapter, the typical six age categories (Table 26) defined by Martin (1957) have been reduced as described for the catalog. It was possible to establish an age at death for 12 of the 15 cremations (80%). One individual (8%) from Schwetzingen was identified as a child, one as a juvenile and 67% as adults. The remaining 2 individuals could not be assigned to a specific age category because there was not enough skeletal material available to study, their average weight was less than 1 g (0.2 g and 0.6 g).

	total ♀		total ♂		undet.		total: all	
	n	%	n	%	n	%	n	%
infant I	0	-	0	-	0	-	0	-
infant II	0	-	0	-	0.9	6	0.9	6
juvenile	0	-	0.3	2	1.4	9	1.7	12
adult	1.3	9	1.3	9	2.2	15	4.8	33
mature	0.8	6	0.3	2	1.7	12	2.8	19
senile	0.8	6	0	-	1.7	12	2.5	17
undet.	1	7	0	-	1	7	2.0	13
total	3.9		1.9		8.9		15.0	

Table 26: Schwetzingen: Distribution of age and sex

The cremations from Grave 63 only included the fragment of a *Pars petrosa,* which made it possible to determine that the individual was probably female, otherwise, it can only be ruled out that the individual was a *neonate* or *infant I*. The individual from Grave 210 was also identified as *infant II* or older. The bone fragments were very gracile but the size allowed the younger age categories to be ruled out. The 14-16 years old sub-adult from Grave 193 was identified as *infant II* to *juvenile* on the basis of the thin cranial bones (Ø 2.7 mm). Grave 206 contained the remains of a *late juvenile* individual. The cranial bones are also very thin (Ø 2.7 mm), however, the bones are more robust than those from Grave 193. The epiphysis of the metatarsal is fused. The three *juvenile* or older individuals (Grave 54, Grave 75 and Grave 127) were determined according to the closure of the tooth roots and the robustness of the bones. The *infant* categories could be excluded.

Tooth Cementum Annulation

Age determination using the tooth cementum annulation method was not very successful for the samples taken from the cremations from Schwetzingen. Four single rooted teeth from three cremations were selected (Grave 135, Grave 202 and Grave 209). The teeth were all burned to burn stage V and were highly fragmented. The crown was no longer preserved and only a portion of the root was available for the TCA method. The teeth were embedded and cut as described in section D.. During the first cutting session, 80 µm thin sections were cut from all four teeth. It was possible to cut four intact sections from tooth 209_1, five from tooth 209_2 and three from tooth 135. It was not possible to cut sections from the tooth from Grave 202 because the tooth root was too short. The examination of these section under the transmitted light microscope at 200x magnification showed that these section were too thick to count the rings. At the time, it was not possible to cut thinner sections because the saw blade pealed the bone away. At a second cutting session with a new saw blade thinner sections could be cut from the two remaining tooth roots 135 and 209_2.

Two sections were cut at 70 µm from tooth 135. Although the sections were thin enough it was not possible to observe or count the tooth rings because the grooves left by the saw blade were too pronounced (Figure 27). Two sections at 60 µm were cut from from tooth 209_2. Only the eruption line could be identified in the thin sections. The remaining lines were obliterated, partially due to the grooves left by the saw. More markedly due to the heat induced changes that occurred during the cremation process. The Cementum lines were completely destroyed and look feathery instead of depicting the annulation rings (Figure 28).

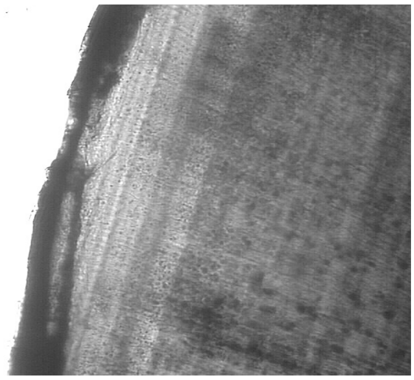


Figure 27: Schwetzingen: Grave 135, cut at 70 µm, 200x magnification

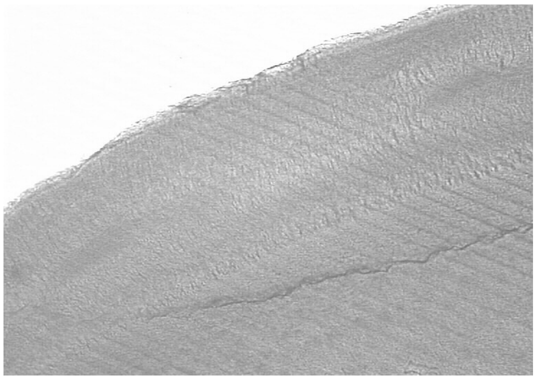


Figure 28: Schwetzingen: Grave 209_2, cut at 60 µm, 200x magnification.

The tooth cementum annulation method was not useful for determining the age of the three individuals from Schwetzingen. The cementum was severely affected by the high burning temperatures. The teeth were soft and the cementum and dentin very fragile so that the saw either simply caused the structure to crumble during the cutting process or left deep grooves on the cut surface, which made it impossible to identify and possible remaining annulation lines. The method was slightly more successful for the teeth examined from Fellbach-Oeffingen.

Histological Age Determination

The probably male individual from Grave 135 (Figure 29) was identified as a young *adult* according to the dental development and the open cranial sutures. The third molar is fully developed. The histological analysis of a femur fragment places the individual in the late *juvenile* age category. The osteons are small, regularly shaped and arranged like a row of pearls. The lamellar structure is still very clear along the periosteal region.

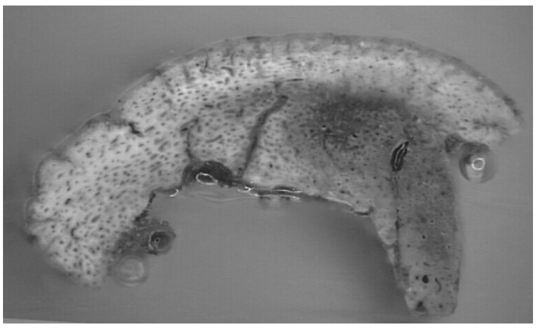


Figure 29: Schwetzingen: Grave 135, juvenile, size 12.4 mm

Grave 191, Grave 192, Grave 198, Grave 202 and Grave 209 were all identified as *adult* and *adult* or older individuals. The individual from Grave 198 was classified as *adult* because the coronal suture is fused. The individual from Grave 202 (Figure 30) is late *adult* to *mature* based on cranial suture closure. In the histological thin section the osteons are very large and irregular. Resorption has begun. However, the structure of the femur thin section looks more like that of a *juvenile* to young *adult* individual. The resorption lacunae may be an indicator for osteoporosis in this individual.

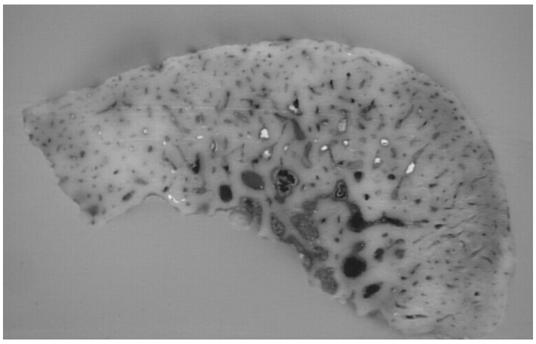


Figure 30: Schwetzingen: Grave 202, late adult or juvenile with osteoporosis? size 12.8 mm

The individual from Grave 209 (Figure 31) was classified as late *adult*, aged 30 to 40, because the saggital suture is fused while the lambdoidal suture is still open, the third molar is complete and the epiphyseal rings on the body of the cervical vertebra are fused. The histological thin section confirms this classification. There is no more recognizable lamellar bone structure, the osteons are rounded. The resorption lacunae are very developed.

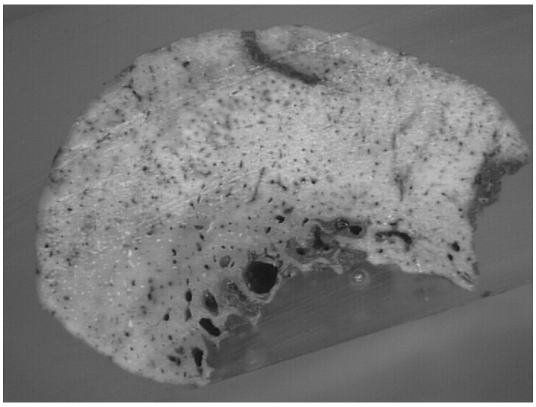


Figure 31: Schwetzingen: Grave 209, late adult, size 12.5 mm

The age and sex determination for unburned body burials from Schwetzingen was carried out by Wahl in Konstanz, but the data has not been published to date. Compared with the age distribution of the unburned body burials from Schwetzingen the children are under-represented (Figure 32). The reasons for why a certain age category may be under- or over-represented in a population will be discussed in depth in section G. The most probable reason for the under-representation of sub-adult cremations is that they did not survive the process of cremation and the past 7,000 years of burial without a ceramic urn to protect them from erosion and weathering. The cremations of sub-adults may not have been buried as deeply as the other cremation and have been eroded through time. It is also possible that children and juveniles were in fact treated differently from adults and were not cremated as frequently.

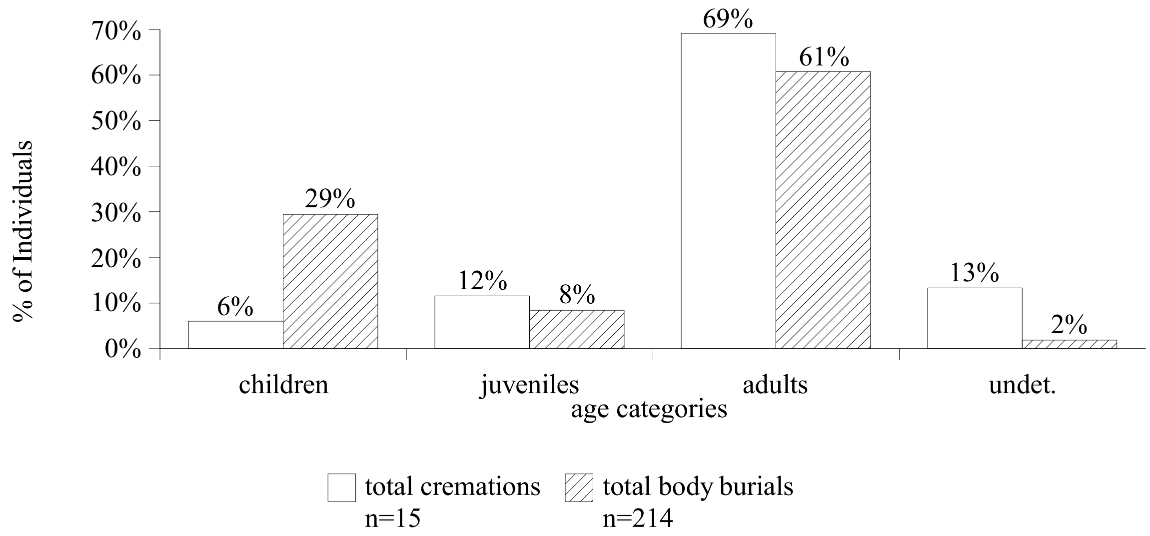


Figure 32: Schwetzingen: Age distribution for cremations and body burials

3.5 Metrics

Values were collected for 9 measurements (Ms1, Ms19; Ms27; Ms28; Ms33; Ms39; Ms43; Ms44 and Ms50) from 10 of the 15 individuals (see Table 27). Not every measurement could be taken from each cremation because the feature was not preserved in the sample. Therefore, the sample size of the statistical evaluation is too small to obtain standard deviations of any significance. These require a sample size greater than five, which was not possible for this population. The average values for the males and females, respectively, are listed in the first part of Table 27. An average value was also calculated for the individuals for which the sex could not be determined. Although these averages have no diagnostic value, they provide an indication of how many males or females may be in this group. An average value that is closer to the average value for the females suggests that there are more females among the undetermined individuals than males, and vice versa. A value that is equidistant from both the male and female average value suggests that there is an equal number of males and females in the sample. This information is purely hypothetical and did not influence the actual number of males and females determined for the population.

The second section adds a standard degree of shrinkage to the values measured from the cremated individuals. The pieces from which the measurements were taken were all identified as burn stage IV-V, therefore a shrinkage factor of +20% for cranial bones, +10% for postcranial bones and +15% for epiphyses was applied (Wahl 1988, 109). This correction of the values makes it possible to compare the measurements from the cremated individuals with the same values taken from the unburned body burials from Schwetzingen to find out whether both groups belong to the same population or not. To make this comparison possible, the typical measurements that were taken for the cremations were applied to the body burials from Schwetzingen. The resulting average values, including standard deviations for samples greater than five, are listed in the third section of the table. The corrected values differ significantly from the values of the body burials. For Ms1, thickness of the cranial vault wall, the female values for the cremations are 2 mm thinner than for the body burials, for the males the difference is still 1 mm. The average breadth of the *Linea aspera*, Ms43, is 4 mm smaller than for the body burials. If the same values resulted from a larger sample size, then this difference would prove to be significant. It would demonstrate that the cremations and the body burials may represent two different populations or, at the least, two separate groups within the population. However, the different values could also result from the different age categories included in the sample. The bones of an senile individual have grown thinner with age. Measurements from such an individual can lower the average value for the entire population. In this case, the two Ms43 measurements were taken from a *juvenile* to *mature* male and an undetermined *adult* to *mature* individual and were probably not significantly affected by thinning bone due to old age. A *t*-test for the significance of these differences is not possible due to the small sample size of the cremations.

	burn stage IV-V									unburned body burials							
1	2		3		4		5	6	7	8	9			10			11
							+ shrinkage*										
	♂		♀		undet.		♂	♀	undet.		♂			♀			t-test
Measurements	Ø (mm)	n	Ø (mm)	n	Ø (mm)	n	Ø (mm)	Ø (mm)	Ø (mm)		Ø (mm)	n	s(n)	Ø (mm)	n	s(n)	p
1	3.9	1	2.9	2	3.6	4	4.7	3.5	4.4	**1**	5.7	23	± 1.0	6.5	28	± 1.1	0.01
19	-	-	-	-	1.5	1	-	-	1.8	**-**	-	-	-	-	-	-	-
27'	30	1	-	-	-	-	33	-	-	**-**	-	-	-	-	-	-	-
28	2	2	-	-	2.3	3	2.2	-	2.7	**28R**	2.7	1	-	-	-	-	-
										28L	2.9	1	-	-	-	-	-
32'	-	-	-	-	-	-	-	-	-	**32R**	22.0	16	± 1.5	20.8	17	± 1.5	-
										32L	21.9	13	± 1.5	20	13	± 0.9	-
33	1.6	1	2.3	1	-	-	1.8	2.6	-	**33R**	-	-	-	2.4	2	-	-
										33L	2.9	6	± 0.6	3.0	4	-	-
39'	40	1	-	-	-	-	44	-	-	**-**	-	-	- -	-	-	-	-
										-	-	-	- -	-	-	-	-
43	5.3	1	-	-	4.9	1	6.1	-	5.6	**43R**	10.2	24	± 1.2	9.4	31	± 1.2	-
										43L	10.6	25	± 1.5	9.4	38	± 1.2	-
44	-	-	4	1	3.1	1	-	4.6	3.6	**44R**	5.7	2	-	5.5	1	-	-
										44L	5.0	2	-	3.9	1	-	-
50	8.5	2	-	-	6.4	3	9.7	-	7.4	**50R**	9.0	2	-	9.7	3	-	-
										50L	11.3	6	± 2.5	8.6	6	± 1.9	-

*Table 27: Schwetzingen: Measurements (column 1) from the cremations, defined in E.5.1. Comparison between males and females (column 2 and 3) and undet. individuals (column 4). Columns 5, 6 and 7 show values for the cremations plus the shrinkage value. These values can be compared to the measurements of the unburned body burials from Schwetzingen (columns 9 and 10).Column 8 lists measurements and the side of the body (R=right, L= left). Column 11, the t-test value, shows that the difference of M1 in the male and female unburned body burials is significant. (' = measurements for body height calculation; * +20% cranial, +10% epiphyses, +15% long bones)*

The shrinkage factors used to correct the values for the cremations were calculated using experimental values determined for a population from the Roman cemetery at Stettfeld (Wahl 1988). The same shrinkage factor does not have to apply to the cremations from Schwetzingen. It is not possible to calculate specific shrinkage values for Schwetzingen, because these cremations were thoroughly burned to burn stage IV-V, so that, at this time, there is nothing to compare the values to. Therefore, it is possible that there was no difference among the individuals from the different burial forms.

The values for Ms1 from the body burials from Schwetzingen need to be discussed in more detail. There is a significant difference in the thickness of the cranial vault walls between the male and female body burials from Schwetzingen ($p=0.01$). The male crania are on average 0.8 mm thinner than the female crania. Usually the cranial walls of females are between 1 and 28% (average 9%) thinner than those of male cranial bones (Rösing 1977; Wahl 1996). It is possible that the results from the Schwetzingen body burials have genetic origins: that the females and males originate from different populations. However, this would suggest that the cemetery only contains one or two generations of individuals. Genetic mixing would cause the different cranial thickness values to blend and even out. It is probable that the thicker cranial values are the result of an adaptation, either due to a certain deficiency or mechanical stress. The cranial vault thickness increases for some females after they reach menopause. A decrease in gonadal hormone production is associated with loss of bone mass due to the inadequate intake of calcium. To make up for this loss the body builds up the diploe and cancellous bone. This phenomenon would be limited to post-menopausal women, yet the thicker cranial vault wall values are present in all adult age categories. A deficiency of red blood cells can also result from malnutrition such as scurvy, vitamin C deficiency, strong menstrual cycles or some other form of anemia. Such deficiencies can be amplified by a simple lack of protein in the diet, for instance, if the females ate very little meat and more cereals. Mechanical stress can also cause the bone to react, for instance, if the females frequently carried very heavy loads on their head. The pattern of thicker cranial vault walls in the female individuals from Schwetzingen is not repeated among the cremated individuals. This comparison is based on a sample size of three individuals. The values for the four unsexed individuals span from 2.7 to 5.4 mm. The sample size is too small, therefore it is not possible to draw conclusions from the comparison of the values for the cremated individuals and the body burials.

The phenomenon of thicker cranial vault walls for the females from Schwetzingen is not limited to this cemetery. During a conversation with Birkenbeil (pers. comm.) from Jena, she mentioned that the cranial vault bones from the females from Wandersleben were extraordinarily robust, which could easily be confused as a characteristic male feature. The body burials were not available for study, therefore this observation could not be confirmed in actual numbers. However, in order to confirm whether this phenomenon is characteristic of the LBK, this author was able to take measurements from another series, Stuttgart-

Mühlhausen “Viesenhäuser Hof”. The cemetery was excavated in two phases, one in 1982 (9 ♂, 8 ♀) and the other in 1991/1992 (13 ♂, 15 ♀). The cranial vault walls of the males are thicker than that of the females (Table 28). The difference is not significant.

	M1 from unburned body burials ♀ t-test								
	♂				♀				t-test
	Ø (mm)	n		s(n)	Ø (mm)	n		s(n)	p
Schwetzingen	5.7	23	±	1.0	6.5	28	±	1.1	0.01
Stuttgart-Mühlhausen 1982	7.0	9	±	1.5	6.9	8	±	0.9	0.88
Stuttgart-Mühlhausen 1991/1992	6.9	13	±	0.8	6.0	15	±	0.9	0.79

Table 28: Comparison of M1 for the body burials from Schwetzingen and Stuttgart-Mühlhausen.

It appears that this is not a general trend in the LBK. It is, however, too early to be certain. The comparison has been limited to two cemeteries and one verbal comment by Dr. Birkenbeil. In the future, a thorough comparison from as many LBK cemeteries as possible may shed more light on this very interesting phenomenon.

3.6 Height Determination

Measurement 27 (the average diameter of the proximal epiphysis of the radius), measurement 32 (average diameter of the proximal epiphysis of the humerus), and measurement 39 (average diameter of the proximal epiphysis of the femur) can be used to determine the body height of a cremated individual. The required skeletal elements were only present in the cremation of one individual, Grave 135. The individual is an early *adult*, probably male. The average body height for unburned females in the LBK is 156.6 cm, for males 165.8 cm (Jaeger et al. 1998). Table 29 presents the height of the probable male from Grave 135 according to Rösing (1977) and Malinowski and Porawski (1969). Both values are lower than the average height of adult males in the LBK. Experience has show that the height calculated according to Malinowski and Porawski (1969) often returns too small values. The height calculated according to Rösing (1977) falls within the range calculated for unburned males in the LBK.

		Rösing	Malinowski /Porawski
	mm	cm	cm
Grave 135			
Ms27	30	<157.0	<151.0
Ms39	40	167,5	162
Ø		**162,3**	**156,5**

Table 29: Schwetzingen: Height of the individual from Grave 135 (♂). Ms32 not available for this individual (Rösing 1977 *and* Malinowski *and* Porawski 1969)

3.7 Pathologies and Epigenetic Characteristics

The thin section from the female individual from Grave 202 suggests that this individual may have had osteoporosis (see Figure 29). The structure of the femur bone resembles the structure typical of *juvenile* to early *adult* individuals: Small, oval osteons arranged like a row of pearls, lamellar structures between the osteons and along the periosteal region. However, the large lacunae show that the bone is already being resorbed. During osteoporosis the bone is resorbed and not replaced. This is a natural consequence of aging but it can also occur due to vitamin D deficiencies or malnourishment. It is common in post-menopausal women due to an estrogen deficiency (Aufderheide and Rodríguez-Martín 1998, 315ff). The female from Grave 202 was still very young. In this case, osteoporosis is likely to be an indicator for malnourishment.

4 Fellbach-Oeffingen, Baden-Württemberg, Germany

4.1 Burn Stage, Color and Degree of Fragmentation

The cremations from Fellbach-Oeffingen (Map 5) were thoroughly and completely burned as illustrated by the creamy white coloring and chalky and smooth texture of the fragments. Over 90% of the cremations were classified as belonging to burn stage IV and V, only two cremation contained material that was only burned to burn staged III. Due to the long period during which the cremations were buried directly in the soil, the outer layer of the bone was colored grey to brown, inside, the material is creamy white. Seven of the cremations for which the sex could be determined all reached burn stage IV-V. There is no difference among the burn stages for males and females. Two males and three females were burned to stage V, the other male and one female to stage IV-V. Only female from Complex 112 was labeled III-V.

		very small		small		medium		total	
		n	%	n	%	n	%	n	%
Burn Stage	I	-	-	-	-	-	-	-	-
	II	-	-	-	-	-	-	-	-
	III	1	3	-	-	-	-	1	3
	III-IV	1	3	-	-	-	-	1	3
	III-V	2	6	-	-	-	-	2	6
	III/V	1	3	2	6	-	-	3	9
	IV	2	6	-	-	-	-	2	6
	IV-V	6	18	3	9	-	-	9	27
	V	12	36	3	9	-	-	15	45
	total	23	75	8	24	-	-	33	100

Table 30: Fellbach-Oeffingen: Distribution of burn stages and degree of fragmentation.

As with the other cemeteries, the higher the degree of burning, the higher the degree of fragmentation will be (Table 30). All of the cremations from burn stage V are fragmented very small, with one exception. Complex 36 has an average fragment size of 16mm, just above the maximum 15 mm required for the very small fragmentation. The cremations from burn stages IV-V vary in size from very small to small.

4.2 Weight, Fragmentation and Preservation

The average weight of all of the cremations from Fellbach-Oeffingen is 15 g (Table 31). This is the smallest average weight from all of the cemeteries in this study. In fact, only one cremation, the male from Complex 107 weighed more than the average weight of all 15 cremations from Schwetzingen (184 g). The weights range from less than 1 g to 221 g. Twenty-eight cremations (88%) weighed less than 20 g, only 2 (6%) weighed more than 50 g. The remaining 3 cremations (9%) weighed between 20 and 50 g.

		Weight					
		total (g)			**average (g)**	**min weight (g)**	**max. weight (g)**
			n	**%**			
Burn Stage	**I**	-	-	-	-	-	-
	II	-	-	-	-	-	-
	III	0.9	1	0.2	1	0.9	0.9
	III-IV	3.6	1	1	4	3.6	3.6
	III-V	54	2	11	27	49.8	50
	III/V	67	3	14	22	13.8	29
	IV	2	2	0.4	1	0.9	1
	IV-V	290	9	60	32	0.4	221
	V	64	15	12	4	0.5	21.5
	total	481	33	100	15	0.2	326

Table 31: Fellbach-Oeffingen: Distribution of weight across burn stages.

Post-cranial elements were identified more frequently than cranial elements (Table 32). The femur, tibia and humerus predominate among the post-cranial elements. This may also be because these elements are especially easy to identify. The small weight of the cremations could suggest that only portions of the cremated individual were deposited in the grave, a *pars pro toto* burial. However, small and more fragile skeletal elements were also recovered for four of the cremations. Rib fragments were recovered from four cremations (12%), vertebra from three cremations (9%), pelvic fragments from two (6%) and a fragment from a phalange in one cremation (3%). Cranial elements were identified in 19 of the 33 cremations (58%), yet they only make up 18% of the total weight. Of these 19 cremations, nearly half contained teeth and 3 included *Pars petrosa*, a valuable element for determining the sex of an individual. The presence of small and fragile skeletal elements such as teeth, phalanges and ribs indicate that great care was taken to collect even small fragments when the individuals were removed from the funeral pyre and deposited in the grave. At the same time, this does apply to all of the cremations identified at the cemetery of Fellbach-Oeffingen. Only seven cremations (21%: Complex 61, Complex 63, Complex 75, Complex 80, Complex 103, Complex 105 and Complex 107) included skeletal elements of the cranium, the torso and the extremities and can be considered representative. These seven also make up over half of the total weight of the cremations. The remaining 26 cremations are not complete and have an average weight of 8 g. Their distribution across the cemetery shows that they are clustered near one of the other seven cremations. It is possible that these do not represent 26 individual cremations but that some are the result of disturbed burials, possibly even belonging to one of the seven more complete cremations.

		Weight Distribution				
		total			**min weight (g)**	**max. weight (g)**
		g	**%**	**% all**		
Skeletal Elements	cranial	88	18	18	0.4	28
	post cranial	195	41	39	0.2	52.2
	rest	199	41	40	0.7	140.3
	total: cremation	481	100			
	animal bones	15		3	0.9	11.9
	other	0		0	-	-
	total: all	496		100		

Table 32: Fellbach-Oeffingen: Distribution of weight across the skeletal elements.

The average weight for the five identified females among the cremations from Fellbach-Oeffingen is 11 g (Table 33). The average weight for the three males is 84 g, nearly eight times that of the females. The male cremation from Complex 107 weighed 221 g, while the other two only weighed 4 and 29 g. This one male was an exceptionally large cremations for this cemetery and its size misrepresents the ratio of female to male cremations. Without this cremation, the average weight for the cremated male individuals is 17 g and very similar to the average weight of the female cremations. The average maximum fragment size for females and males is also nearly identical, 30 mm and 29 mm respectively.

The average weight for the “*infant* o.o.” and “*juvenile* o.o.” age categories are identical, 8 g each. The average maximum fragment size is 16 and 22 mm respectively. The one cremation of an adult weighs 14 g and had the largest maximum fragment size, 37 mm. These weights and fragment sizes show how small the sample size was and explain why it was difficult to identify a more definite age or sex for the cremations (Table 33). At the same time, an average weight of 11 g was sufficient to determine the sex of five individuals! It is not necessarily important to have a large amount of cremated material. It is important to have characteristic skeletal elements that make an age and sex determination possible. In four cases, neither determination was possible. The average weight for this category was 1 g and the material did not include characteristic skeletal elements. The cremations of the individuals of undetermined age also contained the smallest fragments. At the same time, the smaller the degree of fragmentation and the average maximum fragment size, the more difficult it is to identify individual bones and the characteristic features needed for an age and sex determination. In this case, the increasing fragment size happens to correlate with how much information could be gathered for a certain cremations.

	n	Ø max. frag. size (mm)	average weight (g)	weight range (g)		
♀ (adult)	5	30	11	2	-	19
♂ (adult)	2	28	113	4	-	221
♂ (juvenile)	1	31	30			30
undetermined s						
***infant* o.o.**	8	16	8	0.2	-	58
***juvenile* o.o.**	12	22	8	1	-	24
adult	1	37	14			14
undetermined a	4	15	1	0.1	-	3
total	33	22	15			

Table 33: Fellbach-Oeffingen: Distribution of average maximum fragment size and average weight across age and sex categories.

Again, there is no clear correlation between the weight or the fragment size and the sex of the cremated individuals from Fellbach-Oeffingen. The correlation between weight, fragment size and age seems more significant. However, since the "*infant* o.o." category and the "*juvenile* o.o." category only include one actual infant (Complex 117, 0.8 g, 24 mm) this cannot be identified as a trend.

4.3 Sex Determination

The sex could be determined for 8 of the 22 adult cremations (36%) from Fellbach Oeffingen. The *juvenile* male (Complex 77) was sexed due to the shallow angle of the *meatus acustic internus* of the *Pars petrosa*. The sex of the two adult probable males (Complex 94 and Complex 107) was determined due to the robust bones and muscle markings. The fragments from all other cremation in this cemetery were classified as gracile to medium robustness. The probable male from Complex 107 is the largest cremation from Fellbach-Oeffingen, it weighs 221 g. However, it did not contain skeletal elements that are necessary to determine the sex of an individual. The *Pars petrosa*, usually very useful for determining the sex, was only fragmentary and could not be sexed. The *juvenile* to *adult* individual from Complex 62 was classified as female due to the gracile nature of the bones and the sharp border of the *Margo supraorbitalis.* The four probable females (Complex 74, Complex 75, Complex 103 and Complex 106) were sexed due to the gracile bones and muscle markings. In sum, the females make up 63% and the males 37% of the sexed cremations in Fellbach-Oeffingen (Figure 33). The remaining 25 cremations did not contain morphological features which allowed their sex to be determined.

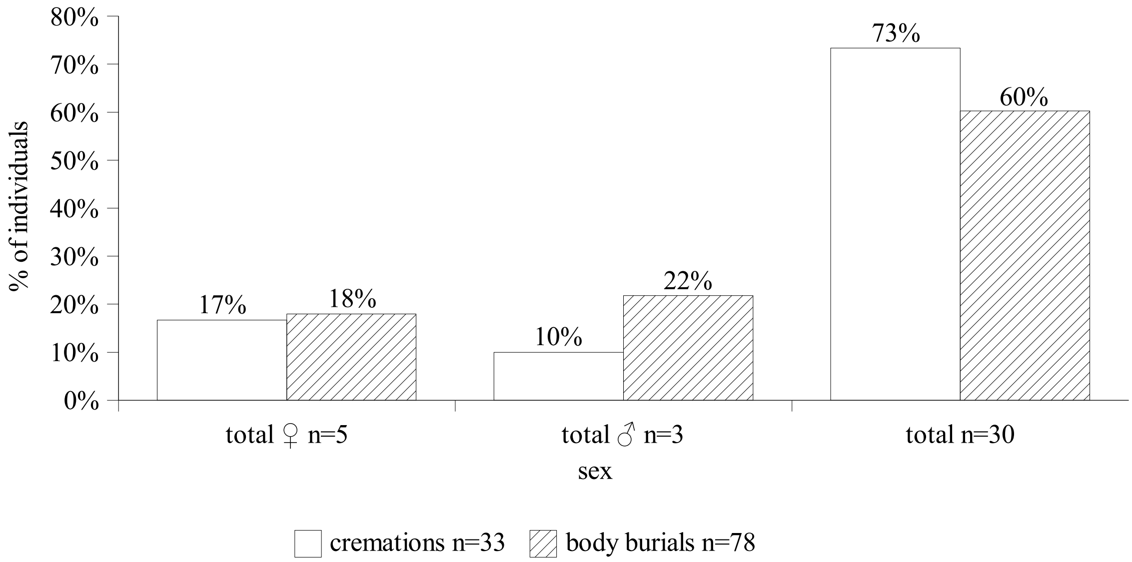


Figure 33: Fellbach-Oeffingen: Distribution of sex among the adult cremations and body burials.

Sex determination using burial goods was not attempted because 26 of the cremations from Fellbach-Oeffingen were also associated with body burials. Therefore, it is not certain whether the burial goods belonged to the body burial or the cremated individual. Of the seven cremations which were not found together with a body burial, two included burials goods, Complex 63 and Complex 105. Both included ceramic sherds. These are not sex specific burials goods because ceramics are associated with both sexes.

4.4 Age Determination

It was possible to determine an age range for 88% (29 of 33) of the cremations from Fellbach-Oeffingen (Table 34). Using the thickness of the bone walls as a guide for the stage of development of the individual 39% (13) of the cremations were classified as "*juvenile* or older". Twenty-four percent (8) individuals were classified as "*infant II* or older".

	total ♀		total ♂		undet.		total	
	n	%	n	%	n	%	n	%
***infant* I**	-	-	-	-	0.7	2	0.7	2
***infant* II**	-	-	-	-	2	6	2	5
juvenile	1.5	5	1.3	4	4.5	14	7.3	22
adult	1.5	5	0.6	2	5.5	17	7.6	23
mature	1	3	0.6	2	4.2	13	5.8	18
senile	1	3	0.6	2	4.2	13	5.8	18
undet.	-	-	-	-	4	12	4	12
total	5	16	3	10	25	77	33	100

Table 34: Fellbach-Oeffingen: Distribution of age and sex.

The cremations were identified as 8% children, 22% juveniles and 58% adults (30% sub-adults, 58% adult) (Figure 34). An age determination for the four remaining cremations (12%) was not possible. The individual from Complex 63 was identified as an early *adult* based on the state of the suture fusion and the closed molar root. The probable male from Complex 107 was classified as late *adult* to *senile* due to the closure of cranial sutures, the development of the teeth and tooth roots as well as the degree of ossification of the proximal epiphysis of the femur. The vertebral body was fused. The best identified individual was the

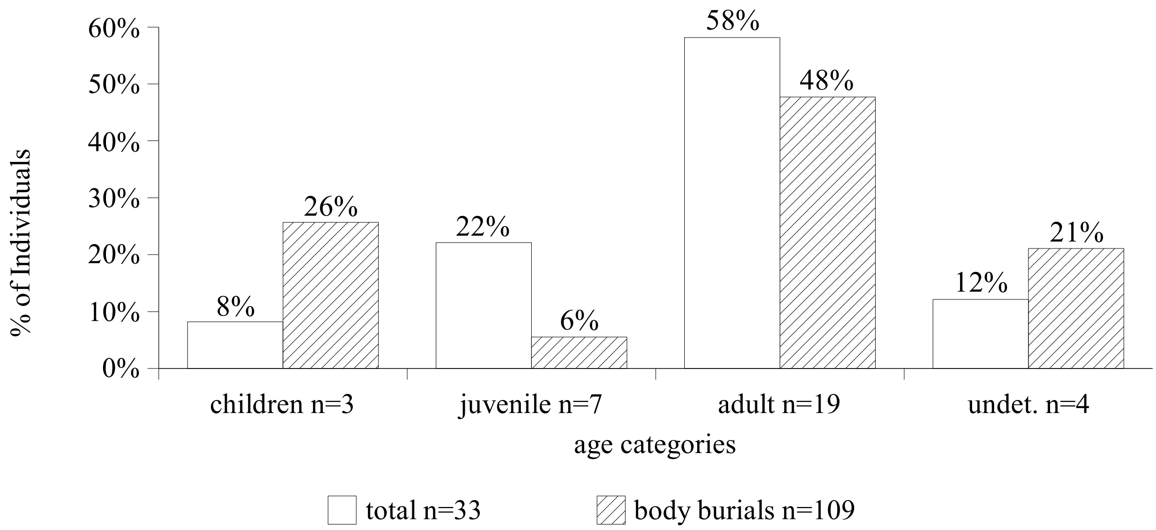


Figure 34: Fellbach-Oeffingen: Distribution of age categories among the cremations and body burials.

juvenile male, aged 14 to 16 years, from Complex 77. The age was determined due to the closure of the epiphyses and the development of the teeth. The epiphyses of a phalange, the femur and the humerus were all not fused. The incisor root was fused while the molar had not yet erupted. The individuals from three cremations (Complex 38, Complex 47 and Complex 81) were identified as "*infant II* or older" based on closed tooth roots.

Tooth Cementum Annulation

Five single rooted teeth from four cremations were selected (Complex 38, Complex 47, Complex 77 and Complex 81). One of the two teeth from Complex 38 could not be used because it was only burned to burn stage III and began to crumble during the very first cut. The tooth from Complex 47 was unburned and it is probable that it did not belong the cremated individual. It was still included in the examination. The remaining teeth were all burned to burn stage IV-V and were highly fragmented. The teeth were embedded and cut as described in section D.4.1. During the first cutting session, 80 µm thin sections were cut from the tooth from Complex 77 and from Complex 38_1. It was not possible to cut intact sections from Complex 47 and Complex 81. After the saw blade was replaced, it was possible to cut five sections at 60 µm from the canine from Complex 47 and one section from the incisor from Complex 81 during the second cutting session. The thin sections of the unburned tooth from Complex 47 broke apart during the cutting process. Yet five sections were cut at 60 µm. Although these section resulted in fantastic pictures underneath the microscope, these could not be used to the tooth cementum annulation because the sections were too thin (Figure 35). It was not possible to make more sections.

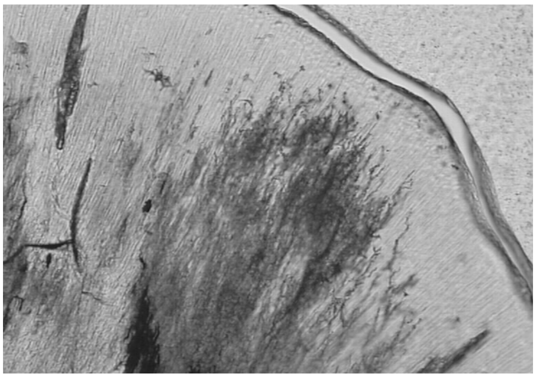


Figure 35: Fellbach-Oeffingen: Complex 57, 60 µm thin section of unburned canine.

Five sections were cut from the single rooted tooth from Complex 38_1 (Figure 36). The sections were cut at 80 µm. The thin sections showed that the tooth was very strongly altered by the heat induced changes, but it was possible to count at least ten rings in one section of the tooth. The outer surface of the root had been destroyed, therefore ten is a minimum count. It could not be clearly determined whether the tooth was an incisor or a canine. Tooth eruption ages for either tooth are 6 to 9 years of age depending on which incisor it was and 10 to 12 years depending on whether it as the upper or

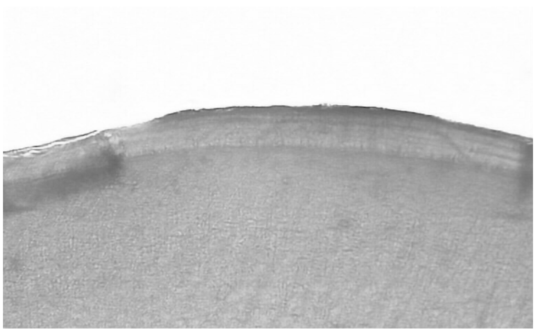


Figure 36: Fellbach-Oeffingen: Complex 38_1, cut at 80 µm, 200x magnification.

lower incisor (Rösing 1977, Tab. 3). Therefore, the individual from Complex 38 was either older than 16 to 19 years or older than 20 to 22 years, a late *juvenile* or older individual. The morphological age determination placed the individual in the category "*juvenile* or older".

The thin sections from Complex 77 were cut at 80 µm. The results from this thin section were of particular interest because it had been possible to determine such a concise age for this individual. The age determination for this individual was that of a *juvenile*, aged 14 to 16. It was possible to count at least 20 rings from multiple points of the six sections cut from this incisor (Figure 37). The tooth eruption age for incisors ranges from 6 to 8 years depending on the location of the tooth (Rösing 1977, Tab. 3). Adding the 20 rings to the tooth eruption age results in an age of 26 to 28 years, 10 years older than the morphological age. Three explanations could explain the discrepancy: first, the tooth was not perfectly straight when it was cut and therefore rings from different levels were cut resulting in the appearance of more annulation rings. Second, Condon et al (1986) and Grosskopf and Hummel (1992) mention a phenomenon called "doubling" where two rings are added each year instead of one. This phenomenon occurred more frequently in males and was also associated with pathological changes of the vertebra. If the rings were doubled, then the TCA method would result in an age of 16 to 18 years and would agree with the morphological age determination. The third explanation is the simplest and most likely. The tooth showed a greater age because it came from an older individual due to mixing of the cremated remains. At this point, it cannot be determined which explanation is responsible for the discrepancy between the morphologically determined age and the TCA age.

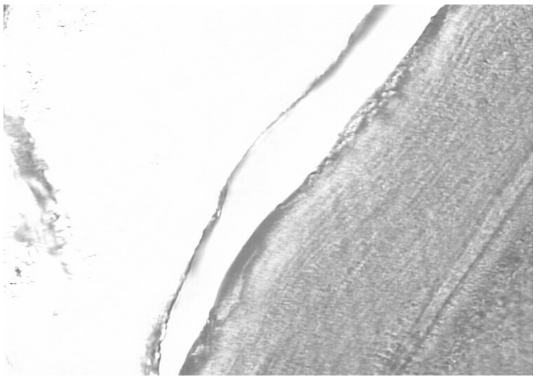


Figure 37: Fellbach-Oeffingen: Complex 77, cut at 80 µm, 200x magnification.

Only one section could be cut from the incisor from Complex 81. The tooth was already damaged and had tears along the tooth root. Cutting the tooth caused it to break. The one intact section was cut at 60 µm. It was not possible to count any rings because the tooth structure had been completely destroyed by the cremation process.

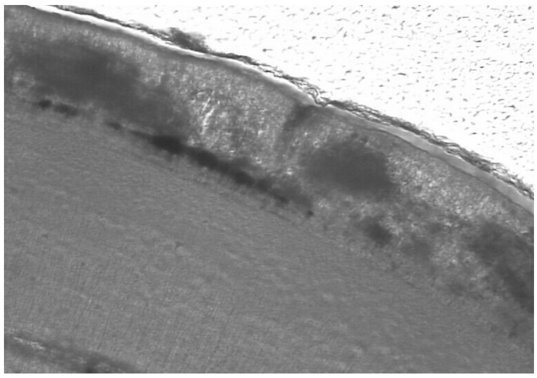


Figure 38: Fellbach-Oeffingen: Complex 81, incisor, cut at 60 µm, 200x magnification.

Overall, the tooth cementum annulation method was not very useful for the age determination of the cremated remains from the cemeteries of Schwetzingen and Fellbach-Oeffingen. Only two teeth from Complex 38 and

Complex 77 could be successfully cut and rings counted. The tooth count from Complex 38 coincided with the morphological age determination. The 20 rings counted for the incisor from Complex 77 do not match the morphological age determination unless the rings were doubled. In this case, the TCA could provide evidence for an as yet undetermined pathological condition or for mixing of the cremated material at Fellbach-Oeffingen.

Histological Age Determination

A thin section was taken from a femur fragment of the cremations in Complex 63, Complex 103 and Complex 105. The structure of the femoral bone made it possible to narrow the previously determined age categories, providing more concise age determinations for these three individuals. The age of the *adult* from Complex 63 was determined based on tooth development and cranial suture fusion (Figure 39). The osteon structure of the femur confirmed this age determination. The structures were regular and rounded. A lamellar structure was only recognizable near the periosteal region.

Figure 39: Fellbach-Oeffingen: Complex 63, adult individual, size 11.7 mm

The age of the "*juvenile* or older" probable female individual from Complex 103 was only determined because the young age categories could be excluded (Figure 40). The long bone wall was thicker than that of an *infant* individual. The thin section of the femoral diaphysis showed small, irregular osteons. The lamellar structure was not recognizable due to the poor preservation of the bone, but a clear pearl string pattern was observed. The structure suggest that the individual was aged *juvenile* to early *adult*.

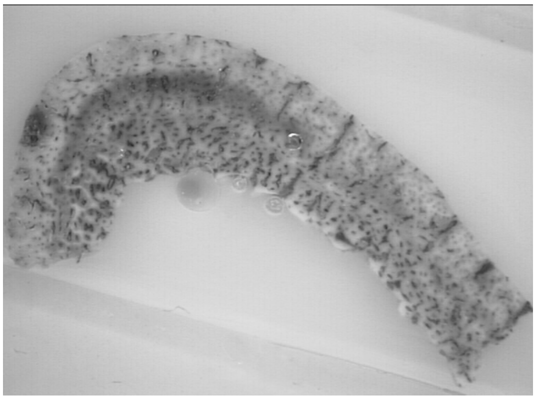


Figure 40: Fellbach-Oeffingen: Complex 103, juvenile to early adult probable female, size 14.2 mm

The age determination of the "late *juvenile* or older" individual from Complex 105 was also only based on the thickness and size of the bone fragments (Figure 41). The evaluation of the femoral thin section suggests that this individual was aged 30 to 40, late *adult*. The lamellar structure is no longer present and overlapping haversian systems were observed.

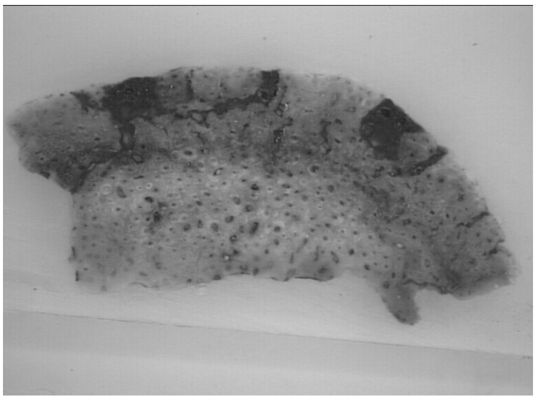


Figure 41: Fellbach-Oeffingen: Complex 105, late adult individual, size 11.0 mm

4.5 Metrics

Values were collected for 10 measurements from 13 of 33 the cremations from Fellbach-Oeffingen (Ms1, Ms16, Ms17, Ms19, Ms22; Ms28; Ms33; Ms43; Ms44 and Ms50). Standard deviations and t-test are not legitimate for such small sample sizes. None of the measurements were available from more than five individuals because the required skeletal element was not preserved (Table 35). It was not possible to take the measurements from the unburned body burials as for the cemetery from Schwetzingen. The unburned body burials were aged and sexed on site during the excavation. Afterwards, they were wrapped and conserved in a plaster cast to keep the fragile material intact. This is the condition in which they were transported to and stored in the osteological collection of the Landesamt für Denkmalpflege in Rottenburg. A thorough preparation of this material is necessary.

		IV-V								
	1	2		3		4		5	6	7
								+ shrinkage*		
		♂		♀		undet.		♂	♀	undet.
		Ø (mm)	n	Ø (mm)	n	Ø (mm)	n	Ø (mm)	Ø (mm)	Ø (mm)
Measurements	1	-	-	3.1	4	3.1	2	-	3.7	3.7
	16	8.8	1	-	-	-	-	10.1	-	-
	17	18.9	1	-	-	-	-	21.7	-	-
	19	-	-	-	-	2.2	1	-	-	2.5
	22	-	-	-	-	2	1	-	-	2.3
	28	1.9	1	2.0	3	2.7	2	2.2	2.3	3.0
	33	-	-	-	-	1.9	1	-	-	2.2
	43	-	-	4.3	2	-	-	-	4.9	-
	44	-	-	3.3	1	4.1	1	-	3.8	4.7
	50	8.4	1	-	-	-	-	9.7	-	-

Table 35: Fellbach-Oeffingen: Measurements of the cremated remains. Column 1 represents the measurements defined in section E.5.1. Column 2, 3 and 4 represent the values in mm for male, female and undetermined individuals. Column 5, 6 and 7 show the values for the cremations plus the shrinkage value. Only adults were included in the table.(+20% cranial, +10% epiphyses, +15% long bones)*

In comparison to the measurements from Schwetzingen (2.9 mm), Ms1 for the four female individuals from Fellbach-Oeffingen is slightly higher (compare Table 27). The corrected value with the 20% shrinkage factored in is still significantly lower than the value for the unburned female body burials from Schwetzingen. It is interesting to note that the average value for the undetermined individuals is exactly the same and it suggests, that these two individuals could also be female. However, as discussed for the measurements from

Schwetzingen, this is purely hypothetical and the values will not be included in the discussion. The next comparable value, Ms28 (thickness of the humerus shaft wall) is also nearly identical, the average value from the males from Schwetzingen is 2 mm. The values for Ms50 (Maximal thickness of the *Margo anterior* of the tibia) are also nearly identical for the measurements from Schwetzingen (8.5 mm) and Fellbach-Oeffingen. These few very similar measurements give the impression that the populations were identical. Due to the small sample size, such impressions are not necessarily accurate and must be treated with caution. If this trend does continue, then it is not surprising to see that Ms43 for the male from Schwetzingen (5.3 mm) is higher than the average value for the two females from Fellbach-Oeffingen. A variation from the near identical values can be observed for Ms44 (Thickness of the femur wall in the area directly across from the *Linea aspera*). The female from Schwetzingen (4 mm) has a higher value than the female from Fellbach-Oeffingen. Whether these similarities are significant cannot be calculated due to the the very small sample sizes of only one to four individuals per measurement. The impression remains that the values are nearly identical. It is possible that the cremated remains represent individuals from the same population.

Height determination for the individuals from Fellbach-Oeffingen was not possible because the necessary skeletal elements for measurements were not preserved. Pathological or epigenetic characteristic could not be identified because of the poor preservation of the cremated material.

4.6 Double and Multiple Burials

Seven cremations were recovered in their own graves, independent of body burials. Six cremations were found in association with body burials of adult males and seven with those of adult females. Five sets of cremated remains were collected from the surface and cannot be directly associated with any one body burial. Of the cremations associated with body burials for which the sex could not be determined, four were associated with infants, two with adults and two with individuals for which neither the age nor the sex could be determined. In sum, 12 cremations were found in body burials of adult individuals and five with sub-adult body burials. The overall arrangement of the cremations in the cemetery showed that there were two general clusters of cremated material, one in the west and one in the southeastern section (Map 5). It is possible that the southeastern group, comprised of Complex 51, 52, 61, 62 and 63 represents one female cremation which was disturbed and scattered. The age determination for these five complexes range from *infant II* to early *adult*. Complex 62 was classified as a probable female and the fragments from the other four complexes were gracile. These classification do not contradict each other and could easily combine to one *juvenile* to early *adult* female. An additional grouping of three complexes (Complex 74, Complex 75 and Complex 68) could be combined to a "*juvenile* or older" probable female. the grouping of Complex 101, Complex 102 and Complex 103 could also represent one *juvenile* female. The possible clusters allow the speculation that the cremations were there prior to the body burials. During the burial, the cremated material may have been disturbed and scattered. The arrangement of the cremations over and in the grave fill of the body burials suggests that the cremations were placed there after the body burials. The cremations were not buried very deep, they were found within 80 cm of the present day surface. Recent disturbances through farming, construction work and natural erosion may have carried off and scattered the cremations buried close to the surface.

5 Stuttgart-Mühlhausen

It is not clear whether the one cremation from Stuttgart-Mühlhausen belongs to the LBK because it was recovered from within an area that was disturbed by younger intrusions into the LBK layers. The cremation was analyzed by Burger-Heinrich (in prep.) The results will be briefly addressed and discussed.

5.1 Burn Stage, Color, Fragment Size and Weight

The cremation was assigned to burn stage II-IV with dark brown to black coloring. This means that the bone was not completely burned and had not yet undergone the chemical change characteristic from cremations of burn stage V. At this point in the burning process, the bone has lost some of its stability, but it is not as fragile as bone of a higher burn stage. The burn stage and coloring is not characteristic of LBK cremations. The weight of the cremation was 185 g. This is a relatively large amount of cremated material compared to the other cremations from this study. No information about the degree of fragmentation was recorded, therefore it is not possible to compare it with the cremations from the other cemeteries.

5.2 Age and Sex Determination

Bones of the cranial and postcranial skeleton were identified. The individual was classified as an adult probable female. The sex was determined based on the small and gracile shape of the mastoid process.

6 *Wandersleben, Thuringia, Germany*

Wandersleben was excavated in 1981 and 1982. Over 100 complexes containing 120 cremations were recovered. The cremations were originally evaluated by Dr. Birkenbeil from the University of Jena. The cremations were evaluated at Kromsdorf, the branch location of the Thüringisches Landesamt für Denkmalpflege und Archäologie in Weimar. The cemetery is still being evaluated and will soon be published. Until then, the only available literature is the article published by BACH in 1986. Birkenbeil and Bach identified 100 sub-adults (22 juveniles and 78 children) and 122 adults (49 ♂ and 73 ♀).

6.1 Burn Stage, Color and Degree of Fragmentation

The degree of cremation, the burn stages, range from II to V. Forty-three percent of the cremations were burned at very high temperatures, above 600°C, and fall into the burn stages IV, IV-V and V (Table 36). Twenty-three percent were identified as burn stage III-V, usually because the insides of the bone fragments were still grey to black in color. Two of the cremations were barely charred and identified as burn stage II. All other cremations show irregular degrees of burning. Although the cremations were primarily burned to burn stage IV-V, a portion of the skeletal fragments were burned to a lesser degree. These bones are grey to black and were identified as burn stage II or III. As can be expected, the degree of fragmentation of these cremations is less than those that were completely burned. Up until temperature of 300°C bone looses circa 1% of its mass. After that, there is no more shrinkage until temperatures of over 750°C are reached. At temperatures between 300 and 500°C, bone gradually looses its elasticity and becomes more brittle, it breaks more easily. Fragments identified as burns stage II can still resemble unburned bone, after burn stage III, the degree of fragmentation increases. The degree of fragmentation is "very small" or "small" for 92% of the cremations, only 8% contained medium sized fragments. Although the range of burn stages is very wide, these degrees of fragmentation speak for thorough cremations.

The uniform degree of fragmentation may also be the result of intentional manipulation of the remains after cremation. At the Roman cemetery of Stettfeld (WAHL and KOKABI 1988) the cremations were intentionally broken into smaller pieces either in the course of ritual practices or to ensure that the cremations fit into the burial urn. The cremations from Wandersleben were associated with ceramic vessels, bowls and *Kumpf* (BIRKENBEIL pers. comm.), but due to the publication status, no additional information is available about the affiliation of cremations and burial goods. In some cases the cremations were found underneath an overturned bowl, in other cases they were found inside a bowl of *Kumpf*. Cremations that were not allowed to cool completely after the burning are still very fragile. If the ashes of the funeral pyre were collected soon after the cremation process, the burned bone fragments could still be very brittle. The collection process and the subsequent transfer into a vessel could have caused the bones to break apart without any additional intentional crushing by the people who collected the ashes.

		Fragmentation							
		very small		**small**		**medium**		**total**	
		n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Burn Stage	**I**	-	-	-	-	-	-	-	-
	II	1	1	-	-	1	1	2	2
	II-IV	1	1	2	2	-	-	3	3
	II+V	-	-	-	-	1	1	1	1
	II-V	7	6	6	5	2	2	15	13
	III	-	-	-	-	-	-	-	-
	III-IV	3	3	1	1	1	1	5	4
	III+V	2	2	-	-	1	1	3	3
	III-V	28	23	1	1	1	1	30	25
	IV	3	3	1	1	1	1	5	4
	IV-V	20	17	6	5	-	-	26	22
	V	19	16	9	8	2	3	30	25
	total	84	70	26	22	10	8	120	100

Table 36: Wandersleben: Distribution of burn stages and degree of fragmentation

There is no clear differentiation between age and sex and the burn stage of the cremations (Table 37). Half of all of the cremations were burned to or included burn stage V, among the females and the individuals of undetermined sex it is the predominant burn stage. Among males, the majority falls into burn stage IV. This difference cannot be considered significant due to the small number of individuals. Forty-seven percent of the undetermined adults are included in burn stage V. At the moment, it is not clear how many possible males and females are still among these undetermined individuals and how they would influence the numbers in each category. The variation in burn stages does show that the the cremations from Wandersleben were not as thoroughly and completely burned as for example the cremations from Schwetzingen or Fellbach-Oeffingen, which were almost exclusively assigned to burn stages IV-V and V.

		Burn Stages									
		I	**II**		**III**		**IV**		**V**		**total**
		n	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
Sex	♀	-	0.3	0.3	3.3	2.8	4.8	4.0	6.5	5.4	15.0
	♂	-	0.8	0.6	1.9	1.6	2.9	2.4	2.4	2.0	8.0
	undetermined $_S$	-	-	-	-	-	-	-	-	-	0.0
Age	***infant* o.o.**	-	0.3	0.2	1.3	1.0	1.3	1.0	12.3	10.2	15.0
	***juvenile* o.o.**	-	1.3	1.0	5.1	4.2	8.1	6.7	14.6	12.2	29.0
	adult	-	0.5	0.4	1.5	1.3	4.5	3.8	7.5	6.3	14.0
	undetermined $_A$	-	4.2	3.5	6.0	5.0	12.5	10.4	16.3	13.6	39.0
	total	0	7	6	19	16	34	28	60	50	120

Table 37: Wandersleben: Distribution of burn stages across age and sex categories.

The average degree of fragmentation for the cremations from Wandersleben is "very small". The higher the degree of burning, the higher the fragmentation (Table 38). For cremations identified as burn stage III or higher the average fragment size is less than 15 mm. The cremations, which include burn stage II have a slightly higher degree of fragmentation, as was to be expected. The average maximum fragment size was 36 mm. The average maximum fragment sizes range from 28 mm to 55 mm, "medium" to "very large" fragmentation. Compared to the values from Schwetzingen (24 mm) and Fellbach-Oeffingen (22 mm) these pieces are twice as long. These large values are another indicator that the cremations from Wandersleben were not burned as thoroughly as the ones from the other evaluated sites. The large average maximum fragment size also shows that the pieces were probably not intentionally broken into smaller pieces.

		n	Fragmentation Ø frag. size (mm)	Ø max. frag. size (mm)
Burn Stage	I	-		
	II	2	small	28
	II-IV	3	small	37
	II+V	1	medium	55
	II-V	15	small	44
	III	-	-	-
	III-IV	5	very small	32
	III+V	3	very small	51
	III-V	30	very small	39
	IV	5	very small	28
	IV-V	26	very small	34
	V	30	very small	33
	total	120	very small	36

Table 38: Wandersleben: Distribution of average fragment size and average maximum fragment size across burn stages.

6.2 Weight, Fragmentation and Preservation

The average weight of all cremations from Wandersleben is 94 g (Table 39). The weights range from 0.4 to 565 g. Twenty-six of the cremations weighed less than 10 g (22%), 53 (44%) between 10 and 100 g and the remaining 41 cremations (34%) weighed between 100 and 565 g. The distribution of weight compared with the fragment sizes shows a discrepancy. Sixty-six percent of the cremation weigh less than 100 g, the average fragment size is “very small” yet the maximum average fragment size is “large”. The preservation of small bones and teeth is nearly identical compared to Schwetzingen (31%), Fellbach-Oeffingen (36%) and Elsloo (26%), they were identified in 37 of the 120 graves (31%). Teeth were found in 20 graves (17%), small bones such as phalanges and wrist bones in 26 graves (22%).

Burn Stage		total (g)	n	%	Weight average (g)	min weight (g)	max. weight (g)
	I	-	-	-	-	-	-
	II	5.2	2	0.1	2.6	2.1	3.1
	II-IV	219.2	3	2	73	18.4	132.7
	II+V	56	1	0.5	56	56	56
	II-V	1573	15	14	105	5.9	404
	III	-	-	-	-	-	-
	III-IV	113	5	1	23	4.6	59.1
	III+V	536	3	5	179	65.5	299
	III-V	4634	30	41	154	6.8	565
	IV	15	5	0.1	3.0	0.4	3
	IV-V	2809	26	25	108	2.7	444.1
	V	1366	30	12	46	1.2	193.7
	total	11326	120	100	94	0.4	565

Table 39: Wandersleben: Distribution of weight according to burn stages.

Eighty-eight percent of the the cremations included both cranial and postcranial elements, only 13 cremation did not include cranial fragments and three only included fragments from the skull (Table 40). Only one cremation, Complex 119, included *Grus* or rest bones, fragments that could not be assigned to the cranial or postcranial category with confidence. *Grus* was not identified in the other cremations, an indication that the pieces of burned bone were gathered from the funeral pyre instead of having been swept up with the ashes. If a cremation includes large amounts of *Grus* or rest bones then it is not certain whether small fragments were gathered intentionally or swept up with the ashes. In the case of Wandersleben, this fact is even more remarkable because small fragments such as bones of the hand and teeth were identified in so many of the cremations. The teeth and phalanges are easy to identify among the many fractured and broken bones, which is also why they were collected instead of being overlooked. Cranial bones make up 27% (3,088 g) of the total weight of the cremations. Diagnostic cranial bones such as the Pars petrosa for sex determination were identified in 32 graves (27%). Of the 106 graves that included cranial bones, 20 (19%) also included the remains of burned teeth important for age determination. Postcranial bones make up 69% (7,847 g). Animal bones were not identified among the cremations. These were sorted prior to the anthropological evaluation by this author. Some stones and charcoal were identified, however, they make up less than 1% of the total weight from the cremations from Wandersleben.

		Weight distribution				
		total (g)			**min weight (g)**	**max. weight (g)**
			%	**% all**		
Skeletal Elements	cranial	3088	27	27	0.3	133
	post cranial	7847	69	69	0.4	361
	rest	391	3	3	391	391
	total: cremation	11326	99			
	animal bones	-	-	-	-	-
	other	8	-	0.1	0.5	7
	total: all	11334		100		

Table 40: Wandersleben: Distribution of weight across the skeletal elements.

The following Table 41, summarized the distribution of weight and fragment sizes across the sex and age categories. The greatest average fragment size and weight was recorded for the adult female and male individuals. The average weight for female cremations (219 g) is 30 g heavier than the average weight for the males (179 g). The average maximum fragment size is also 4 mm larger. The weight for seven of the female cremations ranged between 100 and 200 g, only four weighed more than 200 g. Among the males, three cremations weighed less than 100 g, two between 100 and 200 g and three weighed over 200 g. An interpretation of these results as sex or age specific leads to a circular argument. The amount of available cremated material and the large average maximum size of the fragments are the reason why the sex and age of these individuals was determined. The same can be said for the cremations of undetermined sex. The average maximum fragment size is very similar for the three categories. The weight of the *infant* o.o. category seems relatively high in comparison to the other two categories, however, the suffix "o.o." implies that these may also include the remains of older individuals. The average fragments size and weight of the cremations of undetermined age explains why the age and sex could not be determined for the 26 cremations. Frequently, only a handful of fragments were available for evaluation and these were poorly preserved and of very small size. The average weight, 13 g, shows that the majority of these 26 cremations were very small, even if the weights ranged between 0.4 and 290.4 g.

		n	Ø max. frag. size (mm)	average weight (g)	weight range (g)
Sex	♀ (adult)	12	47	219	68.1 – 444.1
	♂ (adult)	8	43	179	34.6 – 564.8
	undetermined S				
Age	*infant* o.o.	21	35	108	0.2 – 390
	juvenile o.o.	37	39	100	4.5 – 403.5
	adult	16	35	60	6.5 – 219.5
	undetermined A	26	27	13	0.4 – 290.4
	total	120	36	94	

Table 41: Wandersleben: Distribution of weight and fragment size for sex and age determination.

The overall fragment size for the cremations from Wandersleben was very small. The distribution of weight across the different burn stages, the sex and age categories did not identify a clear differences. Although the cremations do not provide information for a trend among the cremated individuals, the material does provide information about the cremation process. On the one hand, the cremations were treated with care. The fragments were collected from the funeral pyre, not just swept together, and frequently placed into a ceramic vessel of some form. Whether other cremations were placed into containers made out of organic materials such as hides or baskets, cannot be determined from the available information. Special care was taken to collect small fragments such as finger bones and teeth in 31% of the cremations. On the other hand, the cremations were not burned as regularly and completely as the cremations from Schwetzingen or Fellbach-Oeffingen, the degree of burning varied from burn stage II to V. It seems that the cremated individuals were treated similarly to the cremations from the other studied cemeteries, however, for some reason, the burning process was not carried out as thoroughly.

6.3 Sex Determination

Of the 120 cremations from Wandersleben 3 were identified as definite females ("♀"; Complex 133, Complex 329 and Complex 338), 13 as probable females ("(♀)"; Complexes 8, 14, 20, 22, 24, 26, 28, 38, 45, 73, 157, 160, 335), 1 as a definite male ("♂"; Complex 327) and seven as probable males ("(♂)"; Complexes 12, 21, 119, 50, 85, 300, 333). The definite female from Complex 133 was sexed based on the steep angle of the *meatus acusticus internus* the rounded shape of the mandible, thin cranial bones without pronounced muscle marking and the general gracile to medium robustness of the bones. The female from Complex 329 was identified due to the round shape of the orbit, the sharp angle of the *Margo supraorbitalis* and the small, rounded *mentum* (chin). The wide *incisura ischiadica* and the steep angle and round border of the meatus *acusticus internus* provided the identification for the female individual from Complex 338. Eight probable females (Complexes 14, 20, 24, 26, 38, 45, 157, 335) were identified due to the steep angle of the *meatus acusticus internus*, the blunt medial angle and the rugged surface of the posterior surface. Half of these individuals (Complexes 20, 25, 38 and 45) were also identified as sub-adult individuals (Figure 42). The validity of the angle *meatus acusticus internus* of the *Pars petrosa* as a criterion for differentiating between male and female sub-adults was provided by Forschner (2001) in her dissertation. In addition, the females from Complex 14 and 157 had a sharp *Margo supraorbitalis,* a feature that was also identified for the females from Complex 8 and 22. The female from Complex 73 was identified due to the wide *incisura ischiadica.* The definite male from Complex 127 showed very characteristic supraorbital ridges and the *Margo supraorbitalis* was rounded. One probable male (Complex 12) was identified based on the

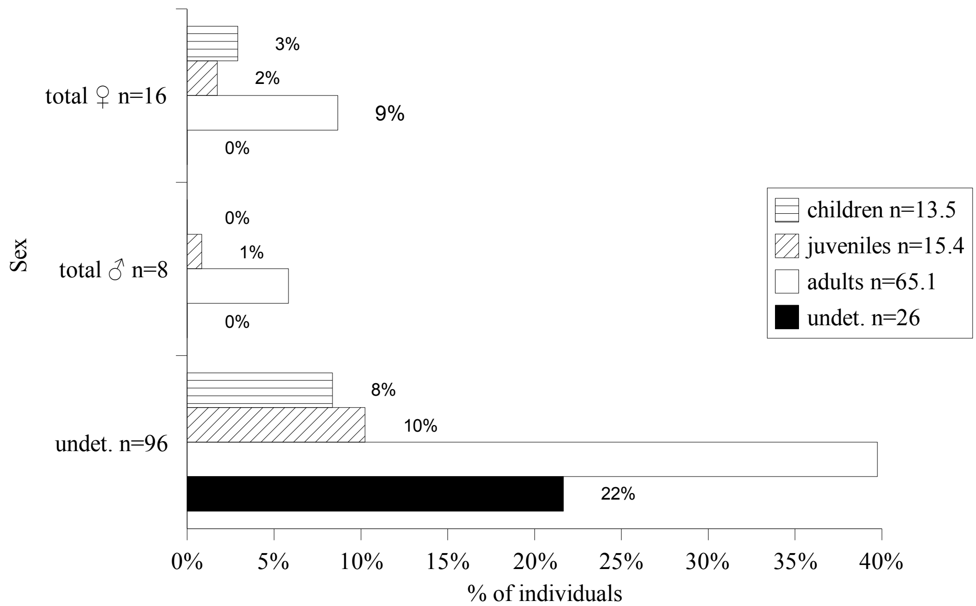


Figure 42: Wandersleben: Distribution of age and sex.

shallow angle of the *meatus acusticus internus*, one (Complex 333) based on the round *Margo supraorbitalis*. All cremations identified as male had medium to robust and robust bones and muscle attachment sites. The muscle markings on the *linea aspera* and the occipital were very robust and pronounced for the probable male from Complex 21. The *mentum* and mandible of the probable male from Complex 300 were very angular and pronounced.

The distribution of the sexes among the cremations is identical to the distribution among the unburned body burials (unpublished data provided by BIRKENBEIL). In both cases, females were identified more frequently than males. Only the sexed adult individuals are included in Figure 43. If the four sub-adult females are included in the calculation, the percentages change to 67% female and 33% male individuals among the cremations. No further archaeological information is available for the cemetery at Wandersleben at this time.

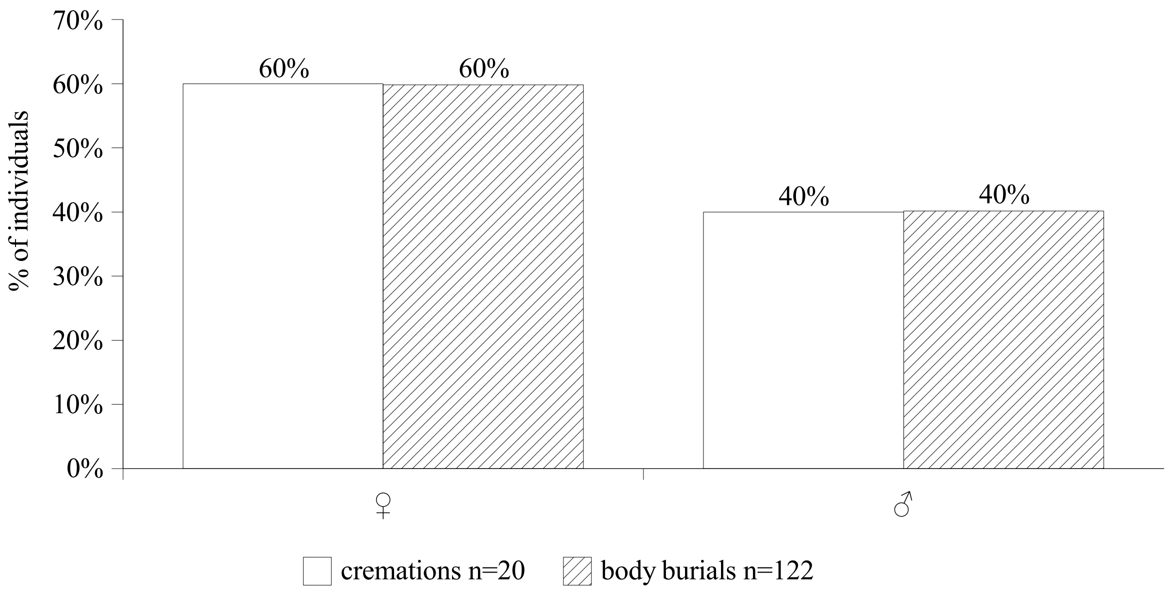


Figure 43: Wandersleben: Distribution of the sexed adult individuals among the cremations and body burials.

6.4 Age Determination

Eighty-eight percent of the cremations from Wandersleben could be assigned an age category or an age span (Figure 44). The children make up 11% of the identifiable individuals, the juveniles 13% and the adults 54%. In contrast to the other cemeteries in this study six definite children of the the category *infant I* (5%) and two definite children of category *infant II* (1.7%) were identified based on the size and thickness of the bones as well as tooth development. Three individuals were aged "*infant II* or older" (Table 42). The age of the "*juvenile* or older" and the adult age categories was determined primarily based on tooth development, fusion of the epiphyses and cranial suture fusion. Two *mature*, one *mature* to *senile* and one *senile* individual were identified based on the fusion of the lambdoidal suture.

No definite *juvenile* individuals could be identified. Only one individual from Complex 90 could possibly be a definite *juvenile* but was classified as "*juvenile* to early *adult*". The vertebra body was already fused (>18 years) but the proximal epiphysis of the humerus was not yet fully fused (<18-20).

	total ♀		**total ♂**		**undet.**		**total: all**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
***infant* I**	1	1	-	-	6.2	5	7.2	6
***infant* II**	2.5	2	-	-	3.9	3	6.4	5
juvenile	2.1	2	1	1	12.3	10	15.4	13
adult	3.4	3	4.8	4	18.3	15	26.5	22
mature	5.1	4	1.8	2	16.3	14	23.2	19
senile	1.9	2	0.3	0.300	13.1	11	15.3	13
undet.	-	-	-	-	26.0	22	26.0	22
total	16		8		96		120	

Table 42: Wandersleben: Distribution of age and sex.

The question of the 'missing' *juvenile* individuals at Wandersleben was addressed in the previous chapter. It should be relatively simple to identify juvenile individuals because of the number of changes occurring in the skeleton at that age. The epiphyses fuse, the final teeth form and complete and the sexual dimorphism becomes more pronounced. Yet these individuals are only present in the age categories "*infant* or older" and "*juvenile* or older". Definite juveniles were identified among the cremated material from Schwetzingen and Fellbach-Oeffingen and they were present among the unburned body burials from Wandersleben (Figure 44). Possibly *juvenile* individuals were treated to a different burial form, they were not cremated. *Juveniles* are no longer children but no yet adults. Every parent and every adolescent knows about the conflicts that ensue at this age. Maybe this 'in-between' state was cause for these individuals to be treated differently from the rest after death. It is also possible that *juveniles* left their families during puberty, either to find a husband or wife, to learn a trade or simple to go visiting or exploring. This could explain why they were not in their local cemetery, however, then they should appear in the cemetery of the place they were visiting. In this case, maybe these visitors were, once again, treated differently from the local population. Although social factors cannot be ruled out, it is more probable that the *juvenile* individuals are just very difficult to identify in the burial record. Tooth eruption and epiphyseal fusion schemes are variable. In addition, the cremation processes is very destructive. Joints that were just starting to fuse when the individual died can burst open again. Teeth are lost or broken. All these factors can lead to an individual appearing younger or older. The fusion process most frequently occur during the *juvenile* phase. Therefore, the effects of the cremation process can cause these individuals to 'disappear' from the record.

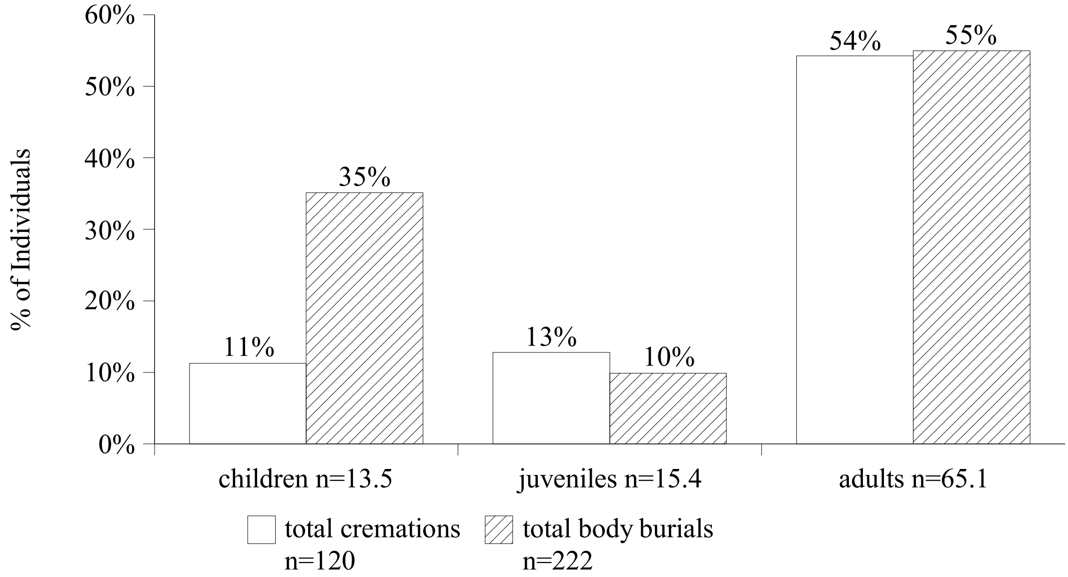


Figure 44: Wandersleben: Age distribution

6.5 Metrics

Values were collected for 23 measurements (Ms1, Ms2, Ms9, Ms10, Ms11, Ms16, Ms17, Ms18, Ms19, Ms20, Ms21, Ms26, Ms27, Ms38, Ms32, Ms33, Ms39, Ms43, Ms44, Ms45, Ms46, Ms47 and Ms50) from 53 of the 120 individuals from Wandersleben (Table 44). Only adult individuals (male, female and undetermined sex) were included in the calculations. Thirteen measurements could only be taken from one individual per male, female and undetermined sex category and only five could be taken for at least five or more individuals (Ms1, Ms28, Ms33, Ms43 and Ms50). These five measurements will be discussed in more detail. The values for Ms1 (thickness of the cranial vault wall) shows that the cranial vault wall of the males (4.7 ± 0.99 mm) was much thicker than in the females (3.6 ± 0.56 mm). The difference is significant (p=0.04). The average value for the adult individuals of undetermined sex is 3.8 mm. Based on these values, it could be possible to label the undetermined individuals with Ms1 > 4.15 mm as male individuals. The individuals below this value must remain undetermined because the lower half of the male range overlaps the female range. Including the newly determined males, the ration of male to female individuals increases by 13 males, bringing the total to 16 females (13%) and 21 males (18%). Compared to the values from Schwetzingen and Fellbach-Oeffingen, the values are higher. The same applies to the Ms1 values of the unburned body burials. The average value for 37 males was 8.7 mm and the value for 36 females was 7.9 mm compared to the 5.7 mm for male and 6.5 mm for females in Schwetzingen and the slightly higher values for the burials from Stuttgart-Mühlhausen (Table

43). The author took two measurements from the first three sample sets herself, therefore the different values cannot be attributed to errors due to the method or inter-observer error. The body burials from Wandersleben were not available for measurements, therefore, the values are reproduced as they were reported in the literature (BACH 1986). Although measurements have been standardized, there is still the possibility of inter-observer error. However, the crania of the body burials from Wandersleben were cited as being very thick both by BACH (1986) and by the currently responsible anthropologist (BIRKENBEIL pers. comm.). Therefore, it is possible that the variability reflects the real anthropological circumstances.

	M1 from unburned body burials ♀ t-test								
	♂				♀				t-test
	Ø (mm)	**n**		**s(n)**	**Ø (mm)**	**n**		**s(n)**	**p**
Schwetzingen	5.7	23	±	1.0	6.5	28	±	1.1	0.01
Stuttgart-Mühlhausen 1982	7.0	9	±	1.5	6.9	8	±	0.9	0.88
Stuttgart-Mühlhausen 1991/1992	6.9	13	±	0.8	6	15	±	0.9	0.79
Wandersleben (Ø)	8.7	37	-	-	7.9	46	-	-	n.s.

Table 43: Comparison of M1 for the body burials from Schwetzingen, Stuttgart-Mühlhausen (excavations from 1982 and 1991/1992) and Wandersleben.

Could this reality be an explanation for the greater thickness of the female cranial vault walls at Schwetzingen? It is possible that some of the females from Schwetzingen immigrated into the population from a population where the cranial vault walls were thicker, such as in Wandersleben. BERNHARD (1978) described regional differences in the LBK and defined a west-/southwestern complex and an east-/northeastern complex based on the breadth and height of the facial skeleton. He did not make any specification based on the thickness of the cranial vault wall. The observations made in this study could present a starting point for further studies that could shed some light on possible regional difference in LBK populations.

The difference between male and female individuals for the remaining measurements does not show any more surprising variations. In all cases, the values for the male individuals are slightly higher than for the female individuals. One exception is Ms44, the thickness of the femur wall across from the *Linea aspera*. The average value for the male individuals (5.5 mm) is 1.1 mm lower than the value for the female individuals (6.6 mm). The values were taken from two individuals each and the difference could result from the small sample size. The values for Ms28 are interesting to look at because the average value for the 2 males (2.3 mm) and the 5 females (2.4 ± 0.64 mm) are both below the average value for the 21 individuals of undetermined sex (2.5 ± 0.66). Therefore, it is likely that the majority of the individuals among the undetermined adults could be male individuals. The value for five of the undetermined adult individuals was above 3.1 mm. However, due to the small sample size of male individuals, these values cannot be confidently considered in the distribution of sex determined individuals. The same argumentation applies to the values for Ms50 (maximal thickness of the *Margo anterior* of the tibia). The undetermined value (8.5 mm) is higher than the value for the male (8.2 mm) and female (7.6 ± 1.72 mm) adult individuals. It is not possible to identify which of the undetermined individuals could possibly be male individuals because the variability within each sex is very high. The standard deviation for the female individuals is very high, the measured values range from 5.8 to 10.7 mm, the male values were 6.9 and 9.4 mm.

The values for Ms33 (thickness of the radius diaphysis) are similar for males (2.4 mm) and females (2.1 ± 0.57 mm). The average value of the undetermined individuals in 2.2 mm, slightly closer to the female values. It is possible that more female individuals could be identified among the undetermined individuals, than males. The values for Ms43 (average breadth of the *Linea aspera*) is 7.7 mm for males and 7.2 ± 0.71 mm for female individuals. The average value for the undetermined individuals is 7.4 mm, in-between the male and female values. It is possible that an equal number of males and females could be among these unidentified individuals.

Overall, the values from the cremated material from Wandersleben are higher than the values from the other cemeteries. The obvious differences are in the thickness of the cranial vault wall. The remaining values, especially on the post-cranial skeleton are only slightly higher. Whether this is an indicator for different populations or a trend in the LBK populations should not be studied using the cremated material since the values are very dependent on the cremation process and how it affects the bone. A comprehensive comparison of the unburned body burials is necessary to answer this question. There does seem to be a difference between the cremations and the body burials at the individual cemeteries. However, this difference was also only observed in Ms1. The values of the cremated materials with the shrinkage factored in were still much lower than the values measured on the unburned material. As stated for the measurements from the cemetery of Schwetzingen (sec F.3.5), this difference probably has more to do with the shrinkage factor being greater than 20% than with a realistic variation.

	burn stage IV-V												unburned body burials				
1	2			3			4			5	6	7	8	9		10	
	♂			♀			undet.			+ shrinkage* ♂	♀	undet.		♂		♀	
Measurements	Ø (mm)	n	s(n)	Ø (mm)	n	s(n)	Ø (mm)	n	s(n)	Ø (mm)	Ø (mm)	Ø (mm)		Ø (mm)	n	Ø (mm)	n
1	4.7	6	± 0.99	3.6	12	± 0.56	3.8	44	± 0.8	5.6	4.4	4.5	1	8.7	37	7.9	36
2	-		-	[15.9]	1	-	-		-	-	19.1	-		-	-	-	-
9	-		-	8.0	1	-	-		-	-	9.5	-		-	-	-	-
10	-		-	-		-	11.4	1	-	-	-	13.7		-	-	-	-
11	-		-	-		-	12.9	1	-	-	-	15.5		-	-	-	-
16	13	1	-	11.4	1	-	16.5	1	-	15.6	13.7	19.8		-	-	-	-
17	-		-	5.8	1	-	-		-	-	7.0	-		-	-	-	-
18	-		-	11.4	1	-	-		-	-	13.7	-		-	-	-	-
19	-		-	2.4	2	-	2.0	1	-	-	2.9	2.4		-	-	-	-
20	-		-	8.2	1	-	-		-	-	9.8	-		-	-	-	-
21	-		-	8.8	1	-	-		-	-	10.6	-		-	-	-	-
26	-		-	-		-	1.8	1	-	-	-	2.1		-	-	-	-
27'	-		-	42.3	3	-	44.0	3	-	-	46.6	48.4		-	-	-	-
28	2.3	2	-	2.4	5	± 0.64	2.5	21	± 0.66	2.6	2.9	3.0		-	-	-	-
32'	16.3	1	-	17.3	1	-	15.6	4	-	18.7	19.9	18.0		-	-	-	-
33	2.4	3	-	2.1	6	± 0.57	2.2	15	± 0.64	2.8	2.4	2.5		-	-	-	-
39'	44	1	-	40.0	1	-	50.3	4	-	48.4	44.0	55.3		-	-	-	-
43	7.7	3	-	7.2	5	± 0.71	7.4	12	± 1.54	8.9	8.3	8.5		-	-	-	-
44	5.5	2	-	6.6	2	-	5.5	9	± 1.85	6.3	7.5	6.3		-	-	-	-
45	-		-	2.91	1	-	-		-	-	33.5	-		-	-	-	-
46	-		-	28.0	1	-	-		-	-	32.2	-		-	-	-	-
47	-		-	13.8	1	-	-		-	-	15.9	-		-	-	-	-
50	8.2	2	-	7.6	8	± 1.72	8.5	21	± 2.1	9.4	8.8	9.8		-	-	-	-

*Table 44: Wandersleben: Measurements (column 1) from the cremations, defined in E.5.1. Comparison between males and females (column 2 and 3) and undet. individuals (column 4). Columns 5, 6 and 7 show values for the cremations plus the shrinkage value. These values can be compared to the measurements of the unburned body burials, M1 from Bach 1986 (columns 9 and 10). (' = measurements for body height calculation; * +20% cranial, +10% epiphyses, +15% long bones)*

6.6 Height Determination

The estimation of height was possible for three female, two male (Table 45) and eight individuals for which the sex could not be determined (Complex 4, Complex 30, Complex 83, Complex 90, Complex 149, Complex 150, Complex 201 and Complex 336). Due to the small sample size available standard deviations were not calculated. As expected, on average, the females were shorter than the males, 4.4 cm shorter according to Rösing (1977) and 7.3 cm shorter according to Malinowski and Porawski (1969). The heights of the two sexes do not overlap. To compare, the Federal Statistical Office of Germany found that the average height across all age categories (18-75+) for females was 165 cm and for males 171 cm in 2005 (Federal Statical Office, Germany http://www.destatis.de/basis/d/gesu/gesutab8.php), the difference in height amounts to 6 cm. The height determination for the individuals from Wandersleben shows that the females were 1.5 to 8.8 cm shorter and the males 3.0 to 7.5 cm shorter than people living in Germany today.

		♀		♂	
	mm	**cm**		**cm**	
		Rösing	Malinowski/ Porawski	Rösing	Malinowski/ Porawski
Complex 28					
Ms27	40	**162,0**	**156,3**	-	-
Complex 73					
Ms27	41	**163,0**	**157,3**	-	-
Complex 133					
Ms27	46	169,5	163,0	-	-
Ms32	17,3	160,0	148,0	-	-
Ø		**164,8**	**155,5**	-	-
Complex 12					
Ms39	44	-	-	**171,0**	**165,0**
Complex 119					
Ms32	16,3	-	-	**165,0**	**<162.0**
Ø for all		163,6	156,2	168,0	163,5

Table 45: Wandersleben: Height determination according to Rösing *1977 and* Malinowski *and* Porawski *1969.*

The variability of the heights determined for the female individual from Complex 133 is similar to the height determination of the probable male individual from Grave 135 (Table 29). The height determinations using Ms27 and Ms32 result in completely different height values with a difference of 9.5 cm according to Rösing (1977) and 15 cm according to Malinowski and Porawski (1969). It is impossible to tell which height determination is correct. In Schwetzingen, the variation was 10.5 cm and 11.0 cm respectively. This variability is even more extreme for the individual of undetermined sex from Complex 83 (Table 46). Three measurements for height determination were available for this individual, Ms27, Ms32 and Ms39. The height determinations according to Rösing (1977) varied between 147.0 cm and

164.5 cm for females and 157 and 172 cm for males. It varies between 144cm and 158.3 cm for females and 157.0 and 165.5 cm for males according to MALINOWSKI and PORAWSKI (1969). The values for Ms27 and Ms39 correlate very well according to RÖSING (1977). These values do not correlate well with Ms32 nor to each other according to MALINOWSKI and PORAWSKI (1969).

		♀		♂	
	mm	**cm**		**cm**	
		Rösing	Malinowski/ Porawski	Rösing	Malinowski/ Porawski
Komplex 83					
Ms27	42	164,5	169,5	158,3	163,3
Ms32	11,7	<147.0	<157.0	<144.0	<157.0
Ms39	45	164,5	172,0	158,0	165,5
Ø		158,7	166,2	153,4	161,9

Table 46: Wandersleben: Height determination of the undetermined individual from Complex 83 according to RÖSING *1977 and* MALINOWSKI *and* PORAWSKI *1969.*

Compared to the average body height for unburned females and males in the LBK (156.6 cm and 165.8 cm JAEGER et al 1998) the values for the females from Wandersleben fit very well when calculated according to MALINOWSKI and PORAWSKI (1969) and are much higher when calculated according to RÖSING (1977). The average value for males in the LBK lies in between the average values calculated for the males from Wandersleben.

6.7 Double and Multiple Burials

In contrast to the cremations from Elsloo, Schwetzingen and Fellbach-Oeffingen, the graves containing cremations also frequently contained ceramic vessels. In some cases the cremated remains were found inside or next to the vessels. Exact numbers are not available at this time because excavation notes on the archaeology of the cemetery are not available. A publication on the cemetery is currently being prepared by the Landesamt für Denkmalpflege in Weimar. Until that time, this study has to rely on the information from the notes written on the find cards. According to BIRKENBEIL (pers. comm.) these are not always accurate. Thirty cremation (25%) were found together with ceramic sherds, either inside or next to the vessel. In one case, Complex 8, BIRKENBEIL was able to fit cranial fragments together that were found in two different vessels in the complex. This is evidence that although multiple vessels containing cremations were included in a complex, these still belong to one individual. Another explanation could be that multiple individuals were cremated together and then placed into vessels. However, the small amount of cremated material does not make this explanation seem likely.

In four cases, cremations were found in graves that also included body burials (Complex 53, Complex 85, Complex 152 and Complex 196). A small pile of cremated remains was found in a horizon above the body burials. The cremations were placed into the grave after the body burial, not at the same time. Complex 196 only consists of one fragment and weighs 2.7 g. It is possible that this does not represent a unique individual but was mixed into the fill. The other three complexes are evidence for the younger age of the cremations. In two cases (Complex 94 and Complex 160) it is possible that two individuals were cremated and interred together. The interpretation for Complex 94 was based on the difference in robustness of some of the fragments. Complex 160 included the find numbers 595, 597 and 599. The fragments from find number 595 were found in a separate vessel, weighed 160 g and had a larger average fragment size. The muscle markings were medium robust. Skeletal elements from all three body regions, cranial, trunk and long bones, were identified. The age determination was *mature* and the individual was classified as possible male. The fragments from find numbers 597 and 599 were found in the second vessel and together also weighed 160 g. The average fragment size was 'small to medium' and all the body regions were represented. The muscle markings were gracile to medium robust. The age determination was *mature* to *senile* and the fragments were interpreted as a possible female. There are no duplicate skeletal elements which is why the find numbers were treated as one individual in this study.

7 Arnstadt, Thuringia, Germany

Of the twenty-five graves excavated in 1938, only 12 were dated to the LBK on the basis of the ceramic burial goods. Three cremations (Grave 3, 8 and 9) and three body burials (Grave 14, 20 and 21) were available for analysis, the remaining six burials were not recovered. The cremations were found in shallow pits underneath overturned ceramic bowls. The three unburned individuals were previously not evaluated after the excavation. They will be briefly addressed in the catalog.

7.1 Burn Stage, Color and Degree of Fragmentation

Two of the cremations, Grave 8 and 9, contained bone fragments burned to burn stage (III)-V, only a few of the fragments were still black on the inside (Table 47). Grave 3 was burned to burn stage IV-V. The cremations were greyish to white and beige from the soil.

	very small		small		medium	
	n	%	n	%	n	%
I	-		-		-	
II	-		-		-	
III	-		-		-	
III-V	-		1	33	1	33
IV	-		-		-	
IV-V	1	33	-		-	
V	-		-		-	
total	1	33	1	33	1	33

Table 47: Arnstadt: Distribution of burn stages and degree of fragmentation

7.2 Weight, Fragmentation and Preservation

The average weight for the 3 cremations is 232 g. Without Grave 3, which only weighs 1.6 g, the average weight increases to 347 g. Cranial and post cranial bones are nearly equally represented, which is an indicator for under-representation of the identifiable post cranial skeletal elements. The average fragment size for all 3 cremations is 35 mm, in the small to medium size range (Table 48).

	n	Ø max. frag. size (mm)	average weight (g)	weight range (g)
adult o.o.	2	33	347	320-374
juvenile o.o.	1	38	2	2
total	3	35	232	

Table 48: Arnstadt: Distribution of weight and fragment size for age classes

The overall preservation of the cremations was average compared to the other studied cemeteries. The cremations had been stored in old cigar boxes and had probably not been opened since the excavation in 1938. The boxes also contained a large amount of stones and some animal bones.

7.3 Sex Determination

It was not possible to confidently determine the sex of the cremated remains due to the lack of characteristic skeletal elements. The individual from Grave 8 might tentatively be identified as male due to wide *Processus frontalis* of the *Zygomatic* bone. Otherwise, the individual is very gracile.

7.4 Age Determination

Grave 3 contained three fragments of cremated human bone, one fragment of the frontal bone including the roof of the orbit, a piece of fibula shaft and a fragment from the vertebra. The size of the bones allowed the *infant* age category to be ruled out. The remaining fragments from the grave were cremated animal bone, primarily from a pig. Grave 8 contained a late *adult* individual, 30 to 40 years old. The saggital suture is fused (~30) but not yet obliterated on the outside, however, the *bregma* region is not yet completely fused (<40) inside. The vertebral body (<18) and the distal epiphysis of the fibula (>16-18) are fused. Grave 9 contained an early *adult* individual, 20-30 years old. The coronal suture is not yet fused on the inside or outside (<30). The distal epiphysis of the metacarpal/metatarsal is fused (>14-16).

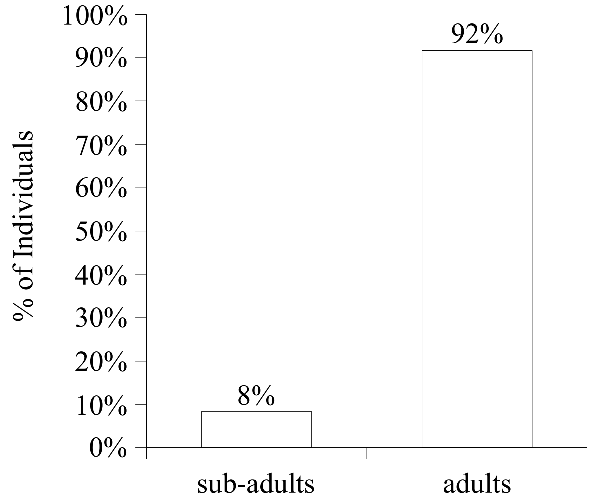


Table 49: Arnstadt: Age distribution

7.5 Metrics

The sample size from Arnstadt is too small for a statistical analysis of the metric values. A comparison of the measurements taken from Grave 8 and Grave 9 shows that the cranial vault wall thickness of the individual from Grave 9 is thicker than that of the individual from Grave 8. Both values correlate well with the average male and female values calculated from 518 female (3.9 mm) and 703 male (4.2 mm) cremations from cemeteries ranging from the late Bronze Age to modern day crematoria (WAHL 1996, Tab. 1). Compared to these values, the individual from Grave 8 was probably female, the individual from Grave 9, a male. However, the values for the other measurements for the individual from Grave 8 are greater. The morphological features also suggest that the individual from Grave 8 is possibly male. Therefore, the sex of both individuals remains uncertain.

		cremations					unburned body burials	
						+ shrinkage*		
		Grave 8	Grave9	undet.		undet.	♀	
		(mm)	(mm)	Ø (mm)	n	Ø (mm)	Ø (mm)	n
Measurements	1	3,3	4,4	3,9	2	4,7	7,6	2
	17	20	16	18,0	2	21,6	18,2	2
	18	6,7	6,8	6,8	2	8,2	11,7	2
	27'	44	37	40,5	2	44,6	-	-
	28	3	1,8	2,4	2	2,8	-	-
	33	-	2	2	1	2,3	33	1
	39'	-	38	38	1	41,8	-	-
	43	>6	-	>6	1	-	-	-
	44	-	4,1	4,1	1	4,7	-	-
	50	-	11,5	11,5	1	13,2	-	-

Table 50: Arnstadt: Metric measurements of cremations compared to body burials.(+ 20% cranial, 15% long bones, 10% epiphyses)

7.6 Height Determination

The proximal epiphysis of the humerus was present in the cremations from Grave 8 and Grave 9. The skeletal material from Grave 9 also included the proximal epiphysis of the femur. Because the sex of the individuals could not be determined, the body height calculation for both females and males was recorded (Table 51). The individual from Grave 8 was between 160 and 171 cm tall. It is possible, that this individual was male. In this case, the person would have been between 164.6 and 171 cm tall. The individual from Grave 9 was between 152.3 and 165 cm tall. Both individuals have been classified as *adult* because they had completed their skeletal growth. If the individual from Grave 8 was male, then this shorter individual could have been a female individual. However, the calculation for male body height according to Rösing (1977) correlates with the average height for males (165.8 cm) according to Jaeger et al. (1998). Therefore, the sex determination of the cremated individual from Grave 9 remains uncertain.

		Rösing 1977	Malinowski and Porawski 1968
		♀/♂	♀/♂
Grave 8			
Ms27	43.5mm	166cm/171cm	160.1cm/164.5cm
Grave 9			
Ms27	37.0mm	158cm/164cm	153.4cm/156.8cm
Ms39	38.0mm	158cm/166cm	151.2cm/160cm
Ø		158cm/165cm	152.3cm/158.4cm
Ø for all		160.7cm/167cm	154.9cm/160.4cm

Table 51: Arnstadt: Height of the individuals from Grave 8 and Grave 9

8 *Aiterhofen-Ödmühle, Bavaria, Germany*

The body burials and cremations from Aiterhofen-Ödmühle were evaluated by B. Lantermann for her Master's thesis at the University of Frankfurt. The skeletons from Grave 1-153 were analyzed in this thesis. The results of the age and sex determination of the skeletons from Grave 154-160 and the cremations from Grave 161-229 were subsequently filed with the Landesamt für Denkmalpflege in Regensburg in 1990. A portion of the skeletal material was sent to M. Schultz in Göttingen for further epidemiological studies. The dental material was evaluated in a separate study by Baum (1990). Since that time, the cremations have not been available for further study. The following data of the cremations from Aiterhofen-Ödmühle were published in the catalog of graves by Nieszery (1995, 297ff). It is not certain that the cremated material dates to the LBK. Only six graves included ceramic sherds with clear LBK patterns. A definite vessel of the Stroke Ornamented Pottery culture was recovered from Grave 229 and the axes from Graves 161, 185 and 209 are typical for the later Neolithic. The cremations were predominantly found in the far south, east and north of the cemetery and were deposited there after the body burials (Nieszery 1995, 88ff).

8.1 Sex Determination

The cremations of 79 individuals were identified among the 69 graves. The sex was determined for 29 of the 46 (63%) identified adult individuals (Figure 45), 14 (29%) female, and 15 (31%) male individuals. These data are based on the anthropological evaluation recorded in the catalog in Nieszery 1995 (297ff). Therefore, among the total cremations, females represent 18% and males 19% of the sex determined cremations from Aiterhofen-

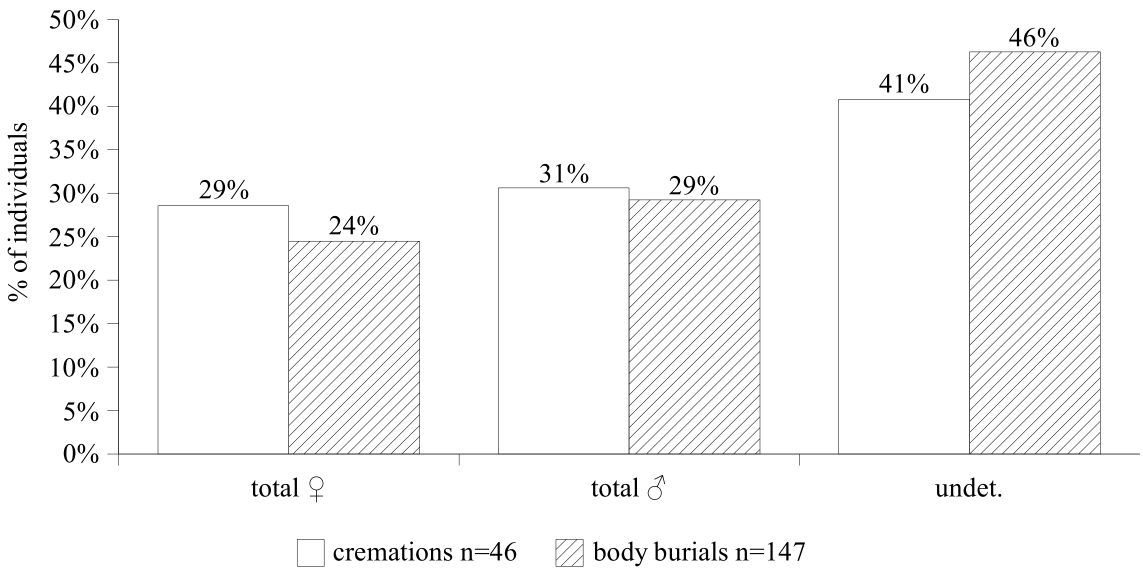


Figure 45: Aiterhofen-Ödmühle: Distribution of sex among the adult individuals.

Ödmühle. This distributions is similar to the distribution among the unburned individuals. The total distribution of females and males for the cemetery of Aiterhofen-Ödmühle equals 26% females and 30% males among the sex determined adult individuals.

The cremations from Aiterhofen-Ödmühle are the only ones among those studied that included large amounts of burials goods, which made it possible to identify male individuals due to the presences of ground stone and flint tools. These have been defined as classic male burial goods (Richter 1969; Pavúk 1971; Peschel 1992). There are no burials goods that could be labeled as classic female burial goods, therefore it is not possible to sex the females based solely on the presence of, for example, ceramics or jewelry because these were also included in male graves. The archaeological evidence identifies 22 males based on the accompanying burials goods. These include 5 individuals of previously undetermined sex, 7 sub-adult individuals, 7 that were also determined as male due to the anthropological evaluation and 3 individuals that had been identified as possibly female. When these males are included, they alters the distribution of females and males among the cremated materials: 11 (14%) females and 30 (38%) males. This would be the first cemetery among those in this study where twice as many males were identified than females. Among the other cremations, the percentages are usually reversed. The sex determination of the cremations from the other cemeteries are based on anthropological analyses. Therefore, the data from the anthropological sex determination will be used for further evaluations; 14 females and 15 males among the adult individuals.

8.2 Age Determination

The age was determined for 89% of the cremations (Table 52). The children make up 28%, the juveniles 10% and the adults 51% of the cremated individuals from Aiterhofen-Ödmühle (38% sub-adults, 51% adults). This is the largest percentage of sub-adult individuals among the cremated material from all the cemeteries in this study. The distribution comes very close to the 'ideal' population from Talheim.

	total ♀		**total ♂**		**undet.**		**total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
***infant* I**	-	-	-	-	8	9	7.5	10
***infant* II**	-	-	-	-	15	18	14.5	18
juvenile	-	-	-	-	8	10	8.0	10
adult	5	7	8	10	5	6	18.0	23
mature	4	6	4	4	3	4	11.0	14
senile	4	6	4	4	3	4	11.0	14
undet.	-	-	-	-	9	11	9.0	11
total	14	18	15	18	50	62	79	100

Table 52: Aiterhofen-Ödmühle: Distribution of age categories

The most surprising aspect of this distribution is that the percentage of juvenile and adult individuals is nearly identical with the percentage among the body burials. However, only 5% (9 individuals) were classifies as children among the body burials, only one-fifth the percentage of the cremated materials (22 individuals). It is possible that the low number of children in the burial record of the LBK can be explained by cremations. Aiterhofen-Ödmühle shows that more of the children were cremated than buried without being burned. Cremations, especially cremations of children, are not always preserved because they were deposited directly in the soil, not in a protective ceramic vessel, and usually were not buried very deep. At Aiterhofen-Ödmühle the cremations were recovered from a depth of 0.60 to 0.80 m below the present day surface, deeper than most of the cremations in this study.

The state of preservation of the cremated material from Aiterhofen-Ödmühle was not recorded in the catalog. The preservation of skeletal material from the unburned body burials was described as being poor (LANTERMANN 1980, 5). However, the preservation of the cremated material in Elsloo, even though the unburned material did not survive, shows that this does not have to be the same for the cremations. It is possible that this material was in better condition than the remaining material, which could explain why such a high percentage of children were identified.

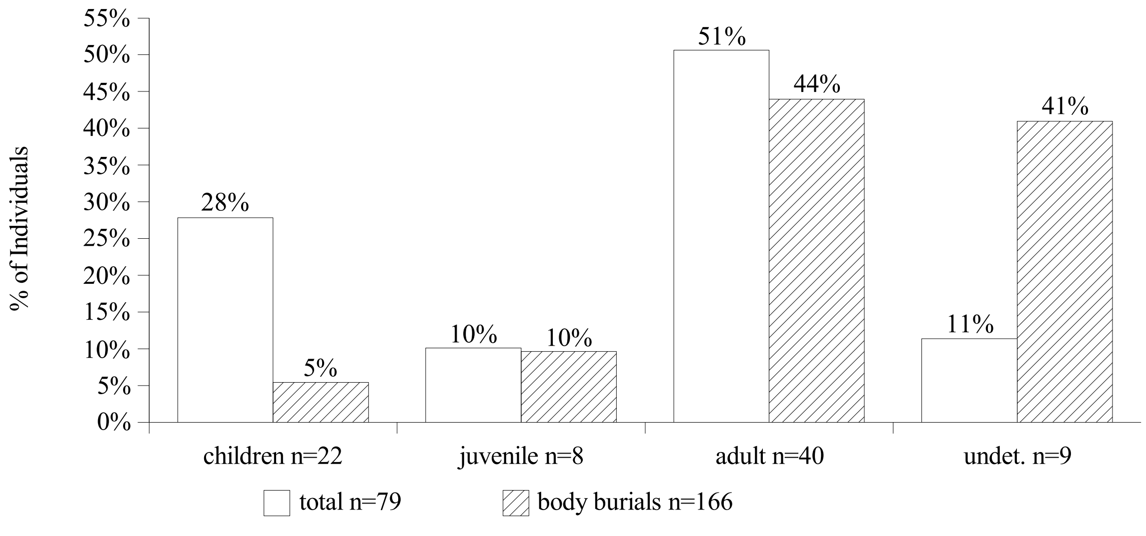


Figure 46: Aiterhofen-Ödmühle: Age distribution among the cremations and body burials.

8.3 Double and Multiple Burials

Sixty-nine graves with 79 cremations were identified, 10 double burials (14%). Only five double burials were recorded among the body burials (3%) (NIESZERY 1995, 297ff). Nine double burials contained an adult buried together with a child, four males and one female. The sex of the remaining adults and one juvenile could not be determined. Two adult males were buried together with older children (Grave 172 and Grave 190), the other two with a second individual older than juvenile (Grave 185 and Grave 186). The female was buried together with a young child (Grave 219). The juvenile was buried together with a child (Grave 197). The remaining four adults were buried together with children (Grave 173, Grave 177, Grave 205 and Grave 227). It is not clear if the individuals were simply buried in the same grave or also cremated together. The double burial may have been intentional or the result of unintentional mixing, maybe from a central cremation site. It is probable that the female with the young child is a true double burial since very young children need their mother to survive.

9 Stephansposching, Bavaria, Germany

The cemetery included 41 graves: 31 cremations, 10 body burials. It is regrettable that the cremated material did not survive. There is also no information about the sex or age of the body burials. It was only possible to excavate a portion of the cemetery, therefore it is not clear how many body burials and cremations were originally buried here. If they are not protected by urns, cremations are usually less likely to survive in the burial record. Their preponderance in this cemetery is surprising and suggests that cremations played a bigger role in the burial practice of the LBK as previously believed.

G. Discussion and Interpretation of the Results

Of the 350 cremations from 12 LBK cemeteries cited in the literature, 216 cremations from 5 cemeteries were analyzed, measured and evaluated by the author. The data for the one cremation from Stuttgart-Mühlhausen and the 79 cremations from Aiterhofen-Ödmühle were also included in the evaluation. In sum 296 cremations (85% of cited cremations) were included in this study. Fifty of the remaining cremations cited in the literature (Niedermerz, 11, Stephansposching, 31 and Nitra, 8) were not preserved and therefore not available for further study. The remaining four cremations from Hollogne-aux-Pierre (one) and Niederdorla (three) were not included in the study because of the small quantity of material and because the classification of the latter three cremations as LBK is unsure. The 296 cremations of this study make up 24% of the 1,257 total burials (cremations and unburned body burials) from the cemeteries in this study. These represent half of all of the cemetery burials in the LBK.

	Cemetery Cremations		**Cemetery Body Burials (studied Cemeteries)**		**Cemetery Body Burials (total LBK)**	
	n	**%**	**n**	**%**	**n**	**%**
total n	**350**	**100**	**1180**		**2090**	**100**
children	26	7	272	23	370	18
juveniles	52	15	65	6	91	4
adults	201	57	598	51	854	41
undet.	71	20	245	21	775	37
Average age	20-40 yrs.		24.4 – 28 yrs.			
♀	46	13	334	28	446	21
♂	34	10	275	23	412	20

Table 53: Summary of age and sex distribution among the cremations and the body burials from the evaluated cemeteries and from all cemeteries in the LBK.

1 Preservation

The material available for study ranged from a few isolated cremated pieces in a plastic bag or box (Elsloo and Wandersleben) to 974 g of cremated remains, including *Grus* (Schwetzingen). The preservation of the material varied from cemetery to cemetery: The material from Elsloo consisted of individual pieces of cremated bone, colored bright white with a chalky texture. In Schwetzingen and Fellbach-Oeffingen, the cremated remains included large amounts of very small pieces of unidentifiable bone, only a few millimeters in size, whereby the material from Schwetzingen showed better preservation and larger fragment sizes than Fellbach-Oeffingen. The same is true for the one cremation from Stuttgart-Mühlhausen. The cremations from Wandersleben were characterized by a wide range of burn stages. The material also consisted of small portions of individual fragments of cremated material as well as a few larger cremations resembling those from Schwetzingen. Of the two cremations from Arnstadt one only consisted of a few pieces, the other included *Grus*. Information about the amount and quality of the material was not available for Aiterhofen-Ödmühle and Stephansposching. The catalog of cremations from Aiterhofen-Ödmühle (NIESZERY 1995) only includes data on the age and sex of the cremated remains, therefore these cremations cannot be included in the evaluation of the preservation of the cremated material.

1.1 Color and Burn Stage

The color of cremated material is dependent on the degree and length of burning and on the deposition of the remains, either inside a vessel or directly in the soil. The surrounding soil and certain burial goods such as pigments can influence the color of the bones. The majority of the cremated remains from the examined sites were colored chalky white to beige. Some included pieces with a blue-grey or black-grey tint, especially in the center of the bones, due to primary carbon coloring The majority of the cranial bones were chalky white to beige in color, only a few of the fragments from Wandersleben included some black and reddish colors. The black coloring was usually found on the inside of the bone, the same was observed for the long bones. The red color was probably the result of red pigments, also observed on the unburned body burials, or due to the coloring in the soil.

The widest range of colors, and burn stages was recorded for the cremations from Wandersleben. The coloring ranged from brown, nearly unburned pieces to beige and thoroughly burned fragments. The least variation in coloring was recorded for the cremations from Elsloo. Forty-nine percent of the cremations were colored chalky-white and were classified as burn stage IV. The remaining 51% were classified as chalky-white to beige (burn stage IV-V, 9%) and beige (burn stage V, 42%). As discussed in section F.2, the soil from this cemetery caused the calcium and color to leach out of the bone, leaving behind a bright white, chalky smooth surface.

In general, half of the cremations in this study were burned to burn stage IV, IV-V, and V. The other half of the cremations included a wider range of burn stages such as, in descending order of occurrence, III-V, II-V; III-IV or III/V. Only three cremations were only burned to burn stage II (Wandersleben Complex 325 and 326) or III (Fellbach-Oeffingen Complex 89). Differences in the burn stages between male and female or sub-adult and adult cremations were not observed.

1.2 Degree of Fragmentation

The average degree of fragmentation for all five cemeteries is “very small”. In sum, 145 (67%) of the cremations fall into this category. Fifty-seven (26%) had a “small” average fragment size and only 14 (7%) had medium size fragmentation. Ten of these medium-sized cremations came from Wandersleben. The maximum fragment size ranged from 5 mm (Elsloo) to 8 cm (Wandersleben). It is not possible to reconstruct whether the cremated materials were intentionally broken into smaller fragments as has been recorded from later cremations in Roman cemeteries (Wahl 1988).

A number of factors can influence the fragment size of a cremation, including the degree of burning and the treatment of the material after the cremation process. Collecting the burned bone fragments from the funeral pyre prior to cooling would result in the fragile bones breaking into even smaller pieces. Additional factors that influence the fragment size are the forces affecting the bones after deposition in the soil. The LBK cremations were usually collected from the pyre and then deposited directly into a shallow grave or pit in the ground without the protection of a ceramic urn. So far, there is no evidence of any kind of organic vessels such as containers made out of animal hides, woven baskets or wooden bowls or boxes. Future excavations of LBK cremations may be able to provide some more information on this matter by collecting soil samples and testing them for plant or animal fibers.

The cremations from the cemetery of Arnstadt and 30 of the cremations from Wandersleben were accompanied by ceramic vessels. In several cases the remains were found next to, inside or covered by a ceramic bowl. In Arnstadt, one cremation (Grave 3) was found underneath and next to the accompanying ceramic bowl and the other (Grave 9) was only mentioned in association with a ceramic bowl. In 11 cases (9%) at Wandersleben the cremations were found inside a ceramic bowl or *Kumpf,* the other 19 were found next to the accompanying ceramic vessel. Ceramic sherds were found together with some of the cremated material from the other three sites (Elsloo, Schwetzingen and Fellbach-Oeffingen), but it is not clear whether these belonged to vessels that covered the cremations nor whether they were intentionally deposited with the cremated material or were simply mixed in with the fill. Although there was no difference in the preservation of the cremations found in or near a ceramic vessel, these cremations were heavier and included more cremated material. This suggests that the deposition directly into the soil did not cause the cremations to break down even further or damage the bone more than the bone found inside a ceramic vessel. However, the quantity does suggest that the bone was destroyed more quickly in the soil than inside the vessels. The total weight of the 30 cremations found in or near a vessel was 3,624 g. The average weight of these 30 cremations is 121 g, compared to the average for the remaining 90 cremations, which is 86 g. These differences could be an indication for the better survival of the cremations in the vessel, but they could also be interpreted as an indicator for social stratification at the cemetery. The association of the burial goods with social status at these particular sites is not clarified at the present time because the archaeological evaluation of the cemetery has not been completed yet (Birkenbeil pers. comm.). Significant differences in the degree of fragmentation between male and female or sub-adult and adult cremations were not observed. The fragments from sub-adult cremations are smaller than those from adult cremations, however, this is to be expected because the bones of children and sub-adults are generally smaller.

1.3 Weight and Representation

The average weight of all cremations is 157 g and the weights range from 0.2 to 974 g. The average weights from the cemeteries Elsloo (77 g), Fellbach-Oeffingen (15 g) and Wandersleben (94 g) lie below the total average weight as well as below the average weights from Schwetzingen (184 g) and Arnstadt (232 g). The small average weight of the cremations from the cemetery of Fellbach-Oeffingen mainly reflects the poor preservation of the material from this site, since the degree of fragmentation and burn stages are similar to the values from the other cemeteries. As an example, the skulls and long bones from the unburned skeletons from the cemeteries of Schwetzingen, Stuttgart-Mühlhausen and Arnstadt were largely intact. In contrast, the skulls from Fellbach-Oeffingen were only held in shape by the soil inside the cranial vault and the wrappings around it. The total average weight for females (202 g) and males (210 g) was nearly identical, although the ranges slightly differed, spanning from 11 to 424 g for females and 53 to 675 g for males for the individual cemeteries.

The distribution of the represented skeletal elements is similar for all cemeteries. Greater variability was observed within the cemeteries, not between them. In 29% of the cremations, bones from all three sections of the body (cranium, torso and extremities) were identified among the remains. For the remaining cremations, only bones from one or two of the sections could be identified. There were a number of cremations within each cemetery, which included all the sections of the body. These were usually the larger cremations, although some very light cremations such as Complex 77 from Fellbach-Oeffingen (28.9 g) or Complex 6 (21.1 g) and Complex 171 (9 g) from Wandersleben also included fragments from all three sections of the body. No significant differences in the distribution of represented skeletal elements between male and female or sub-adult and adult cremations were observed.

Especially interesting are very small fragments such as teeth, phalanges and bones of the wrist. Their presence in 29% of the cremations show that these cremations were collected from the pyre with great care since these small pieces could easily be overlooked. If the cremated material was simply swept together and then dumped into a burial pit, more ashes and *Grus* would be present in the graves. Therefore it is highly improbable that the cremations represent a *pars pro toto* deposit.

Within the LBK, the preservation of the cremations seems to be relatively uniform, although there are local variations such as the decalcification of bones in Elsloo, poor preservation in Fellbach-Oeffingen or the deposition inside ceramic vessels in Wandersleben. The variations in the preserved skeletal elements and the differences in weight, paired with the color and bone structure suggest that preservation is the key factor responsible for the differences within and between the cemeteries. The relatively uniform degree of burning and treatment of the cremation at all five cemeteries suggest that cremation process was identical throughout the LBK.

2 Distribution of Age and Sex

The age and sex determination was carried out for the 216 individuals from the analyzed LBK cemeteries. The individual from Stuttgart-Mühlhausen and the 79 individuals from Aiterhofen-Ödmühle were also included in the evaluation. Of the 153 identified adults, the sex was determined for 62 individuals (41%). The percentage of individuals of undetermined sex (59%) is relatively high, especially when compared to the number of sex determined (76%) and undetermined (24%) individuals among the unburned adult individuals from the corresponding cemeteries. However, the value of undetermined individuals from other series of cremated materials also ranges from as low as 15% undetermined individuals to as many as 63% undetermined individuals (Wahl 1988, 97). The difference is due to the degree of preservation of the material. Clearly, the chance of determining the sex or the age of a cremated individual is a question of quality not quantity of the material to be analyzed. Although finding the pieces necessary to determine the sex or age of an individual is easier with a greater quantity of material, quantity does not guarantee that the required skeletal features were preserved. For example, the Complex 77 from Fellbach-Oeffingen, weighing only 29 g, could be identified as representing the remains of a juvenile probable male, thus a handful of the distinctive pieces of cremated material is enough for relatively accurate identification.

Of the 62 sex-determined individuals 34 (55%) were identified as female or probable female and 28 (45%) as male or probable male. The two categories, female and probable female as well as male and probable male, were pooled together in order to increase the sample size available for further analysis. The females outnumber the males in four of the analyzed cemeteries (the individual from Stuttgart-Mühlhausen was classified as female). The males only predominate among the adult individuals in Elsloo and Aiterhofen-Ödmühle (Figure 47). This distribution results in a sex ratio of 819.2[8] Among the unburned skeletons of the corresponding cemeteries this sex ratio equals 850.3. This value shows that the sexes are distributed nearly equally among the body burials and the cremations. Among the total adult individuals from the body burials 209 (36%) were identified as females and 178 (31%) as males. The sex for 190 (33%) of the adults was not determined.

8 ratio = (number of males x 1,000)/number of females). An equal distribution of males and females results in a value near 1000, a prevalence of males results in a value above 1,000.

The predominance of female individuals among the cremated and unburned individuals can have a number of explanations. The sex could not be determined for 58% of the adult individuals among the cremations. The distribution of males and females for 87 of the adult individuals is therefore not known and could change the ratio of females to males in the total population. The results suggest that it is not likely that females were intentionally cremated more frequently than males. The predominance of males among the cremations at the cemeteries of Elsloo and Aiterhofen-Ödmühle speaks against this as an LBK wide practice. In fact, the archaeological evidence from Aiterhofen-Ödmühle showed that significantly more males may be among the cremated materials, 15 additional probable male cremations were identified based on the presence of typical male burial goods such as the shoe-last-adze. Since burial goods other than ceramic goods were not available from the other cemeteries, additional males could not be identified based on such criteria.

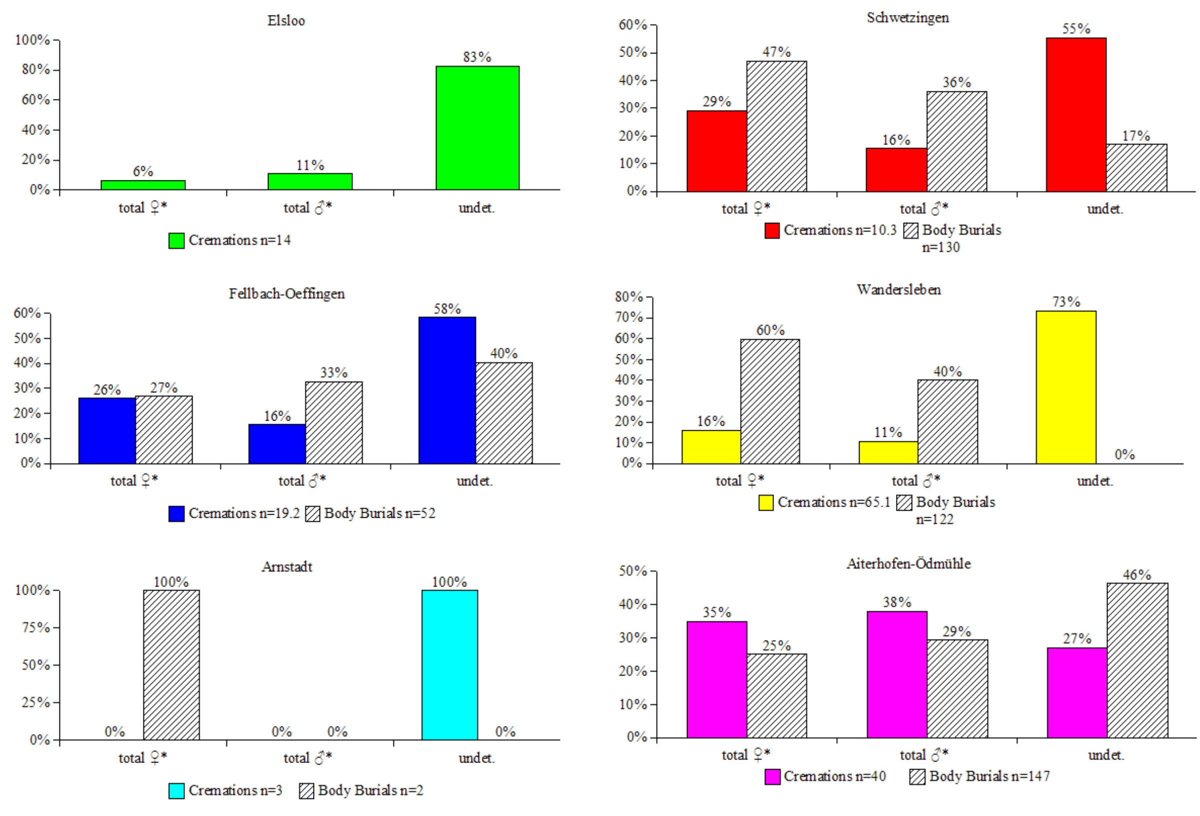


Figure 47: Distribution of male and female ***adult*** *individuals for the cremations and the body burials for each cemetery. Not in figure: unburned body burials from Elsloo (n=66), Stuttgart-Mühlhausen (n=1) and Stephansposching (n=31) because there is no anthropological information available for these individuals. (* =% sex determined individual divided by the number of the adult individuals)*

Another explanation for the greater number of female cremations could be that males were buried or cremated away from the cemeteries. It has been assumed that males were more mobile than females. Strontium isotope analyses have shown that males, especially younger males, frequently spent a significant amount of their early life away from the settlement, probably herding animals (Knipper 2004; Bentley and Knipper 2005). It is possible that older males also spent time traveling. Signs of conflict and possible warfare increased toward the end of the LBK (see C.3). Men who died in battle may have been buried at the battle site instead of being returned to their home village and being buried at the local cemetery. However, one-sex cemeteries have not been found in the LBK. The most plausible explanation seems to be that the difference between the number of males and females is the result of poor state of preservation. Males were not identified because the sex specific skeletal traits were not preserved. It is still possible that the ratio of female to male individuals could be evened out if the sex for the undetermined individuals could be determined.

The demographic and social statistics department of the United Nations lists the population size for 201 countries around the world for 2005 (United Nations Statistics Division, Tab. 1a http://unstats.un.org/unsd/demographic/products/indwm/indwm2.htm). The sex ratio for all listed countries is 1,053 and shows that, in 2005, males make up 51% and females 49% of the world's population. This very slight predominance of males is more pronounced among younger individuals and decreases with increasing age. After age 50, females predominate for the remaining life span. More male babies are born, however, the life expectancy of males is lower than that of females. The world-wide trend is not identical with the trend in individual countries: In the United States and in Germany, for example, females have predominated in the record since 1950 (IDB Data Access, US Census Bureau http://www.census.gov/ipc/www/idbprint.html). Nevertheless, the ratio of males and females in the individual populations and throughout the world is nearly equal and therefore we should expect an equal distribution of male and female individuals in archaeological populations as well. A slight predominance of either sex is possible, however, this predominance should only vary by a few percent in a normal population.

Among the cremations analyzed in this study the females predominate in Schwetzingen, Fellbach-Oeffingen and Wandersleben while the males predominate in Elsloo and Aiterhofen. Overall, more females were identified among the cremated remains. The distribution of the males and females among the cremations mirrors the distribution of the unburned body burials of the cemeteries. It is possible that the large percentage of undetermined individuals could even out the distribution of female and male individuals among the cremations and the body burials. Either the large percentage of undetermined individuals includes more males and therefore evens out the distribution or the males were really under-represented in these cemeteries.

Individuals from all age categories, including a very young infant aged 2 to 3 years old (Wandersleben Complex 183) and a senile individual, older than 50 (Wandersleben Complex 101) were included among the 216 individuals examined in this study (Table 57 in the appendix). Children and juveniles make up 27% of the total cremated individuals from the cemeteries. Adults comprise 50% and for 23% the age could not be determined. This distribution reflects an under-representation of *infant* and *juvenile* individuals, a common feature at prehistoric cemeteries. In order to enable a comparison between different samples, the results of the age determination were reduced to sub-adult and adult individuals as previously discussed. An itemized comparison of the age determination across all six age categories is presented in Table 55 for females and Table 56 in the appendix for males and summarized for both sexes in Table 57. Various demographic models suggest that the percentage of sub-adult individuals in prehistoric and historic cemeteries should lie between 45 and 60% (Rösing 1977, Wahl 1988). The values can range anywhere from 0 to 60% sub-adult individuals. More recent studies suggest that these values are too high and we should only expect 25 to 30% sub-adult individuals in the cemeteries (Kölbl 2004). A nearly identical distribution of sub-adults and adults was observed among the total number of unburned individuals from the cemeteries analyzed in this study (Figure 48). If we accept that the distribution represents the actual percentage of sub-adults and adults among the cremated materials, then this result suggests that age was not a deciding factor for cremation. It confirms that some sort of a social, cultural or religious aspect was probably involved in whether an individual was cremated or not.

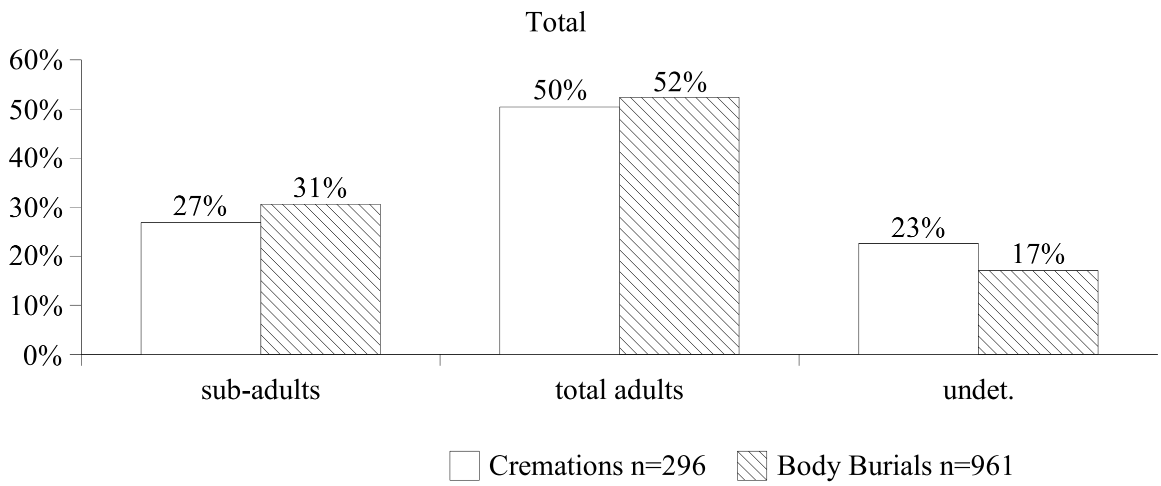


Figure 48: Total distribution of sub-adult and adult individuals for the cremations and the body burials.

The nearly identical distribution for sub-adults and adults was observed by comparing the total number of cremations with the total number of unburned body burials from the analyzed cemeteries. This statement remains true for the adult individuals when looking at the comparison in the individual cemeteries. However, the values for sub-adult individuals are only identical for the cemetery of Fellbach-Oeffingen. The percentages from Schwetzingen and Wandersleben show that the sub-adult individuals are under-represented among the cremations compared to the unburned body burials. Only in the cemetery of Aiterhofen-Ödmühle the sub-adult cremations outweigh the unburned sub-adults. However, this is also the only cemetery where the percentage of undetermined body burials, which may include a number of sub-adults as well as adults, is greater than that of the cremations. A number of factors could explain why sub-adult individuals, cremated and unburned body burials, were under-represented in the LBK cemeteries in this study.

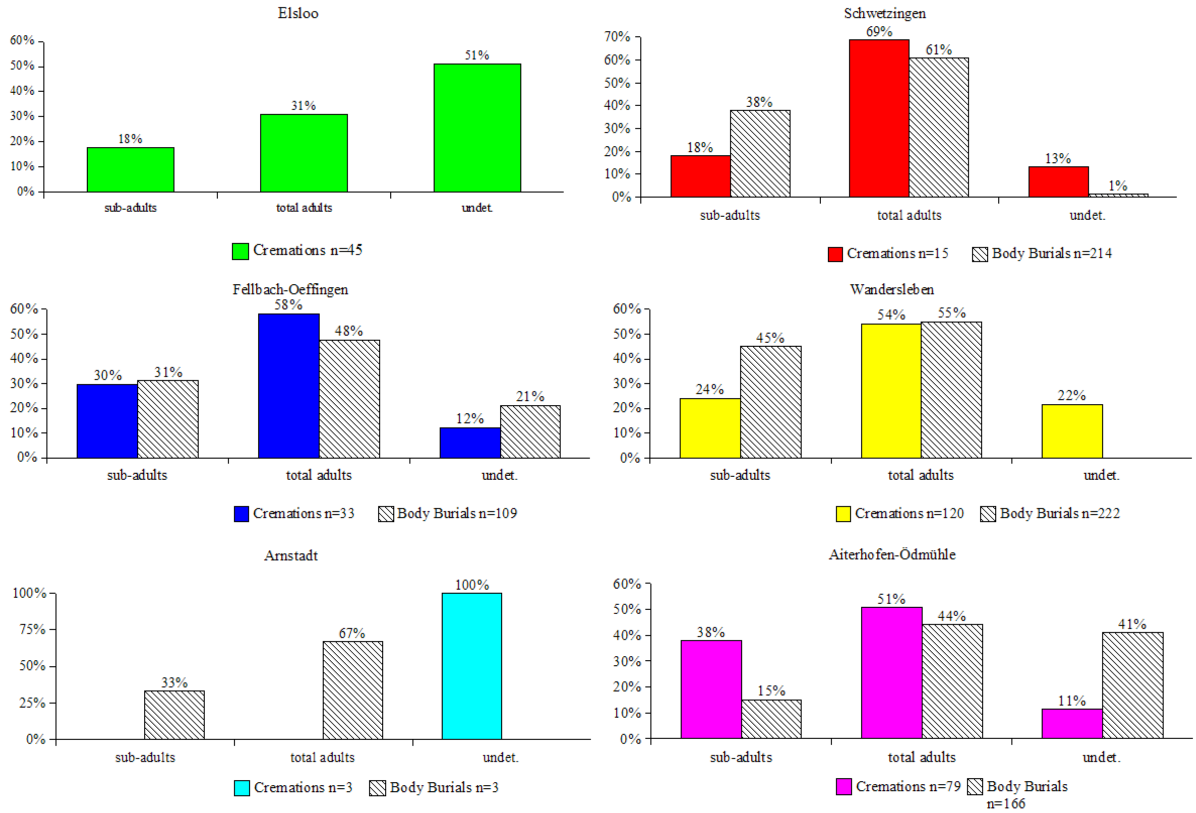


Figure 49: Distribution of sub-adult and adult individuals for the cremations and the body burials in each cemetery. Not in figure: unburned body burials from Elsloo (n=66), Stuttgart-Mühlhausen (n=1) and Stephansposching (n=31) because there is no anthropological information available for these individuals.

The previously mentioned results from the strontium isotope analyses have shown that especially young male individuals spent a significant amount of their youth away from the local village, probably herding the animals. It is possible that some of these individuals died while away from home. They may have been left or buried where they died and would therefore not show up in the burial record. Another explanation focuses on the sub-adults identified among the settlement burials. They represent 55% of the identified individuals among these burials. It is possible that sub-adults, especially young children were not buried in the cemetery, instead they were kept closer to the house and buried within the confines of the settlement. However, the most likely explanation is that since the bones of children and sub-adults are smaller and more fragile than adult bones they are less likely to survive in the burial record. In addition, the graves containing children's cremations were often not dug as deep as those for adult cremations. These graves, located closer to the surface, could have been destroyed much more easily due to erosion. Thus the sub-adults were not under-represented in the living population, their remains just have not been preserved or recovered.

The average life expectancy of an individual living in the early Neolithic period was 28 years. The life expectancy of males was slightly higher than that of females (Bach 1978, 20ff; Nieszery 1995, Spatz 2002). The average age of death calculated for the individuals from the mass grave at Talheim was 23.6 years (Wahl and König 1987). If we continue to assume that sub-adults are under-represented in the LBK burial record, then the average life expectancy should be lower than 28 years since these individuals have not been included in the calculation. In addition, the individuals from Talheim were murdered and did not die a natural death, therefore this life expectancy can be considered lower than it would have been had these individuals lived. The average life expectancy for an individual living in the LBK should therefore lie between 24.6 and 28 years of age. The majority of the cremated individuals from the LBK died between the age of 20 and 40, which corresponds well with this average life expectancy[9].

The age determination of the cremated remains often spanned multiple age categories. These individuals were evenly distributed across all age categories. This classification may have caused the number of sub-adults, especially the *juveniles*, to be over-represented. The same can be said for the other extreme, the *senile* individuals. Only one definite *senile* and two *mature* to *senile* individuals were identified among the 216 analyzed cremations, yet 13% of the cremations were classified as *senile*. This problem was discussed in detail in section E.2. Although the *senile* age category probably had too many individuals assigned to it, the presence of the three mentioned *mature* to *senile* and *senile* individuals does show that people of the LBK could and did reach such old age. An equal distribution of the 20% undetermined cremated individuals across the six age categories results in 38% sub-adult and 62% adult individuals. However, re-distribution does not reflect the actual pattern since e.g. the bones of infants can be recognized based on their size and thickness and, therefore, would have been identified as sub-adults. It is more probable that *juvenile* individuals and adults comprise the majority of the undetermined category. Therefore, the undetermined age category should not be viewed as a source for the missing sub-adult individuals.

2.1 Metric Analysis

The metric analysis using the measurements described in section D.5.1.was carried out for the cremated remains from the five analyzed cemeteries. Metric data are not available for the cremations from Aiterhofen-Ödmühle and the one individual from Stuttgart-Mühlhausen. In order to compare the data from the cremations, the same measurements were also taken

9 The small sample size of the individual cemeteries and the identified individuals, the age determination of a large number of individuals that spans a number of age categories do not justify reproducing life tables for these populations. However, out of curiosity, a life table was constructed for the cremations analyzed in this study. The resulting life expectancy for juveniles (aged 15 to 20) was calculated as to be 10 years, which corresponds very well to the 23.6 to 28 years calculated for the body burials from the LBK era.

from the unburned body burials at Schwetzingen and Ms1 was measured on the crania from Stuttgart-Mühlhausen. The measurements that were most frequently available for analysis were Ms1 (average thickness of cranial vault), Ms27 (average diameter of the proximal epiphysis of the radius), Ms32 (average diameter of the proximal epiphysis of the humerus), and 39 (average diameter of the proximal epiphysis of the femur). All four measurements are also important for determining age and sex of an individual. The three post-cranial measurements were also used to determine the height of an individual.

1	2				3				4	5
	♂				♀				♂	♀
	Ø (mm)	**n**		**s(n)**	**Ø (mm)**	**n**		**s(n)**	**Ø (mm)**	**Ø (mm)**
Schwetzingen	3.9	1		-	2.9	2		-	4.7	3.5
Fellbach-Oeffingen	-	-		-	3.1	4		-	-	3.7
Wandersleben	4.7	6	±	0.99	3.6	12	±	0.56	5.6	4.4
Schwetzingen BB	-	-		-	-	-		-	5.7	6.5
Stuttgart Mühlhausen 1982 BB	-	-		-	-	-		-	7.0	6.9
Stuttgart Mühlhausen 1991/1992 BB	-	-		-	-	-		-	6.9	6.0
Wandersleben BB	-	-		-	-	-		-	8.7	7.9

Table 54: Comparison of M1 for the cremations and body burials. Comparison between males and females (column 2 and 3). Columns 5 and 6 show values for the cremations plus the shrinkage value (+20% cranial, +10% epiphyses, +15% long bones). These values are compared to the measurements of the unburned body burials, M1 from Schwetzingen, Stuttgart Mühlhausen 1982 and 1991/1992 and Wandersleben.

Only one measurement, Ms1 from Wandersleben, showed statistically significant differences between the cremated males and females. The female cranial bones (3.6 mm) were significantly thinner than the male cranial bones (4.7 mm). The measurements from Schwetzingen (♀=2.9 mm; ♂=3.9 mm) and Fellbach-Oeffingen (♀=3.1 mm) are thinner than the measurements from Wandersleben, however, they are within the range of the later. However, the small sample size does not make it possible to draw significant conclusions from these measurements. A comparison of the Ms1 measurements from the unburned body burials from these cemeteries showed that the crania from Wandersleben were thicker compared to those from the other burial sites (Table 54). The thickness for males in the cemeteries of Schwetzingen and Stuttgart-Mühlhausen varies from 5.7 to 6.9 mm and equals 8.7 mm for Wandersleben. Among the females, the thickness in cemeteries Schwetzingen and Stuttgart-Mühlhausen varies between 6.0 and 6.9 mm and equals 7.9 mm for the females from Wandersleben. It is probable that the crania of the LBK individuals from Schwetzingen, Fellbach-Oeffingen and Stuttgart-Mühlhausen in the south were thinner than those from Wandersleben further north.

To compare the cremations to the unburned body burials a 20% shrinkage value was added to the measurements. These corrected values were still 1 to 3 mm thinner for the male cremations and 3 to 3.5 mm thinner for females than the values from the corresponding body burials. It is possible that this difference is due to the presence of different populations in the cemetery. This would be the evidence explaining the difference in burial practice in the LBK. However, it is quite possible that the shrinkage value for the cremations from the LBK is higher than the value calculated by WAHL (1988) for the cremations from Stettfeld.

Measurements for the height determination were available for three females and two males from Wandersleben (see Table 45) and one probable male from Schwetzingen (see Table 29). Again, the sample size was very small and it is impossible to draw positive conclusions, however, the impression left by measurement Ms1 was confirmed by the height determination. The probable male individual from Schwetzingen was 6.3/7.0 cm (162.3 cm RÖSING (1977)/ 156.5 cm MALINOWSKI and PORAWSKI (1969)) shorter than the males from Wandersleben. The values rather correspond to the height for the female individuals from Wandersleben. Either the probable male was not male but female, or the individuals from Wandersleben were generally taller and more robust than the individuals from the southern cemeteries. It is regrettable that there are no comparative values from Elsloo and that the sex could not be determined for the two adult individuals from Arnstadt. The height determination for the individual from Arnstadt Grave 8 corresponds to the height values for the males from Wandersleben. The female values were taller than the height values for the females from Wandersleben. Even if the individual represents a shorter male, the height values for the individual from Arnstadt Grave 9 were greater than the male value from the individual from Schwetzingen.

Although these results are not suggestive of the reason why certain individuals were cremated while others were buried as unburned body burial, the measurements show that there were significant population differences within the younger LBK. The initial impression suggests that the LBK people from the northeastern region of the LBK were taller and more robust compared to the LBK people from southwestern Germany. More comprehensive studies of the body burials from the LBK are necessary to prove or disprove this observation.

3 Interpretation of Cremations - an ethnographic comparison

Prior to the discovery of the Wetterauer cremations, body burials were considered the predominant burial form in the LBK. The discovery of the Wetterauer cremations first caused a lot of excitement and then skepticism about the 'new' burial form. In the 1970's cremations in the LBK were rehabilitated as more cremations were discovered at cemeteries throughout the regions inhabited by the LBK people. Cremations are now accepted as the second most common burial form within the LBK. Who these cremated individuals were and why they were cremated instead of deposited according to the traditional methods, in a crouched position, has remained a mystery. In later periods, cremation became more dominant and has remained a dominant form of burial in a number of cultures throughout the world (Wahl and Wahl 1983). Interestingly, cremation was rarely the only practiced burial form and was usually limited to a certain group within the population, either based on biological factors such as age or sex or on the social status of the cremated individual. Dying away from home, cause of death or burning as a form of punishment could also be another reason for cremation. The results of this study have shown that age and sex alone cannot be the decisive factor for cremation versus body burials in the LBK. Individuals from all age categories, including some very young and very old individuals were identified and, although more females were identified than males, both sexes were represented among the cremated individuals. Therefore, as an explanation for the different burial form the social, cultural or religious practices of the LBK should be considered.

However, it should be kept in mind that difference in burial practices must not be limited to one reason or social category. Ucko (1969, 271) shows that a variety of groups “may be singled out for different burial from the rest of the population. These include lepers, those killed by lightning, those who died in childbirth, those who have died violently in battle, those who have drowned, those who are said to have died of smallpox, or dropsy, witches, twins, priests, chiefs, the murderer, the suicide and the very old.” Ucko also points out that children are frequently distinguished in burial form from the adults, predominantly because they were not viewed as full-fledged human beings. This study has shown that sub-adults are nearly equally represented among the cremations and body burials in the cemeteries, but that a much higher percentage of sub-adults was recovered from settlement burials. Again, not the age of the individuals alone was responsible for the differential treatment. Some other reason must have existed for burying at least some of the sub-adults in the cemetery or as cremations.

In the majority of observed ethnographic cases cremations were reserved for individuals of a higher social status (Schlenther 1960; Ucko 1969; Wahl and Wahl 1983; - 1984). The cremation process is very costly both in the sense of resources and time, but at the same time also a much more “impressive” burial form. Depending on the construction of the funeral pyre and additional catalysts, such as oils and fat or wet brush, which causes the fire to burn longer and hotter, between 45 and 150 kg of wood are needed to completely cremate a human body (Wahl and Wahl 1983; McDonnell 2001; McKinley and Bond 2001; Grosskopf 2005). In regions where wood was sparse multi-person cremations or partial cremations where carried out. Wood was not in short supply in the early Neolithic in the areas inhabited by the LBK people, therefore the cost of wood was probably not a factor contributing to whether or not an individual was cremated (Behre 2002). Today, cremation of an adult individual takes between one to three hours, depending on the temperature of the cremation oven at the time. A pyre cremation took between seven to ten hours, depending on the weather, the construction of the funeral pyre, the quality of the wood and how thoroughly the individual was to be cremated.

Ethnographic sources have shown that the majority of cremations took place in the evening, just before dusk and continued until the morning. This increased the psychological and festive aspect of the cremation process (UCKO 1969; WAHL and WAHL 1984).

Burial goods are frequently viewed as indicators for the status of an individual. A greater quantity and better quality of burial goods in the grave would indicate an individual of higher social status. An analysis of the burial goods in the LBK have shown that certain burial goods such as the shoe-last-adze, arrow heads or other stone tools can be attributed to individuals of a certain sex and, in some cases, of a certain age. The burials of males and older individuals, both males and females, included these items (PAVÙK 1972, PESCHEL 1992; MÜLLER et al. 1996; VEIT 1996; MÜLLER 2005). This distribution shows that males and females were given different burial goods and that sometimes the graves of older individuals were furnished with richer burial goods. However, a clear distinction of status cannot be reconstructed. UCKO (1969) suggests that burial goods are not necessarily tied to a higher or lower social status of an individual within his or her population. Instead, they may simple reflect the individual's livelihood. Ethnographic observations have shown that the dead were only given nominal amounts of goods while the belongings were distributed among the family and inhabitants of the village. Burial goods were only recovered for the cremations from Aiterhofen-Ödmühle where 22 males were identified based on the presence of shoe-last-adze. The only burial goods accompanying the cremations from the other cemeteries in this study were ceramic vessels and sherds, and these are not characterized as sex-specific.

A comparison of the burial goods accompanying the body burials does not shed more light on the social differences between the two burial forms. The body burials from Schwetzingen and Fellbach-Oeffingen were accompanied by ceramic sherds and some stone tools. Only ceramic sherds remain from the body burials in Elsloo and archaeological information about the burial goods from Wandersleben are not available at the present time. In Aiterhofen-Ödmühle 48% of the cremations and 63% of the body burials included burial goods. The body burials included a larger spectrum of goods, while the artifacts in the cremation burials were limited to shoe-last-adze and ceramics. Only one cremation from Grave 185 included six different types of artifacts (NIESZERY 1995). These results could be interpreted as a lower social status for the cremated remains, however it should be considered that a number of organic burial goods such as clothing and objects made out of wood or bone probably did not survive the cremation process. Therefore, burial goods cannot be used as a definite indicator for social status among the cremated remains. It has become clear that it is not possible to determine whether social status was an important factor in determining whether an individual would be cremated or not. However, if the social status of an individual and his or her family was a criterion that caused these individuals to be cremated, then it is very probable that the individual was of the higher social status within the community (SCHLENTHER 1960; UCKO 1969; WAHL and WAHL 1984). Other criteria that could have shed some light on the possible social status of an individual, such as pathological or epigenetic alterations and body height in correlation to age, could not be analyzed for these LBK series due to the, in part, small amount of material available in this study.

The cause of death, such as illness, accidental or violent death, could also be interpreted as a reason for cremation. Although the people of the LBK were almost surely not aware of bacteria and pathogenic germs and the ways of disease transmission from a sick person to a healthy person, they probably were aware of the fact that contact with a sick person could lead to sickness. A person who died of some illness may have been burned to prevent the illness from spreading. In this context, cremations could also be viewed as a method for cleansing an individual or a place. To what degree the people of the LBK believed in life after death or a spirit cannot be reconstructed today. Burial goods have also been interpreted as provision needed for the journey to the afterlife or as supplies the deceased will need in his or her new life. The cremation process itself could serve to speed the spirit on its way out of the body and into heaven or the next life. Such spiritual or religious ideology is pure speculation for the LBK.

However, some evidence exists that suggests that the people of the LBK made provisions to ensure that a body could not return from the grave. The orientation of the body on its stomach has been interpreted as a method to ensure that the individual cannot rise from the grave. In other cases, a heavy stone was placed on the individuals legs, weighing the person down, or the feet and legs were manipulated, making it impossible for the person to walk. The position of the body of the individual from Königschaffhausen with an extremely flexed position of the legs suggests that the individual was tied up inside the grave (Peschel 1992, 242ff). The reason for the special care taken to prevent these specific individuals from returning is unclear. The extreme depth of 1.8 to 2 m has also been interpreted as a way to prevent the individual from returning. Peschel (1992) also speculates that one female from Sondershausen was probably pregnant at the time of death making her a "dangerous person". The woman was lying on her stomach, the right leg was twisted upwards at an 80° angle and her spinal column had been broken. Manipulated skeletons with bound or intentionally destroyed arms or legs were identified at a number of cemeteries throughout the LBK and included males as well as females and also children.

Judging by the ethnographic sources it could be possible that the LBK people were afraid of ghosts or spirits returning to the village, especially the ghosts and spirits of individuals who died an unnatural death due to illness, an accident, during birth, because they were murdered or committed suicide. These individuals could also include people who harmed the village during life. Cremation of the bones would be another very effective method to prevent an individual from rising from the grave. In the case of the murderer, the cremation could also be interpreted as a form of punishment (Ucko 1969; Wahl and Wahl 1984; Peschel 1992). However, it seems unlikely that all 350 cremations identified in the literature were individuals whose return the LBK populations feared and wanted to prevent by burning and destroying them.

Yet another interpretation of the cremation process in the LBK is that they represent the remains of a second cultural group either within the LBK or living alongside the LBK. According to SCHLENTHER (1960), when two different cultures meet and come into closer contact with each other, different burial practices will be observed. Evidence for interaction between the local Mesolithic populations and the people of the LBK was presented in chapter B of this study. mtDNA analyses of cattle and the presence of sheep and goats in the LBK are proof that at least some people migrated into Europe from the Near East. The comparison of the mtDNA of the skeletons and mtDNA from present day samples showed that it is probable that a significant amount of the modern European genetic material originated from Palaeolithic populations (HAAK et al. 2005). According to the mtDNA analyses, it is likely that there was a significant amount of interaction between the newly arrived people of the LBK and the local Mesolithic people. It is possible that the two populations lived alongside each other and, possibly, mixed. In this context, it could be possible that one group felt that it was necessary to preserve their own identity and exhibited this in practicing a different burial practice. This theory seems unlikely for a number of reasons: First, the differentiation in burial practices would be expected to appear early on in the LBK period, however the cremations analyzed in this study were all dated to the younger period of the LBK. Additionally, cremations were not the predominant burial form among the Mesolithic populations.

Strontium isotope analyses of LBK individuals from cemeteries in Baden-Württemberg have presented evidence for interaction and mixing between people of the LBK and the local populations (BENTLEY et al. 2002; KNIPPER 2004, 652f.; PRICE and BENTLEY 2005; BENTLEY and KNIPPER 2005). These analyses identified a number of females with strontium isotope signatures indicative of a life in the highlands instead of the typical loess signatures. These females were interpreted as possible immigrants into the LBK communities. These immigrants and their families may have chosen or received a different burial treatment to distinguish them from the intrinsic LBK population. It is regrettable that, at the present time, it is not possible to successfully sample cremated material for mtDNA or strontium isotope analyses. These methods would enable us to determine whether the cremated individuals came from another population or not. The question remains whether these individuals could originate from a different settlement within the LBK. The results of mtDNA would probably be similar throughout such samples and the strontium isotope values for the loess soils on which the people of the LBK predominantly resided would also be identical. However, people moving between villages may have received different treatment after death.

Another practical interpretation is that an individual was cremated to ease transportation. Among certain North American populations a woman carried the ashes of her parents with her for one year before they were buried. In Australia, a widower carried the ashes of his wife with him until he remarried (WAHL and WAHL 1984). There is evidence that the people of the LBK were very mobile and, especially the females and young males, moved between different villages. As mentioned in the previous paragraph, such mobility could not be easily traced with chemical methods. To some extent it is possible to trace family affiliations using epigenetic characteristics.

Eisenhauer (2003) investigated whether the LBK communities were a patriarchate or a matriarchate society based on epigenetic data from the individuals from the mass grave at Talheim. She found that the females from Talheim were not as closely related to each other as the males from the population. These results are supported by the finding by Price et al. (2001) based on the strontium analyses of females from Schwetzingen, that females came to live in the village of their marriage partner. The females from Talheim were genetically related with a number of the males and children from the mass grave, but not to each other. One female was especially closely related with the remaining population and Eisenhauer suggests that she may have originally come from this population. She further suggests that this woman had been married, left the village and then returned to Talheim, possibly as a widow. This suggestion is very interesting when considering the burial practices. It is possible that individuals who traveled to other villages, especially the females who married and left with their partner, were cremated and then returned to their home village. This would also be an explanation for the possible predominance of females among the cremated remains. The children and males among the cremated remains could also be explained by this possibility. The strontium isotope analyses have shown that young boys and males traveled away from their village to herd the animals (Price et al. 2003). It is possible that young males traveled to other villages to learn a trade. Trade and travel are also documented by the presence of raw materials for tools imported from sites up to 200 km (Gronenborn 1994) and beads and jewelry made from Mediterranean shells (Peschel 1992). If it was custom to return the deceased to their home village, then it would have been much simpler to do so if the individual was cremated. This interpretation suggests that either only individuals who originated from villages in the vicinity of the cremation bearing cemeteries traveled and were returned to their home villages or that there are many more cremations, previously destroyed or left to be discovered, which we do not yet know about.

In sum, there are very different explanations for why an individual could be cremated. The most simple is the pure disposal of a body. Another is that the cremation process makes it easier to transport the remains of a deceased individual. Cremations could be used to differentiate individuals who did not die a natural death or as a form of punishment. In cultures where the people believe in a soul or spirit, cremation could be used to free the soul from the body, either to speed its way toward the afterlife or to ensure that the soul cannot return to the body to haunt the living. The cremation process can also be interpreted as a form of cleansing the body or soul. It may be used to completely destroy a dangerous person, both in body and in soul. At the present state of research, we cannot determine with certainty the specific reasons why the people of the LBK chose to cremate some of their dead.

Funeral pyres on which the cremated remains from the LBK were burned have not been identified. Some burned wood has been recovered from the graves containing cremated material, but it is not enough to suggest that the individual was burned on site. There are a few cases in which a larger amount of charcoal and post holes were found in the immediate vicinity of the cremated remains. These were interpreted as wooden death huts that were constructed around the deceased and then burned down with the body inside it. However, these represent the exception and cremated material was not recovered from these specific sites. Also, baked soil due to the immense heat that developed during the cremation process has also not been identified. Therefore, the cremations must have been burned elsewhere and, as previously mentioned, collected from the funeral pyre prior to interment. It seems reasonable that a site was set apart for the cremation process. Such a site has yet to be found. The presence of such as site would suggest that cremations were more significant in the LBK than we can reconstruct based on the available material. It does not make sense to create such a site to be used by only a small portion of the population. Therefore, future excavations should make a special effort to look for cremations and traces of a site at which the cremations were carried out.

It is my belief that the cremated individuals do not represent one specific group within the LBK. The cremation ritual was most probably not just limited to a group of individuals with a higher social status. It is also unlikely that they represent only individuals of a lower social status, were limited to the sick or served as a form of punishment. The people of the LBK were very mobile as evidenced by the number of trade objects and imported raw materials. It makes a lot of sense that the cremation process helped ease the transportation of a deceased individual. Young boys traveled with the herd animals, young men and women may have traveled to other villages to learn a trade, women married and moved to the village of their partner, men and women traveled as traders or to visit relatives. The people of the LBK traveled along the main waterways and spread their culture throughout Central Europe in less than 300 years. Why should this sense of adventure and travel have ebbed as soon as the village was founded and settled? Again, ease of transportation was probably not the exclusive reason for a cremation, nor were all travelers cremated for transportation. A number of the mentioned factors, such different causes of death, may have contributed to the reason for why an individual was cremated.

Another plausible explanation may be that the cremated individuals represented individuals of a separate cultural entity within the LBK. It is my belief that the arrival of the LBK did not wipe out the local Mesolithic populations. It seems very likely that there was at least some interaction and, possibly, some intermarriage between the populations. It may be that the local Mesolithic people and their descendants attempted to preserve their identity in death by practicing separate burial rites. However, it is not possible to identify the different populations based solely on the traditional morphological and histological methods. Metrics may help identify a difference. To do this, a complete study and comparison of the known

Mesolithic skeletons to those of the LBK is necessary. Isotope and DNA studies could also help distinguish one population from another. At this point, these methods cannot be successfully applied to cremated remains.

Isotope and mtDNA studies are continuously advancing and improving. In England, strontium analysis on the dentin of teeth is being investigated. DNA analyses have been carried out on cremated material, but were not successful. However, research continues. The traditional morphological, metrical and histological methods can be applied to cremated material and return satisfactory results. However, epigenetic and pathological criteria are very rarely available on cremated material, therefore making kinship analysis and determination of health and cause of death impossible. An advancement of the isotope and DNA studies could significantly increase the amount of information that cremations can provide for us, thereby shedding more light on the origins and family connections between the cremated individuals and the unburned body burials.

H. Conclusion

The aim of this study was to identify trends or patterns that could explain why certain individuals in the LBK were subjected to different burial rites from the rest: Cremation. In order to do so, the known cremations from the seven cemeteries in this study, including Elsloo in the Netherlands, Schwetzingen, Fellbach-Oeffingen, Wandersleben and Arnstadt, all in Germany, were analyzed. The data from the literature for the cremations from Stuttgart-Mühlhausen and Aiterhofen-Ödmühle were also included in the study. Cremations are cited from five additional cemeteries, however, the remains were either not preserved or the sample size too small to have been included in the study. When available, data concerning age and sex of the unburned individuals from the respective cemeteries were included for comparison. Multiple anthropological methods including morpho-metric analyses, tooth cementum annulation and histological evaluation of thin sections of the femur were applied.

The cremation ritual seems to have been consistent at each cemetery and throughout the LBK. The same burn stage, color and degree of fragmentation were observed throughout the cemeteries analyzed in this study. There was not a lot of variation within or between the cemeteries. Wandersleben is an exception. At this site, the burn stages varied and included a larger amount of cremations including burn stage II or III. However, the majority of the cremations could be classified as burn stage IV-V. The color of the cremations was predominantly white to beige with a smooth, chalky texture. The inside of some long bones and cranial fragments remained grey. The variation in color can be attributed to the milieu in which the bones were deposited. The degree of fragmentation throughout the LBK is "very small" with a few "small" and only a handful of "medium" sized fragments. The weight of the cremations varied from less than 1 g to nearly 1 kg. This large range of weights is attributed to the preservation of the material and not to a variation in burial practice. The heavier cremations include a large amount of *Grus.* Skeletal remains from the cranial and postcranial skeleton were recovered. Small fragments such as teeth, wrist bones and phalanges were also recovered. These small fragments and the presence of all portions of the skeleton show that the people of the LBK took great care when collecting the ashes from the funeral pyre. A *pars pro toto* deposition of the cremated remains does not seem likely in this case.

Overall, the females predominate among the cremations, and body burials, from the cemeteries in this study. Among the individual cemeteries, females predominate in Schwetzingen, Fellbach-Oeffingen and Wandersleben, males in Elsloo and Aiterhofen. If the females had predominated among all cemeteries, then it could have been interpreted as a possible significant factor affecting whether an individual was cremated or not. However, the prevalence of the sexes varies and, compared with the overall distribution of the sexes for all of the known burials in the LBK, including the settlement burials and mass graves, is nearly equal. Therefore, the sex of an individual was not a determining factor for cremation. All age categories were present among the cremations from the analyzed cemeteries. As was to be expected, the very young individuals were under-represented. The youngest individual from all the cemeteries was 2 to 3 years old. An explanation for the low frequency of infant cremations could be that they were not cremated but received some other burial treatment. It is very interesting that the percentage of sub-adults and adults was nearly identical for the cremations and the body burials. Therefore, the different treatment of the children and sub-adults must have been independent of the reasons for cremation. The overview of burials from the settlements showed that 55% of these burials were sub-adults. It is possible that children were generally not interred in the cemetery but kept within the confines of the settlement.

The life expectancy of the cremated individuals was early adulthood. The majority of the cremations died in the *adult* phase, between the age of 20 and 40. The *juvenile* and *senile* individuals were over-represented among the cremations due to the limitations of the age determination. While unburned skeletal material usually offers the possibility to determine the age or sex of an individual based on a number of characteristic traits, cremations usually only include one or two traits. These, coupled with robustness and muscle markings must suffice. Cremated material does deliver valuable information about the age and sex of a significant portion of the LBK population, however, due to the fragmentary nature of the material and the poor preservation, it was often only possible to identify an age range, usually including the *juvenile* individuals and without a maximum age determination.

Cremations make up 10% of all known burials. It is very probable that a number of cremations were destroyed. The close proximity to the surface for the majority of the cremations could easily lead to their destruction through natural erosion, farming or construction. The majority of the cremations were buried less than 80 cm into the soil. This is within the frost margin, an additional factor that could lead to the destruction of the cremated bone.

The cremated individuals did not represent only one specific group within the LBK and the cremation ritual was probably not limited to a group of individuals with a higher or lower social status. The people of the LBK were very mobile and it is logical that the cremation of a deceased individual who died while away from home helped ease transportation. This could include young boys herding the animals, young men and women who traveled to other villages to learn a trade, women who married and moved to their partner's village as well as individuals who traveled as traders or to visit relatives. Ease of transportation was probably also not the exclusive reason for cremation. Another explanation may be that the cremated individuals represented individuals of a separate cultural entity within the LBK. Interaction and, possibly, intermarriage between the Mesolithic and Neolithic populations seems likely and it is plausible that one of the groups and their descendants attempted to preserve their identity in death by practicing separate burial rites. Cremations have been classified as the second most important burial form, after unburned body burials, in the LBK. It is my opinion that cremations were even more significant in the LBK than we have previously assumed.

I. Zusammenfassung

Das Ziel dieser Arbeit war bestimmte Tendenzen oder Muster zu identifizieren, die eine Erklärung dafür liefern, warum bestimmte Individuen in der LBK anderen Bestattungssitten unterlagen. Dazu wurden die bekannten Leichenbrände aus insgesamt sieben Gräberfeldern herangezogen. Die Leichenbrände aus Elsloo in den Niederlanden, Schwetzingen, Fellbach-Oeffingen, Wandersleben und Arnstadt in Deutschland wurden anthropologisch untersucht. Die Daten für die Leichenbrände aus Stuttgart-Mühlhausen und Aiterhofen-Ödmühle wurden aus der Literatur zitiert. Leichenbrände wurden für fünf weitere Gräberfelder in der Literatur zitiert, jedoch wurden diese entweder nicht erhalten oder der Materialumfang war so gering, dass sie nicht in dieser Arbeit berücksichtigt wurden. Daten zur Alters- und Geschlechtsbestimmung der unverbrannten Individuen aus den untersuchten Gräberfeldern wurden für Vergleichszwecke herangezogen. Anthropologische Methoden wie die morphometrische Analyse, die Zahnzementannulation und histologische Untersuchungen der Femurdünnschliffe wurden durchgeführt.

Die Leichenverbrennung scheint in jedem der Gräberfelder und innerhalb der LBK ähnlich verlaufen zu sein. Ein ähnlicher Verbrennungsgrad, Färbung und Fragmentierung wurde in allen untersuchten Gräberfeldern beobachtet. Es gab wenig Variation zwischen den Gräberfeldern. Wandersleben war eine Ausnahme. In diesem Gräberfeld variierte der Verbrennungsgrad, mehrere Leichenbrände mit einem Teilverbrennungsgrad II oder III wurden beobachtet. Jedoch konnte der Großteil dieser Leichenbrände dem Verbrennungsgrad IV-V zugeordnet werden. Die Farbe der Leichenbrände war überwiegend alt-weiß bis beige mit einer weichen, kreideartigen Struktur. Die inneren Bereiche einiger Lang- und Schädelknochenfragmente blieben jedoch grau. Abweichungen von der Färbung alt-weiß bis beige werden durch das Milieu verursacht in dem die Knochen lagerten. Der Fragmentierungsgrad der Leichenbrandknochen in der LBK ist „sehr klein". Es wurden auch einige „klein" und sehr wenige „medium"-große Knochenfragmente beobachtet.

Das Gewicht der Leichenbrände variiert zwischen weniger als ein Gramm bis fast ein Kilogramm. Diese große Variationsbreite des Gewichts ist auf den Erhaltungszustand des Materials zurückzuführen und nicht auf eine Abweichung der Bestattungssitte. Die schweren Leichenbrände beinhalteten eine große Menge an Grus. Es wurden kraniale und postkraniale Skelettelemente identifiziert. Zusätzlich wurden auch kleine Fragmente wie Zähne, Handwurzel- und Fingerknochen geborgen. Diese kleinen Fragmente und das Vorhandensein von Knochen des ganzen Skelettes zeigen, das Menschen der LBK die Leichenbrandfragmente besonders vorsichtig und gründlich von dem Verbrennungsplatz geborgen haben. Eine *pars pro toto* Bestattung der Leichenbrände scheint nicht stattgefunden zu haben.

In der Summe wurden in den untersuchten Gräberfeldern mehr Frauen identifiziert als Männer. In Schwetzingen, Fellbach-Oeffingen und Wandersleben konnten mehr Frauen identifiziert werden, in Elsloo und Aiterhofen-Ödmühle mehr Männer. Wenn die Frauen unter den geschlechtsbestimmten Leichenbränden in allen Gräberfeldern in der Überzahl gewesen wären, dann hätte dies als ein mögliches Kriterium für die Leichenverbrennung interpretiert werden können. Jedoch variiert das Übergewicht der Geschlechter und im Vergleich mit der Gesamtverteilung der Geschlechter für alle bekannten Bestattungen in der LBK, inklusive der Massengräber- und Siedlungsbestattungen, wurden Frauen und Männer gleichermaßen identifiziert. Daher scheint das Geschlecht eines Individuums kein ausschlaggebender Faktor für die Leichenverbrennung gewesen zu sein.

Alle Alterskategorien wurden unter den Leichenbränden der untersuchten Gräberfelder identifiziert. Wie zu erwarten, waren die sehr jungen Individuen unterrepräsentiert. Das jüngste Individuum aus allen Gräberfeldern war 2 bis 3 Jahre alt. Eine Erklärung für die geringe Anzahl an Kindern wäre, dass diese nicht verbrannt wurden sondern einer anderen Bestattungsform unterlagen. Es ist interessant zu beobachten, dass die Verteilung der sub-adulten und erwachsenen Individuen für die Leichenbrände und die Körpergräber fast identisch ist. Daher scheint die unterschiedliche Behandlung der Kinder und sub-adulten Individuen unabhängig von den Gründen die für eine Leichenverbrennung zu sein. Unter den Siedlungsbestattungen wurden 55% als sub-adult identifiziert. Es ist durchaus möglich, dass die Kinder nicht in den Gräberfeldern bestattet wurden sondern innerhalb den Siedlungsbegrenzungen behalten wurden. Die meisten der verbrannten Individuen starben zwischen einem Alter von 20 bis 40 Jahren. Die *juvenilen* und *senilen* Individuen waren aufgrund der Art der Altersbestimmung unter den Leichenbränden überrepräsentiert. Während unverbrannte Skelette normalerweise durch mehrere charakteristische Merkmale einer Alterskategorie oder einem Geschlecht zugewiesen werden können, sind für die Bestimmung von Leichenbränden häufig nur ein oder zwei Merkmale erhalten. Diese, zusammen mit der Robustheit und den Muskelmarken, müssen ausreichen. Leichenbrände können wichtige Informationen über das Alter und Geschlecht eines wichtigen Teils der LBK Bevölkerung liefern. Durch den hohen Grad der Fragmentierung und die schlechte Erhaltung war es jedoch häufig nur möglich eine Altersspanne, inklusive der Kategorie *juvenile* ohne eine Einschränkung nach oben, zu bestimmen.

Leichenbrände sind die zweitwichtigste Bestattungsform nach den Körpergräbern in der LBK. Zehn Prozent aller Bestattungen waren Leichenbrände. Die Leichenverbrennung spielte höchstwahrscheinlich eine größere Rolle in den Bestattungssitten der LBK als bis heute angenommen wird. Es ist sehr wahrscheinlich, dass eine große Anzahl an Leichenbränden zerstört wurde. Die meisten Leichenbrände wurden relative nahe an der heutigen Oberfläche gefunden und können durch Erosion, Ackerbau oder Bauarbeiten zerstört werden. Die meisten wurden weniger als 80 cm tief gefunden. Dies ist innerhalb der Frostgrenze, ein weiterer Faktor der die Leichenbrände zerstört haben könnte. Verbrennungsplätze oder Scheiterhaufen wurden bislang noch nicht in Fundstellen der LBK gefunden. In einigen Gräbern wurden verbrannte Holzreste zusammen mit dem Leichenbrand gefunden, jedoch war dies nicht genug Holz um ein Individuum vollständig zu verbrennen. In ein paar wenigen Fällen wurde eine größere Menge Holzkohle und Pfostenlöcher in der direkten Umgebung der Leichenbrände gefunden. Diese wurden als Totenhütten interpretiert, die um den Toten herum gebaut und danach abgebrannt wurden. Jedoch stellen diese Totenhütten eine Ausnahme da, bisher fand man in ihnen keine Leichenbrandreste. Verziegelte Erde, durch die hohen Temperaturen während der Leichenverbrennung gebacken, wurde noch nicht identifiziert. Daher müssen die Leichenbrände an einem anderen Ort verbrannt und, wie schon beschrieben, vom Verbrennungsort aufgesammelt und bestattet worden sein. Vermutlich hielt man dafür einen gesonderten Platz bereit, jedoch wurde ein Ort dieser Art noch nicht beobachtet. Ein solcher Ort würde jedoch daraufhin deuten, dass die Leichenbrände eine signifikantere Rolle in der LBK gespielt haben, als wir mit dem heutigen Material rekonstruieren können. Es macht keinen Sinn, dass solch ein Ort nur für eine kleine Gruppe in der Bevölkerung angelegt wurde. Daher sollte bei zukünftigen Ausgrabungen besondere Rücksicht darauf gelegt werden Leichenbrände und mögliche Orte an denen die Leichenverbrennung ausgeführt wurde zu erkennen.

Wahrscheinlich war die Leichenverbrennung nicht ausschließlich auf eine bestimmte Gruppe innerhalb der LBK beschränkt. Die Leichenverbrennung war bestimmt nicht nur für Individuen mit einer höheren sozialen Stellung vorbehalten. Es ist außerdem unwahrscheinlich, dass sie nur für Individuen einer niedrigeren sozialen Schicht, für Kranke oder als Strafe eingesetzt wurde. Die Menge an Handelsgütern und importierten Rohmaterialien sind Beweise für die hohe Mobilität der Menschen in der LBK. Die Verbrennung von Verstorbenen erleichterte es, sie nach Hause zu transportieren. Jungs sind mit den Tierherden umhergereist, junge Männer und Frauen sind vielleicht in andere Siedlungen gezogen, um ein Handwerk zu erlernen, Frauen haben geheiratet und sind in das Dorf ihres Partners gezogen, Männer und Frauen sind als Händler gereist oder haben einfach Verwandte besucht. Die Menschen der LBK reisten entlang der Hauptwasserwege und verbreiteten ihre Kultur innerhalb von 300 Jahren in ganz Zentral- Europa. Aus welchem Grund sollte diese Abenteuer- und Reiselust abgeklungen sein nachdem eine Siedlung gegründet wurde? Der einfachere Transport von Verstorbenen war bestimmt nicht der einzige Grund für eine Leichenverbrennung und bestimmt nicht alle Reisenden wurden verbrannt. Eine Vielzahl der genannten Faktoren, wie unterschiedliche Todesursachen, können dazu geführt haben, dass ein Individuum verbrannt wurde.

Eine weitere mögliche Erklärung ist, dass die verbrannten Individuen eine andere Kultureinheit innerhalb der LBK darstellten. Die Mesolithiker müssen nicht mit der Ankunft der Menschen der LBK ausgestorben sein. Es ist sehr viel wahrscheinlicher, dass es Interaktionen und möglicherweise auch Mischehen gegeben hat. Es ist möglich, dass die lokalen Mesolithiker und ihre Nachkommen versucht haben ihre eigene Identität durch eine abweichende Bestattungssitte erhalten wollten. Jedoch ist es nicht möglich die unterschiedlichen Populationen nur anhand der traditionellen morphologischen und histologischen Methoden zu erkennen. Metrische Untersuchungen könnten einen Unterschied deutlich machen. Eine ausführliche Untersuchung und Vergleich mit bekannten mesolithischen Skeletten und denen der LBK ist dafür notwendig. Isotopen- und DNA-Analysen können auch eine Population von der anderen unterscheiden. Jedoch können diese Methoden im Moment nicht für Leichenbrand angewandt werden.

Isotopen- und DNA-Untersuchungen schreiten immer weiter voran. In England wird versucht Strontium-Isotopen-Analysen anhand von Dentin in Zähnen durchzuführen. DNA -Analysen an verbrannten Knochen wurden in Tübingen durchgeführt, waren aber leider noch nicht erfolgreich. Die traditionellen morphologischen, metrischen und histologischen Methoden können für verbrannte Knochen verwendet werden und liefern zufriedenstellende Resultate. Leider sind epigenetische und pathologische Kriterien selten an Leichenbrand erhalten und machen daher eine Verwandtschaftsanalyse und eine Bestimmung der allgemeinen Gesundheit oder der Todesursache nahezu unmöglich. Die Weiterentwicklung der Isotopen- und DNA -Analyse Methoden könnten die Informationsquelle Leichenbrand noch aussagekräftiger machen. Sie könnten es möglich machen Verwandtschaftsbeziehungen zwischen den verbrannten Individuen und den Körpergräbern zu erkennen.

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Acknowledgements Figure:

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K. List of Tables

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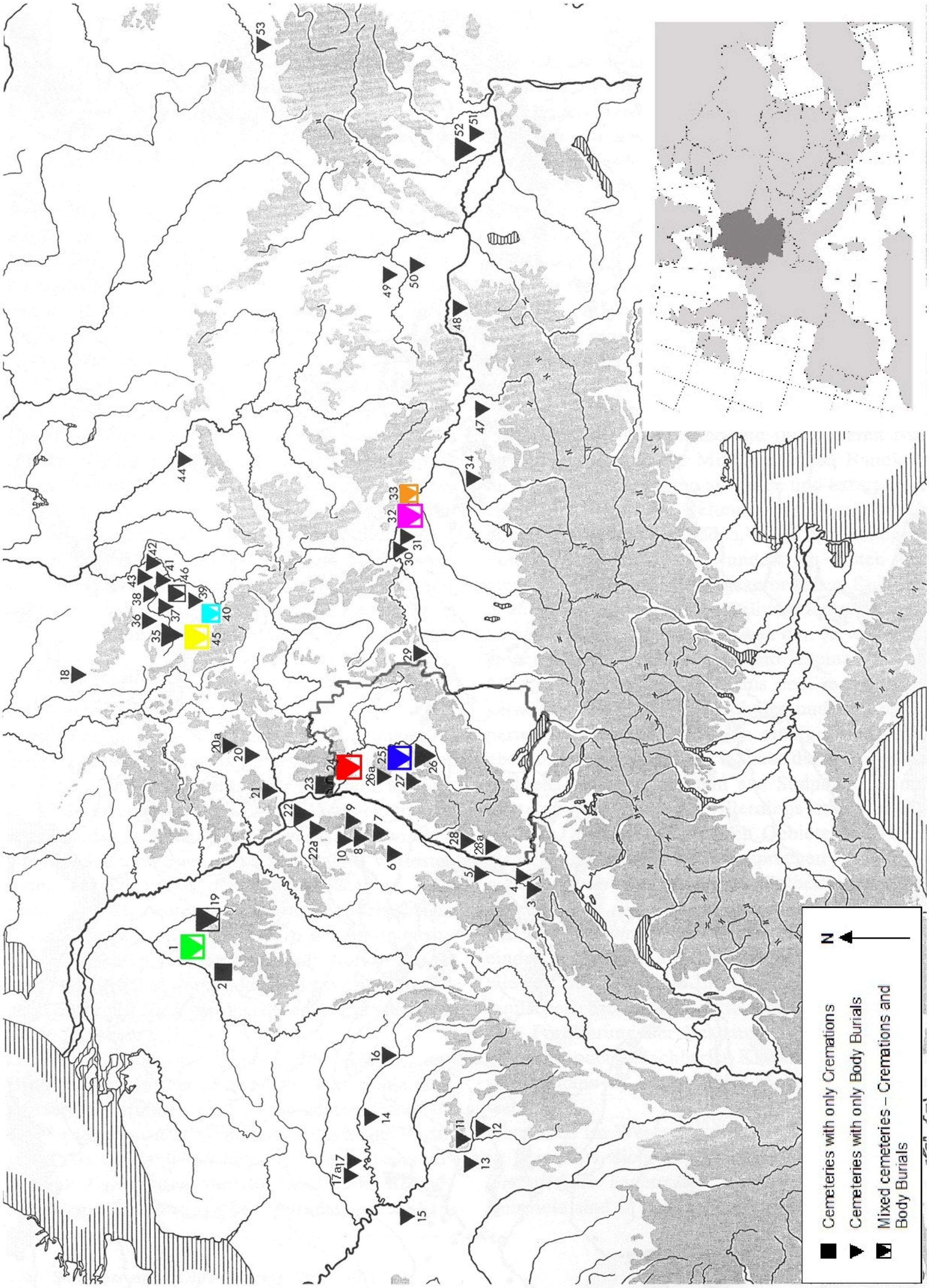
O. Abbreviations

LBK	Linearbandkeramik, the Linear Bandceramic Culture
°C	Degree Celcius
°F	(Fahrenheit) = 9/5 °C + 32
mtDNA	mitochondrial DNA
♀	female
♂	male
o.o.	or older
undet.	undetermined
B.C.	Before Christ
b.c.	uncalibrated B.C.
B.P.	Before Present (present=1950)
m	meter = 3.28 feet
m^2	square meter
µm	micrometer = 1/1,000,000 meter
mm	millimeter = 1/1,000 meter
cm	centimeter = 1/100 meter
km	kilometer = 1,000 meters
acre	4,046.8 square meters
ha	hectare = 10,000 square meters = 2.47 acres
g	gram = 1/1,000 kilogram
kg	kilogram = 1,000 g = 2.2 U.S. pounds

Appendix A: Maps, Lists and Tables



Map 1: Distribution of the LBK cemeteries (adapted from NIESZERY *1995). The numbers correspond those listed in List 1.*

		total burials	*total body burials*	adult	juvenile	children	(♀ / ♂)	undet.	*total cremations*	*adult*	*juvenile*	*children*	*(♀ / ♂)*	*undet.*
The Netherlands														
1	Elsloo*	111	66	-	-	-	- -	66	45	37	-	8	1 2	-
Belgium														
2	Hollogne-aux-Pierres*	23	22	-	-	-	- -	22	1	-	-	-	- -	1
France														
3	Ensisheim	27	27	5	-	-	- / 5	22	-	-	-	-	- -	-
4	Rixheim	27	27	17	-	6	10 / 7	4	-	-	-	-	- -	-
5	Wettolsheim	7	7	5	-	-	2 / 3	2	-	-	-	-	- -	-
6	Hoenheim-Souffelweyersheim	52	52	21	-	-	- / 21	31	-	-	-	-	- -	-
7	Entzheim	9	9	-	-	-	- -	9	-	-	-	-	- -	-
8	Quatzheim	13	13	6	2	-	- / 8	5	-	-	-	-	- -	-
9	Lingolsheim	8	8	-	-	-	- -	8	-	-	-	-	- -	-
10	Marainville-sur-Madon	6	6	-	-	-	- -	6	-	-	-	-	- -	-
11	Charmoy	7	7	-	-	-	- -	7	-	-	-	-	- -	-
12	Chichery	7	7	-	-	-	- -	7	-	-	-	-	- -	-
13	Vinneuf	16	16	-	-	-	- -	16	-	-	-	-	- -	-
14	Dormans	1	1	-	-	-	- -	1	-	-	-	-	- -	-
15	Champcueil	12	12	-	-	-	- -	12	-	-	-	-	- -	-
16	Lazicourt	6	6	-	-	-	- -	6	-	-	-	-	- -	-
17	Menneville	7	7	4	-	3	- -	-	-	-	-	-	- -	-
17a	Maizy	31	31	-	-	-	- -	31	-	-	-	-	- -	-
Germany														
18	Wittmar	16	16	10	3	3	7 / 3	-	-	-	-	-	- -	-
19	Niedermerz *	113	102	17	12	2	63 / 42	71	11	11	-	-	6 / 5	-
20	Butzbach	18	18	13	2	1	6 / 7	2	-	-	-	-	- -	-
20a	Oberweimar	?	-	-	-	-	- -	-	-	-	-	-	- -	-
21	Wiesbaden-Biebrich	18	18	-	-	-	- -	18	-	-	-	-	- -	-
22	Flomborn	85	85	25	-	7	11 / 10	53	-	-	-	-	- -	-
22a	Wachenheim,	20	20	-	-	-	- -	20	-	-	-	-	- -	-
23	Mannheim-Seckenheim	?	-	-	-	-	- -	-	-	-	-	-	- -	-
24	Schwetzingen *	229	214	130	18	63	61 47	3	15	10	2	1	4 2	2
25	Fellbach-Oeffingen *	142	109	53	5	30	14 17	21	33	23	7	3	4 / 3	-
26	Stuttgart-Mühlhausen *	182	181	118	-	54	58 / 60	9	1	1	-	-	- -	-
26a	Vaihingen a.d. Enz	120	120	19	3	18	10 / 12	80	-	-	-	-	- -	-
27	Waiblingen	5	5	-	-	-	- -	5	-	-	-	-	- -	-
28	Königschaffhausen	7	7	3	-	-	- 1	4	-	-	-	-	- -	-
28a	Bischoffingen	6	6	-	-	-	- -	6	-	-	-	-	- -	-
29	Dillingen-Steinheim	25	25	-	-	-	- -	25	-	-	-	-	- -	-
30	Mangoldingen	12	12	8	-	-	1 / 7	4	-	-	-	-	- -	-
31	Sengkofen	31	31	1	2	1	1 / -	27	-	-	-	-	- -	-
32	Aiterhofen-Ödmühle *	239	160	110	8	22	40 / 36	20	79	52	27		14 / 15	-
33	Stephansposching *	41	10	-	-	-	- -	10	31	-	-	-	- -	31
34	Essenbach-Ammersbreite	29	29	17	3	9	7 / 6	-	-	-	-	-	- -	-
35	Bruchstedt	55	55	27	5	16	21 / 11	7	-	-	-	-	- -	-
36	Sondershausen	47	47	31	2	11	17 / 16	3	-	-	-	-	- -	-
37	Seehausen	5	5	3	-	2	1 / 2	-	-	-	-	-	- -	-
38	Roßleben	5	5	2	1	-	1 / 1	2	-	-	-	-	- -	-
39	Bischleben	6	6	2	-	1	2 / -	3	-	-	-	-	- -	-
40	Arnstadt *	12	9	2	-	1	3 -	6	3	2	1	-	- -	-
41	Naumburg	6	6	2	-	-	1 / 1	4	-	-	-	-	- -	-
42	Halle-Trotha	5	5	4	-	-	3 / 1	1	-	-	-	-	- -	-
43	Grossörner	5	5	5	-	-	1 / 4	-	-	-	-	-	- -	-
44	Dresden-Nickern	5	5	-	-	-	- -	5	-	-	-	-	- -	-
45	Wandersleben *	342	222	122	22	78	73 / 49	-	120	65	15	14	16 8	26
46	Niederdorla*	13	10	-	-	-	- -	10	3	-	-	-	- -	3
Austria														
47	Rutzing/Haid	24	24	16	2	6	8 / 8	-	-	-	-	-	- -	-
48	Kleinhadersdorf	70	70	10	1	9	2 / 3	50	-	-	-	-	- -	-
Czech Republic														
49	Brno	?	-	-	-	-	- -	-	-	-	-	-	- -	-
50	Vedrovice	27	27	-	-	5	- -	22	-	-	-	-	- -	-
51	Mlynárce	20	20	-	-	-	- -	20	-	-	-	-	- -	-
52	Nitra*	83	75	46	-	22	22 / 24	7	8	-	-	-	- -	8
Poland														
53	Giebultowie	2	2	-	-	-	- -	2	-	-	-	-	- -	-
Total: 57 cemeteries		2440	2090	854	91	370	446 / 412	775	350	201	52	28	45 35	71

List 1: LBK cemeteries including the number of body burials and cremations (*data compiled from* Peschel 1992*;* Nieszery 1995*;* Veit 1996). *The numbers correspond to the cemeteries marked on the Overview Map 1.*

	total burials	***Settlement Burials***				
		adult	juvenile	children	undet.	(♀ / ♂)
Austria	***119***	***46.5***	***5.5***	***26***	***41***	***17 / 31***
Frauenhofen	1	-	-	-	1	- -
Hainburg-Teichtal	1	-	-	-	1	- -
Hameten	1	-	-	1	-	- -
Poysdorf	2	2	-	-	-	- / 2
Schletz (Asparn)	**100**	**41**	**6**	**21**	**33**	**15 28**
Taborac	8	2	-	3	3	2 / -
Trasdorf	4	1	-	-	3	- -
Wultendorf	1	-	-	1	-	- -
Würnitz	1	1	-	-	-	- / 1
Hungary	***3***	***2***	***-***	***1***	***-***	***- / -***
Letkés	3	2	-	1	-	- -
Slovakia	***16***	***2***	***0***	***1***	***13***	***0 / 0***
Bešeňov	1	-	-	-	1	- -
Bíňa	?	-	-	-	-	- -
Hurbanovo-Bacherov Majer	3	-	-	-	3	- -
Ludanice	?	-	-	-	-	- -
Štúrovo	5	2	-	1	2	- -
Vel'ký Grob	7	-	-	-	7	- -
Czech Republic	***25***	***7***	***1***	***11***	***6***	***2 / 2***
Blučina	3	2	-	1	-	- / 1
Ladowitz	1	1	-	-	-	- / 1
Mikulov	3	-	-	3	-	- -
Nová Ves	1	-	-	-	1	- -
Ohníč	1	1	-	-	-	1 / -
Prag-Dejvice	1	-	-	-	1	- -
Prag-Podbaba	2	1	-	1	-	1 / -
Prag-Veleslavín	1	-	-	-	1	- -
Prag-Vokovice	1	-	-	-	1	- -
Přerov-Předmostí	3	1	-	1	1	- -
Tuchomyšl	2	1	1	-	-	- -
Tvršice	1	-	-	-	1	- -
Vedrovice	5	-	-	5	-	- -
Poland	***18***	***4***	***0***	***4***	***10***	***3 / 1***
Giebultowie	7	-	-	1	6	- -
Gródek Nadbuzny	1	-	-	-	1	- -
Igolomia	5	3	-	2	-	2 / 1
Nosvice	?	-	-	-	-	- -
Samborzec	2	1	-	1	-	1 / -
Stary Zamek	?	-	-	-	-	- -
Zlotniki	3	-	-	-	3	- -
Ukraine	***1***	***1***	***-***	***-***	***-***	***- / 1***
Nevisko	1	1	-	-	-	- 1

List 2: Settlement burials in the LBK - including the number of body burials (data taken from PESCHEL *1992;* NIESZERY *1995;* VEIT *1996).*

	total burials	***Settlement Burials***				
		adult	juvenile	children	undet.	(♀ / ♂)
Romania	***1***	***1***	***-***	***-***	***-***	***- / -***
Cipau	1	1	-	-	-	- -
Germany	***242***	***68***	***11***	***50***	***113***	***36 / 34***
Aiterhofen (Bavaria)	5	-	-	2	3	- -
Altdorf (Bavaria)	2	1	-	1	-	- -
Ammerbuch-Reusten (Baden-Wuerttemberg)	1	-	-	1	-	- / 1
Assenheim (Hesse)	1	1	-	-	-	1 / -
Bad Sulza (Thuringia)	1	-	-	-	1	- -
Ballenstedt (Saxony Anhalt)	3	3	-	-	-	1 / 2
Bietigheim-Bissingen (Baden-Wuerttemberg)	2	-	-	-	2	- -
Bischoffingen (Baden-Wuerttemberg)	1	-	-	-	1	- -
Bösenburg (Saxony Anhalt)	1	-	-	1	-	- -
Brackenheim-Dürrenzimmern (Baden-Wuerttemberg)	1	-	-	-	1	- -
Bretten (Baden-Wuerttemberg)	1	-	-	1	-	- -
Cösitz (Saxony Anhalt)	1	-	-	-	1	- -
Eilsleben (Saxony Anhalt)	6	1	2	-	3	3 -
Eisleben (Saxony Anhalt)	3	2	-	1	-	1 / 1
Eltingen (Baden-Wuerttemberg)	1	-	-	1	-	- -
Ensingen (Baden-Wuerttemberg)	1	-	-	-	1	- -
Erfurt (Thuringia)	1	-	-	-	1	- -
Esbeck (Lowe Saxony)	1	-	-	1	-	- -
Essenbach (Bavaria)	1	-	-	1	-	- -
Fellbach-Oeffingen (Baden-Wuerttemberg)	1	-	-	1	-	- -
Frankfurt a. M.-Praunheim (Hesse)	2	-	-	-	2	- -
Friedberg (Hesse)	5	-	1	2	2	- / 1
Friedrichswerth (Thuringia)	2	-	-	-	2	- -
Gerlingen (Baden-Wuerttemberg)	1	1	-	-	-	1 / -
Goddelau (Hesse)	1	1	-	-	-	1 / -
Griedel (Hesse)	3	1	-	-	2	1 / -
Gröbzig (Saxony Anhalt)	1	-	-	-	1	- -
Großörner (Saxony Anhalt)	9	5	-	-	4	1 / 4
Gudensberg (Hesse)	1	1	-	-	-	1 / -
Hagelstadt (Bavaria)	2	1	-	1	-	- -
Halle Trotha (Saxony Anhalt)	6	4	-	2	-	3 / 1
Heidelberg (Baden-Wuerttemberg)	3	1	-	2	-	- / 1
Heilbronn-Großgartach (Baden-Wuerttemberg)	1	-	-	1	-	- -
Heilbronn-Neckargartach (Baden-Wuerttemberg)	1	-	-	1	-	- -

List 2 cont: Settlement burials in the LBK - including the number of body burials (data taken from Peschel *1992;* Nieszery *1995;* Veit *1996).*

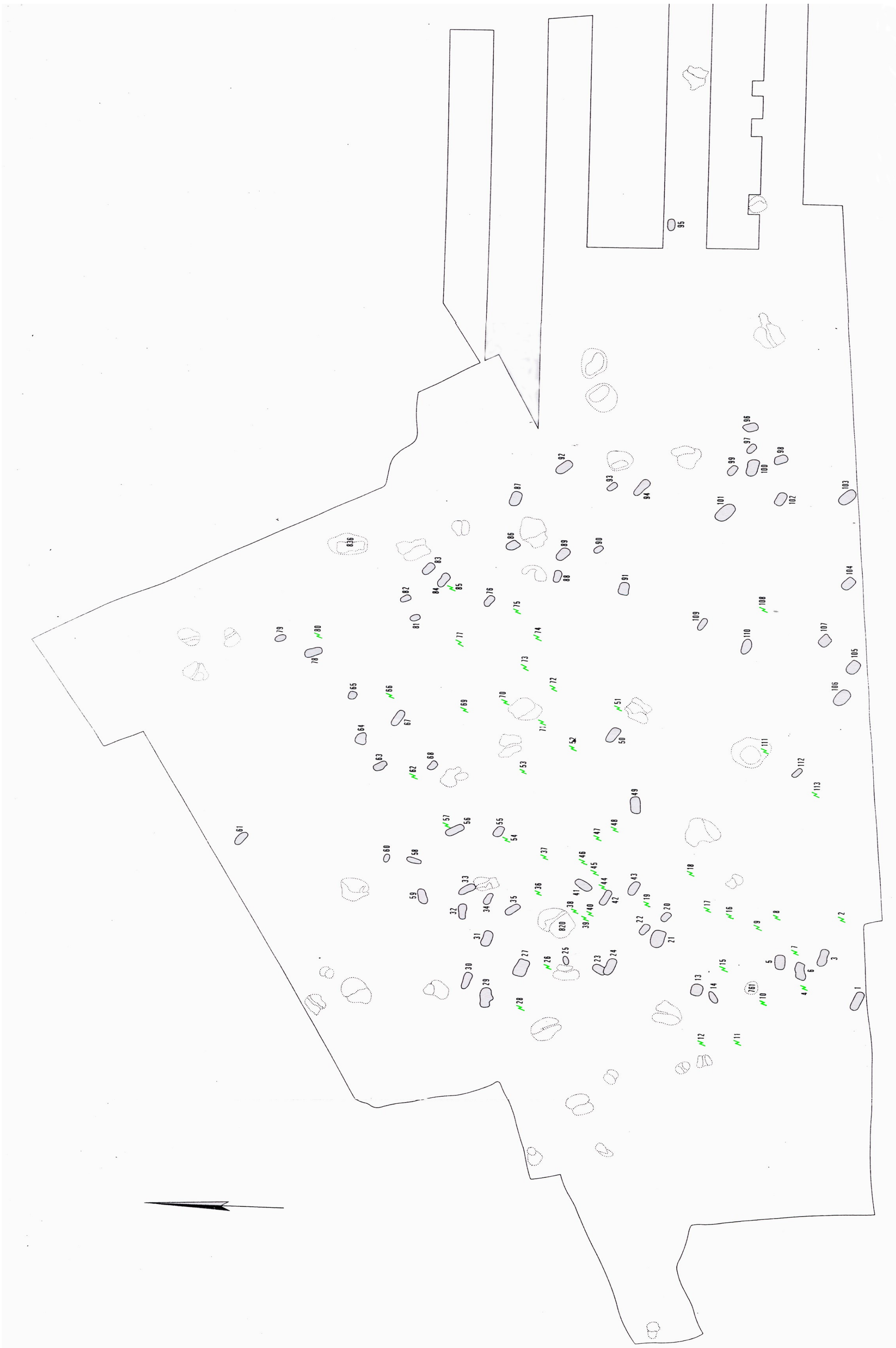
	total burials	Settlement Burials				
		adult	juvenile	children	undet.	(♀ / ♂)
Heiligenthal (Saxony Anhalt)	1	-	-	-	1	- -
Helfta (Saxony Anhalt)	1	-	-	-	1	- -
Hofgeismar (Hesse)	?	-	-	-	?	- -
Koblenz-Rübenach (Rhineland Palatinate)	1	-	-	-	1	- -
Köln Lindenthal (North-Rhine Westfalia)	2	1	-	-	1	1 / -
Königsaue (Saxony Anhalt)	6	2	-	2	2	2 / 0
Köthen-Geuz (Saxony Anhalt)	1	-	-	-	1	- -
Krichampfer (Bavaria)	1	1	-	-	-	1 / -
Lauffen am Neckar (Baden-Wuerttemberg)	1	-	-	-	1	- -
Leigestern (Hesse)	3	1	-	-	2	- / 1
Leipzig-Eutritzsch (Saxony)	2	-	-	-	2	- -
Leipzig-Wahren (Saxony)	2	-	-	-	2	- -
Mannheim-Vogelstang (Baden-Wuerttemberg)	1	-	-	1	-	- -
Mannheim-Wallstadt (Baden-Wuerttemberg)	2	-	-	-	2	- -
Minsleben (Saxony Anhalt)	1	-	-	-	1	- 1
Mücheln (Saxony Anhalt)	2	-	-	-	2	- -
Müddersheim (North-Rhine Westfalia)	5	2	-	2	1	2 / 2
Murr (Baden-Wuerttemberg)	1	-	-	-	1	- -
Naumburg (Saxony Anhalt)	6	3	-	-	3	1 / 2
Nerkewitz (Saxony)	3	2	-	1	-	3 / -
Neudietendorf (Thuringia)	1	-	-	-	1	- -
Nieder-Mörlen (Hesse)	4	1	-	-	3	- -
Oberbergen im Kaiserstuhl (Baden-Wuerttemberg)	2	1	-	1	-	- -
Obertreba (Thuringia)	2	-	-	-	2	- -
Opfingen (Baden-Wuerttemberg)	1	-	-	1	-	- -
Pfäffingen (Baden-Wuerttemberg)	2	1	-	1	-	- -
Polleben (Saxony Anhalt)	1	-	-	-	1	- -
Poppenweiler (Baden-Wuerttemberg)	2	1	-	1	-	- / 1
Reiser (Thuringia)	?	-	-	-	?	- -
Röblingen am See (Saxony Anhalt)	2	-	1	-	1	1 / 0
Roitzsch (Saxony Anhalt)	1	-	-	-	1	- -
Roßleben (Saxony Anhalt)	8	-	-	1	7	- -
Rothenschirmbach (Saxony Anhalt)	3	2	-	1	-	- / 2
Schöckingen (Baden-Wuerttemberg)	3	-	-	-	3	- -
Schwaigern (Baden-Wuerttemberg)	6	-	-	-	6	- -

List 2 cont. Settlement burials in the LBK - including the number of body burials (data taken from PESCHEL *1992;* NIESZERY *1995;* VEIT *1996*).

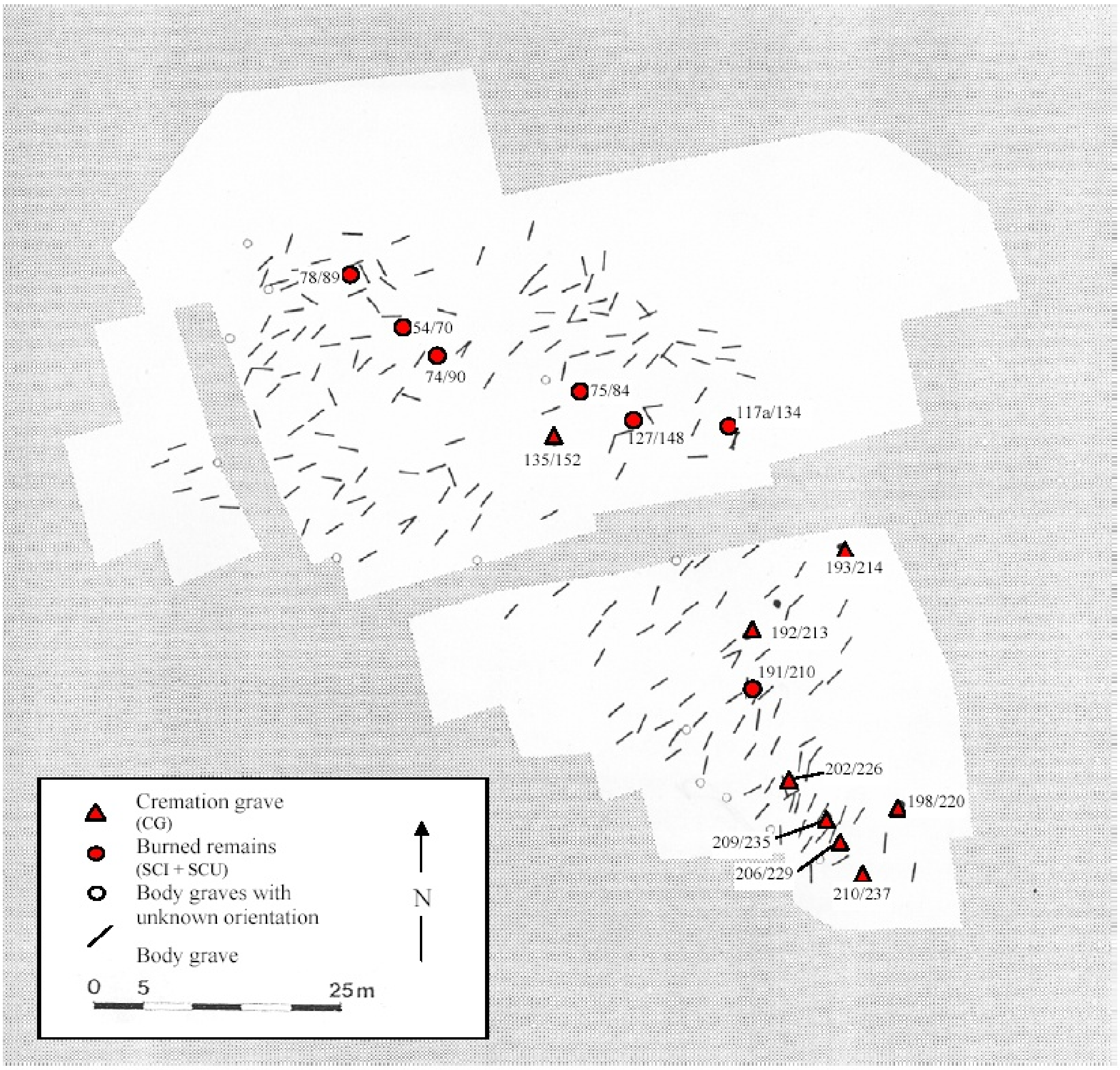
	total burials	*Settlement Burials* adult	juvenile	children	undet.	(♀ / ♂)
Schwanfeld (Bavaria)	2	1	-	1	-	- / 1
Schweinfurt (Bavaria)	2	1	-	1	-	- -
Seehausen (Saxony Anhalt)	6	3	-	2	1	1 / 2
Spören-Prusendorf (Saxony Anhalt)	1	-	-	1	-	- -
Steinhaleben (Saxony Anhalt)	1	-	-	-	1	- -
Straubingen (Bavaria)	3	1	1	1	-	1 / -
Stuttgart-Bad-Cannstatt (Baden-Wuerttemberg)	1	1	-	-	-	1 / -
Stuttgart-Mühlhausen (Baden-Wuerttemberg)	10	1	3	-	6	- / 1
Stuttgart-Mühlhausen (Baden-Wuerttemberg)	1	1	-	-	-	1 -
Stuttgart-Zuffenhausen (Baden-Wuerttemberg)	2	1	-	-	1	- / 1
Talheim (Baden-Württemberg)	**34**	**18**	**3**	**13**	**-**	**7 9**
Tornau (Saxony Anhalt)	1	-	-	-	1	- -
Tröbsdorf (Saxony Anhalt)	1	-	-	-	1	- -
Westeregeln (Saxony Anhalt)	1	-	-	-	1	- -
Wiesbaden-Biebrich (Hesse)	1	-	-	-	1	- -
Wiesbaden-Dotzheim (Hesse)	1	-	-	-	1	- -
Wiesbaden-Erbenheim (Hesse)	20	-	-	-	20	- -
Wolmirstedt (Saxony Anhalt)	2	-	-	-	2	- -
Zauschwitz-Wiederoda (Saxony)	6	-	-	2	4	- -
France	***62***	**12**	**1**	**35**	**14**	**2 / 3**
Berry-au-Bac	3	1	-	2	-	- / 1
Champigny-sur-Marne	2	-	-	-	2	- -
Chassemy	9	5	3	1	-	1 / 2
Chaumont-sur-Yonne	3	-	-	-	3	- -
Cheny	10	-	-	-	10	- -
Cuiry-lès Chaudardes	6	-	-	6	-	- -
Cys-la-Commune	3	-	-	-	3	- -
Dachstein	4	2	1	1	-	1 / 1
Ensisheim	6	1	-	3	2	- -
Escolives-Sainte-Camille	2	-	-	-	2	- -
Menneville	36	7	-	24	5	- -
Merxheim	3	-	-	2	1	- -
Reichstett	2	-	-	1	1	- -
Rouffach	4	1	-	3	-	- / 1
Stützheim	2	1	-	1	-	1 / 1
Viellejuif	?	-	-	-	?	- -
Villeneuve-la-Cuyard	?	-	-	-	?	- -
Wettlosheim	2	-	-	-	2	- -
Wittenheim-Schönensteinbach	1	-	-	-	1	- -
Total	**487**	**143.5**	**18.5**	**128**	**197**	**60 / 72**

List 2 cont: Settlement burials in the LBK - including the number of body burials (data taken from Peschel *1992;* Nieszery *1995;* Veit *1996).*

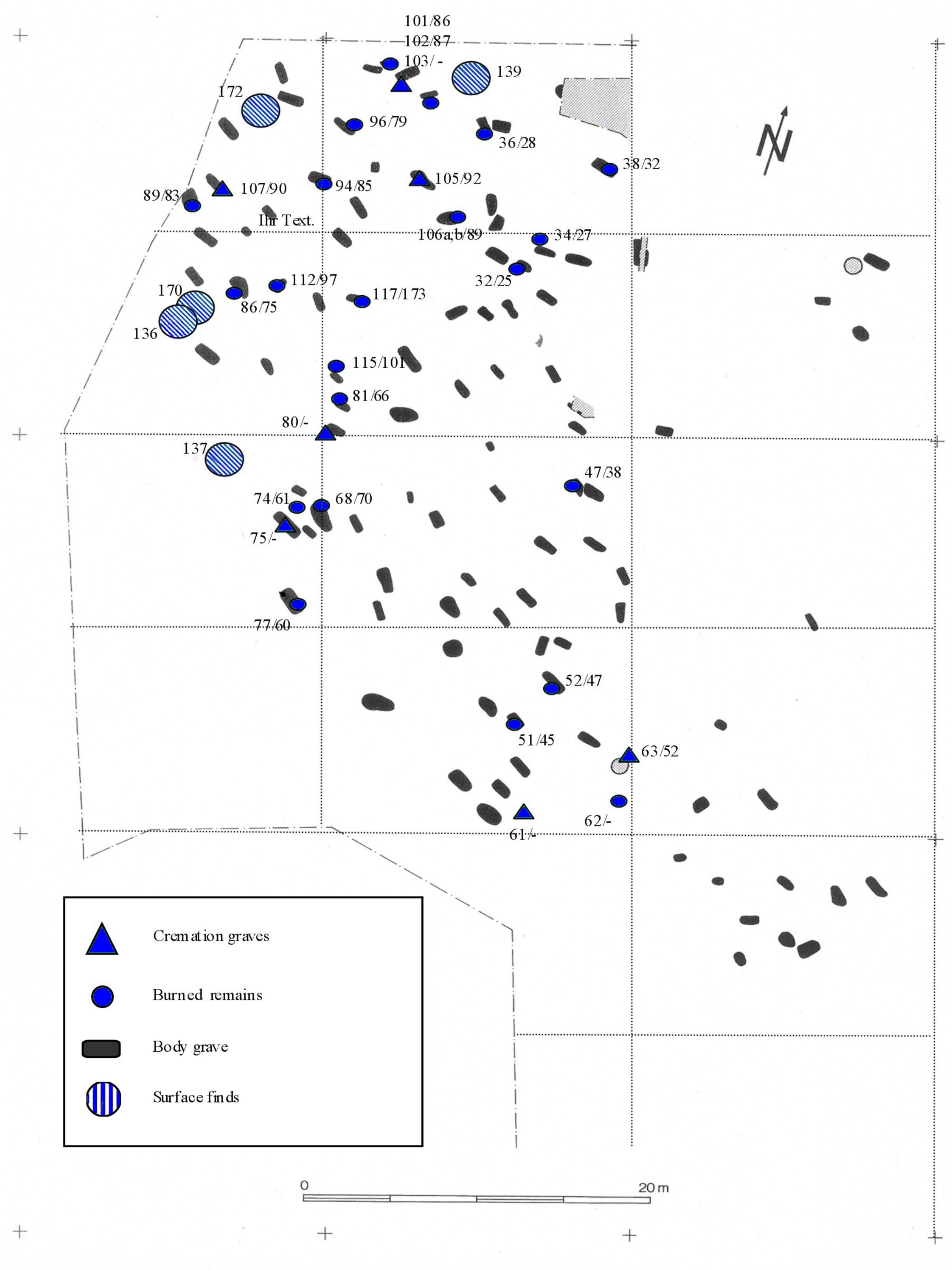
Map 2: Elsloo: Map of the excavated settlement, including the ground pattern of longhouses from the younger LBK. The cemetery is located to the north of the settlement (MODDERMAN 1970).



Map 3: Elsloo: Distribution of cremations and body graves in the cemetery. The zig-zags represent the cremations, the round shapes represent the body graves (MODDERMAN 1970, Tab 118)



Map 4: Schwetzingen: Distribution of the cremations and body burials in the cemetery (*redrawn and adapted after* BEHRENDS 1989, 46 Fig. 20)



Map 5: Fellbach-Oeffingen: Distribution of cremations and body burials in the cemetery (redrawn and adapted from the excavation plan and notes).

	Elsloo		Schwetzingen		Fellbach-Oeffingen		Wandersleben		Arnstadt		Aiterhofen-Ödmühle*		Total	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
infant 1	-	-	-	-	-	-	1.0	1	-	-	-	-	1.0	5
infant II	-	-	-	-	-	-	2.5	2	-	-	-	-	2.5	9
juvenile	0.3	1	-	-	1.5	5	2.1	2	-	-	-	-	3.9	13
adult	0.3	1	1.3	9	1.5	5	3.4	3	-	-	5.3	7	11.8	22
mature	0.3	1	0.8	5	1.0	3	5.1	4	-	-	4.3	5	11.5	16
senile	0.3	1	0.8	5	1.0	3	1.9	2	-	-	4.3	5	8.3	13
undet.	-	-	1.0	7	-	0	0.0	0	-	-	-	-	1.0	22
total	1	2	4	26	5	15	16	13	-	-	14	18	40	100

Table 55: Distribution of female cremations across the age categories.

	Elsloo		Schwetzingen		Fellbach-Oeffingen		Wandersleben		Arnstadt		Aiterhofen-Ödmühle*		Total	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
infant 1	-	-	-	-	-	-	-	-	-	-	-	-	0.0	5
infant II	0.2	0	-	-	-	-	-	-	-	-	-	-	0.2	9
juvenile	0.2	0	0.3	2	1.3	4	1.0	1	-	-	-	-	2.8	13
adult	0.5	1	1.3	9	0.6	2	4.8	4	-	-	8.0	1	15.3	22
mature	0.5	1	0.3	2	0.6	2	1.8	2	-	-	3.5	4	6.8	16
senile	0.5	1	-	-	0.6	-	0.3	0.3	-	-	3.5	4	5.0	13
undet.	-	-	-	-	-	-	-	-	-	-	-	-	0.0	22
total	2	4	2	13	3	9	8	7	-	-	15	19	30	100

Table 56: Distribution of male cremations across the age categories.

	Elsloo		Schwetzingen		Fellbach-Oeffingen		Wandersleben		Arnstadt		Aiterhofen-Ödmühle*		Total	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
infant 1	-	-	-	-	0.7	2	7.2	6	-	-	7.5	9	15.4	5
infant II	3.0	7	0.9	6	2.0	6	6.4	5	-	-	14.5	18	26.8	9
juvenile	5.2	12	1.7	11	7.3	22	15.4	13	0.25	8	8.0	10	37.9	13
adult	5.0	11	4.9	33	7.6	23	27.0	23	2.25	75	18.0	23	64.8	22
mature	4.4	10	2.9	19	5.8	18	23.0	19	0.25	8	11.0	14	47.4	16
senile	4.4	10	2.6	17	5.8	18	15.0	13	0.25	8	11.0	14	39.1	13
undet.	23.0	51	2.0	13	4.0	12	26.0	22	-	-	9.0	11	64.0	22
total	45	100	15	100	33	100	120	100	3	100	79	100	296**	100

*Table 57: Age distribution for the cremations from the analyzed cemeteries. *Including cremations from Aiterhofen-Ödmühle (data from* NIESZERY 1995, 297ff*). **Plus one adult from Stuttgart-Mühlhausen.*

Appendix B: Catalog of Cremations

0 Grave and find number

1 Weight of the cremation (g)

2 Burn stage and color

3 Average and maximum fragment size (mm)

4 Completeness

5 Description of identifiable elements of bone

6 Age categories

7 Sex

8 Measurements (M:)

9 Comments

A dash (-) is used to mark fields for which no information is available.

A star (*) indicates that teeth were taken for the Tooth Cementum Annulation analysis.

A hash mark (#) indicates that femur fragments were taken for thin section analysis.

Elsloo

Find number 408

1. tb 14.0; cr 2.0; pc 12.0; gr -; ab -; rest -
2. V; old white, milky white, chalky
3. small; 30mm
4. –
5. temporal (mastoid process lt.), vertebrae (facies articularis vl)
6. **juvenile o.o.**
7. **undet.**
8. –
9.

Find number 422

1. tb <1.0; cr -; pc -; gr -; ab -; rest -
2. IV; milky white, chalky
3. small; 21mm
4. –
5. undet. fragments
6. **undet.**
7. **undet.**
8. –
9. –

Find number 464

1. tb 132.0; cr 14.0; pc 118.0; gr -; ab -; rest -
2. V; beige, old white
3. very small; 36mm
4. (–)
5. calotte, occipital, ribs, vertebrae (vt), humerus, radius, ulna, femur (prox. epiphysis), fibula
6. **juvenile o.o.**
7. **undet.**
8. Ms1: 3.2mm (3.6 3.3 3.5 2.6 3.3 3.1 3.4 2.2 4.0 3.2)
9. –

Find number 658

1. tb <1.0; cr -; pc -; gr -; ab -; rest -
2. IV; milky white, chalky
3. very small, crumbs
4. –
5. 2 undet. fragments
6. **undet.**
7. **undet.**
8. –
9. –

Find number 720

1. tb 474.0; cr 67.0; pc 407.0; gr -; ab -; rest -
2. V; beige, old white
3. very small
4. (+)
5. teeth (9 roots, incisor, premolar, lower molar), calotte, occipital, mandible (caput mandibulae), pars petrosa, ribs, pelvis, scapula, vertebra (dens axis), humerus, radius, phalange (distal), femur (linea aspera), tibia, fibula
6. vertebral body fused, cranial suture not fused: **juvenile o.o.**
7. medium robustness: **undet.**
8. Ms1: 3.4mm (5.9 2.5 2.2 2.3. 3.8 2.8 3.3 4.0 4.2 3.2 2.6); Ms18: 5.8mm; Ms20: 7.3mm; Ms21: 8.6mm; Ms33: 1.7mm; Ms43: 7.8mm; Ms50: 6.1-6.6mm
9. –

Find number 724

1. tb 453.0; cr 69.0; pc 394.0; gr -; ab -; rest -
2. V; old white
3. medium; 51mm
4. (+)
5. occipital, mandible/maxilla, ribs, vertebrae, pelvis, femur (prox. epiphysis), tibia, metatarsus
6. suture fused inside and outside: adult **o.o.**
7. medium robustness: **undet.**
8. Ms1: 3.5mm (3.5 4.6 3.5 4.1 3.0 2.4 4.0 3.8 3.9 2.5 3.5 3.3); Ms50: 9.1mm 12.0mm 9.5mm
9. –

Find number 751

1. tb 7.0; cr -; pc 5.0; gr -; ab 2.0; rest -
2. IV; milky white, chalky
3. very small; 19mm
4. –
5. ribs, long bone fragments
6. **undet.**
7. **undet.**
8. –
9. –

Find number 820

1. tb 149.0; cr 7.0; pc 142.0; gr -; ab -; rest 3.0
2. IV-V; beige, old white, milky white, chalky
3. small; 41mm
4. (+)
5. calotte (with suture), ribs, pelvis (ilium), humerus, fibula
6. suture not fused: **undet.**
7. medium robustness: **undet.**
8. Ms1: 3.8mm (4.8 3.5 3.2 3.7 4.5 3.2)
9. burned wood

Grave 6, Find number 753

1. tb -; cr -; pc -; gr -; ab -; rest <1.0
2. –
3. –
4. –
5. –
6. –
7. –
8. –
9. stones and burned wood

Grave 7, Find number 703

1. tb 465.0; cr 89.0; pc 376.0; gr -; ab -; rest -
2. V; beige, old white
3. medium
4. +
5. cranial base, temporal, mandible (mandibular process), zygomatic, frontal, ribs, clavicle, vertebra, humerus, radius, femur (distal epiphysis), tibia, fibula, tarsal
6. **juvenile o.o**.
7. medium robustness: **undet.**
8. Ms1: 3.7mm (4.1 2.8 4.7 2.6 3.1 3.8 2.9 4.7 4.9); Ms19: 2.2mm; Ms33: 2.2; Ms50: 8.4
9. –

Grave 9, Find number 706

1. tb 9.0; cr 3.0; pc 6.0; gr -; ab -; rest -
2. V; old white
3. very small; 29mm
4. –
5. pars petrosa, calotte, long bone fragments
6. **undet.**
7. **undet.**
8. –
9. –

Grave 11, Find number 758

1. tb <1.0; cr -; pc <1.0; gr -; ab -; rest -
2. IV; milky white, chalky
3. very small; 14mm
4. –
5. long bone fragments
6. **undet.**
7. **undet.**
8. –
9. –

Grave 12, Find number 759

1. tb <1.0; cr -; pc <1.0; gr -; ab -; rest -
2. IV; milky white, chalky
3. very small; 14mm
4. –
5. long bone fragments
6. **undet.**
7. **undet.**
8. –
9. –

Grave 16, Find number 707

1. tb 55.0; cr 6.0; pc 49.0; gr -; ab -; rest -
2. V; beige, old white
3. small; 40mm
4. (–)
5. calotte, mandible (caput mandibulae), radius, ulna, tibia
6. **undet.**
7. **undet.**
8. Ms33: 2.6mm
9. –

Grave 19, Find number 716

1. tb 54.0; cr 12.0; pc 42.0; gr -; ab -; rest -
2. V; old white
3. small; 33mm
4. (–)
5. cranial base, calotte, ribs, long bone fragments
6. **undet.**
7. medium robustness: **undet.**
8. Ms1: 4.6mm (4.9 4.5 6.0 3.6 5.8 2.7)
9. –

Grave 20, Find number 715

1. tb 68.0; cr 33.0; pc 35.0; gr -; ab -; rest -
2. V; old white
3. small; 35mm
4. –
5. calotte (suture), mandible (coronoid process), femur, phalange (distal)
6. **undet.**
7. medium robustness: **undet.**
8. Ms1: 4.0mm (3.5 2.9 3.2. 3.9 3.4 4.3 4.9 5.1 4.6); Ms19: 2.1mm
9. –

Grave 21, Find number 714

1. tb 7.0; cr 5.0; pc 2.0; gr -; ab -; rest -
2. IV-V; old white, milky white, chalky
3. very small; 25mm
4. –
5. calotte and long bone fragments
6. **undet.**
7. **undet.**
8. Ms1: 2.9 (3.4 3.3 2.3 3.6 3.0 2.3)
9. –

Grave 22, Find number 755

1. tb <1.0; cr -; pc -; gr -; ab -; rest -
2. IV; milky white, chalky
3. very small; 14mm
4. –
5. undet. crumbs
6. **undet.**
7. **undet.**
8. –
9. –

Grave 24, Find number 828

1. tb 2.0; cr 2.0; pc -; gr -; ab -; rest -
2. IV; milky white, chalky
3. very small; 20mm
4. –
5. calotte
6. **undet.**
7. **undet.**
8. Ms1: 3.9mm (3.8 3.9)
9. –

Grave 26, Find number 824

1. tb 130.0; cr 25.0; pc 105.0; gr -; ab -; rest 2.0
2. IV; milky white; chalky
3. small; 31mm
4. (–)
5. teeth (root, canine crown), parietal (ss), frontal (orbit), ribs, humerus, radius, femur, tibia
6. saggital suture not fused: **undet.**
7. **undet.**
8. Ms1: 4.1mm (6.0 5.5 3.2 4.9 3.0 3.4 5.1)
9. –

Grave 28, Find number 827

1. tb 1.0; cr -; pc 1.0; gr -; ab -; rest -
2. IV; milky white; chalky
3. very small; 10mm
4. –
5. undet. fragments
6. **undet.**
7. **undet.**
8. –
9. –

Grave 37, Find number 818

1. tb <1.0; cr -; pc -; gr -; ab -; rest -
2. VI; milky white; chalky
3. very small; 8mm
4. –
5. ribs, undet. fragments
6. **undet.**
7. **undet.**
8. –
9. –

Grave 38, Find number 823

1. tb <1.0; cr <1.0; pc -; gr -; ab -; rest -
2. IV; milky white; chalky
3. very small; 10mm
4. –
5. calotte
6. **undet.**
7. **undet.**
8. –
9. –

Grave 39, Find number 826

1. tb 159.0; cr 16.0; pc 143.0; gr -; ab -; rest 3.0
2. IV; milky white; chalky
3. very small; 40mm
4. (–)
5. occipital, parietal (suture), maxilla, ribs, vertebra (facies articularis), humerus (trochlea rt.), femur (facies patellaris distal femur rt.)
6. femur and humerus epiphyses fused: **late juvenile o.o**.
7. suture open: **undet.**
8. Ms1: 3.1mm (2.0 3.6 4.2 3.6 4.9)
9. –

Grave 40, Find number 825

1. tb 305.0; cr 13.0; pc 292.0; gr -; ab -; rest 9.0
2. V; old white
3. small; 42mm
4. (–)
5. calotte (suture), tooth (crown), frontal (orbit), pelvis, vertebra, ribs, radius, phalange (distal epiphysis), patella, fibula, tibia
6. phalange epiphysis fused: **juvenile o.o**.
7. **undet.**
8. Ms50: 6.2mm
9. –

Grave 41, Find number 822

1. tb <1.0; cr -; pc -; gr -; ab -; rest -
2. IV-V; old white, milky white, chalky
3. very small; 2mm
4. –
5. undet. fragments
6. **undet.**
7. **undet.**
8. –
9. –

Grave 42, Find number 754

1. tb <1.0; cr -; pc -; gr -; ab -; rest -
2. IV; milky white; chalky
3. very small; 9mm
4. –
5. undet. fragments
6. **undet.**
7. **undet.**
8. –
9. –

Grave 46, Find number 718, 719

1. tb 2.0; cr 1.0; pc <1.0; gr -; ab -; rest -
2. IV; old white, milky white, chalky
3. very small; 15mm
4. –
5. calotte and long bone fragments
6. **undet.**
7. **undet.**
8. Ms1: 3.8mm (3.5 4.2)
9. –

Grave 48, Find number 721

1. tb 40.0; cr 1.0; pc 39.0; gr -; ab -; rest -
2. V; old white
3. small; 25mm
4. –
5. calotte, phalange, tibia, fibula
6. **undet.**
7. medium robustness: **undet.**
8. Ms50: 7.9mm
9. –

Grave 51, Find number 731

1. tb 42.0; cr 2.0; pc 40.0; gr -; ab -; rest -
2. V; old white
3. small; 37mm
4. (–)
5. calotte (suture), radius, femur (linea aspera)
6. suture almost completely fused: **juvenile o.o**.
7. medium to robust, linea aspera very high (5mm): **(♂)**
8. Ms43: 6.6-7.0mm
9. –

Grave 52, Find number 735

1. tb 81.0; cr 27.0; pc 54.0; gr -; ab -; rest -
2. V; old white
3. small; 46mm
4. (–)
5. occipital (sl), tooth (canine), vertebra (facies articularis), radius, femur (linea aspera) fibula
6. root closed, suture open: **infant II o.o.**
7. medium robustness: **undet.**
8. Ms1: 3.0mm (3.7 1.8 2.9 2.8 2.7 4.4 2.4 1.9 4.1 2.8); Ms43: 6.0
9. –

Grave 54, Find number 812

1. tb <1.0; cr -; pc -; gr -; ab -; rest <1,0
2. IV; milky white; chalky
3. very small; 15mm
4. –
5. undet. fragments
6. **undet.**
7. **undet.**
8. –
9. ceramic shards

Grave 57, Find number 797

1. tb 401.0; cr 122.0; pc 379.0; gr -; ab -; rest -
2. V; beige, old white
3. very small; 50mm
4. (–)
5. calotte (suture), occipital, teeth, ribs, pelvis, vertebra (dens axis), humerus, radius, ulna, phalange (epiphysis)
6. epiphysis fused, molar root slightly open, saggital suture S3/S4 not fused, coronal suture un fused: **infant II to adult**
7. medium robustness: **undet.**
8. Ms1: 3.1mm (3.0 3.6 2.0 2.9 2.4 2.7 3.4 2.4 3.7 4.5)
9. only top half of skeleton ?

Grave 62, Find number 793

1. tb 159.0; cr 16.0; pc 143.0; gr -; ab -; rest 10.0
2. V; old white
3. small; 28mm
4. (+)
5. calotte (suture), parietal, ribs, pelvis, vertebra (dens axis), scapula, humerus, radius, ulna, fibula
6. suture not fused: **undet.**
7. gracile to medium robustness: **(♀)**
8. Ms1: 3.2mm (2.8 3.4 3.4 3.9 2.8 2.5 3.8 2.6); Ms20: 8.4mm; Ms21: 9.7mm; Ms22: 27.5mm
9. only upper half of skeleton

Grave 63, Find number 830

1. tb <1.0; cr <1.0; pc -; gr -; ab -; rest -
2. IV; milky white; chalky
3. very small; 10mm
4. –
5. calotte fragments
6. **undet.**
7. **undet.**
8. –
9. –

Grave 64, Find number 786

1. tb 3.0; cr -; pc 2.0; gr -; ab -; rest 20.0
2. IV-V (II); old white, milky white; chalky; black, dark brown
3. very small; 32mm
4. –
5. undet. fragments
6. **undet.**
7. **undet.**
8. –
9. burned wood, ceramic shards

Grave 66, Find number 790

1. tb 56.0; cr 3.0; pc 53.0; gr -; ab -; rest -
2. IV; milky white; chalky
3. small; 29mm
4. (–)
5. occipital, humerus (prox. epiphysis), metacarpal (proximal), phalange (distal), tibia
6. proximal metacarpal epiphysis closed: **juvenile o.o**.
7. gracile: **(♀)**
8. –
9. –

Grave 69, Find number 740

1. tb 2.0; cr -; pc 2.0; gr -; ab -; rest -
2. IV; milky white; chalky
3. very small; 13mm
4. –
5. long bone fragments
6. **undet.**
7. **undet.**
8. –
9. –

Grave 70, Find number 737

1. tb 3.0; cr <1.0; pc 2.0; gr -; ab -; rest -
2. V; beige, old white
3. very small; 25mm
4. –
5. calotte and long bone fragments
6. **undet.**
7. **undet.**
8. –
9. –

Grave 71, Find number 736

1. tb 17.0; cr 4.0; pc 13.0; gr -; ab -; rest -
2. V; old white
3. very small; 21mm
4. (–)
5. calotte, tooth root, long bone fragments
6. tooth root closed: **infant I o.o.**
7. **undet.**
8. –
9. –

Grave 73, Find number 725

1. tb 63.0; cr 31.0; pc 32.0; gr -; ab -; rest 17.0
2. V; old white
3. small; 35mm
4. (–)
5. calotte (suture), tooth, frontal (rt. orbit), zygomatic, long bone fragments
6. suture not fused: **undet.**
7. **undet.**
8. –
9. –

Grave 74, Find number 729

1. tb 10.0; cr 3.0; pc 7.0; gr -; ab -; rest -
2. IV; milky white; chalky
3. very small; 29mm
4. –
5. calotte (suture), radius/ulna, humerus/femur (prox. epiphysis)
6. suture not fused: **infant to juvenile**
7. **undet.**
8. Ms1: 2.2mm (1.9 2.8 2.9 2.0 2.0 1.6 2.8 1.7 1.7 2.5); Ms33: 1.7mm
9. –

Grave 77, Find number 770

1. tb <1.0; cr -; pc -; gr -; ab -; rest -
2. IV; milky white; chalky
3. very small; 9mm
4. –
5. undet. fragments
6. **undet.**
7. **undet.**
8. –
9. –

Grave 80, Find number 778

1. tb <1.0; cr -; pc -; gr -; ab -; rest -
2. IV; milky white; chalky
3. very small; 5mm
4. –
5. –
6. –
7. –
8. –
9. –

Grave 85, Find number 766

1. tb 23.0; cr <1.0; pc 22.0; gr -; ab -; rest -
2. IV; milky white; chalky
3. small
4. –
5. calotte (2 pieces), humerus, radius/ulna, femur (linea aspera)
6. distal epiphysis of phalange not fused: **infant to juvenile**
7. gracile: **undet.**
8. Ms43: <6.0mm
9. –

Grave 88, Find number 796

1. soil sediments, tooth enamel unburned

Grave 96, Find number 505

1. soil sediments, tooth enamel unburned

Grave 98, Find number 501

1. soil sediments, tooth enamel unburned

Grave 113, Find number 508

1. tb 29.0; cr 1.0; pc 28.0; gr -; ab -; rest -
2. IV; milky white; chalky
3. very small; 26mm
4. (–)
5. calotte, vertebra (facies articularis), fibula
6. **undet.**
7. medium robustness: **undet.**
8. –
9. –

Schwetzingen RNK “Schälzig”

Grave 54, Find number 70

1. tb 3.0; cr - ; pc 3.0; gr -; ab - ; rest –
2. III-V; beige, old white, blue-grey
3. small; 34mm
4. –
5. humerus, ulna
6. **juvenile o**.**o**.
7. **undet.**
8. Ms28: 2.6-2.9
9. with body burial of an adult to mature male

Grave 74, Find number 90

1. tb 3.7; cr 3.7; pc - ; gr -; ab - ; rest –
2. III-V; beige, old white, grey
3. very small; 27mm
4. –
5. Pars petrosa (lt.)
6. **undet.**
7. **(**♀**)**
8. –
9. with body burial of a probable female

Grave 75, Find number 84

1. tb 18.7; cr 0.6; pc -; gr -; ab 17.9; rest –
2. IV; milky white, chalky
3. very small; 12mm
4. –
5. tooth (Pm or M)
6. root closed; **juvenile o.o**.
7. **undet.**
8. –
9. with body burial of a male, probably adult

Grave 78, Find number 89

1. tb 0.6; cr -; pc 0.6; gr -; ab - ; rest –
2. IV-V; beige, old white, milky white, chalky
3. small; 22mm
4. –
5. scapula (glenoid cavity)
6. **undet.**
7. **undet.**
8. –
9. with body burial of an adult, sex unknown

Grave 117a, Find number –

1. tb 0.2; cr -; pc -; gr -; ab - ; rest –
2. IV; milky white, chalky
3. very small; 10mm
4. –
5. undet. Fragments
6. **undet.**
7. **undet.**
8. –
9. with body burial of an adult male

Grave 127, Find number 148 (#)

1. tb 190.7; cr 18.6; pc 106.9; gr 65.2; ab -; rest 7.9
2. V; beige, old white, grey
3. very small; 35mm
4. (+)
5. parietal, occipital (rt.), teeth (incisor or canine, premolar or molar), ribs, scapula, humerus, radius/fibula (prox. epiphysis), phalange, femur (linea aspera), tibia, fibula
6. joints well preserved; **juvenile to mature**
7. medium to robust for the population; **(♂)**
8. Ms28: 1.9mm; Ms33: 1.3-1.8mm; Ms43: 4.7-5.8mm;Ms50: 9.8mm
9. with body burial of an adult/mature individual, sex unknown

Grave 135, Find number 152 (,#)*

1. tb 579.9; cr 148.0; pc 62.9; gr 369.0; ab -; rest 17.8
2. III-V; old white, milky white, inside grey, teeth inside blue
3. small; 29mm
4. +
5. maxilla, frontal (orbit), teeth (canine, incisor, premolar, molar), parietal, occipital (sl), wrist bones, humerus, vertebrae and ribs, humerus/femur (prox. epiphysis), femur, fibula, tibia
6. roots closed, saggital suture fused inside, lambdoidal suture not fused inside: **early adult 20-30**
7. Margo supraorbitalis round, medium to robust: **(♂)**
8. Ms1: 3.9mm (4.3 4.5 3.3 5.3 5.1 3.1 3.0 4.9 3.2 3.1); Ms27: 3.0mm; Ms28: 2.0mm; Ms39: 38-42; Ms50: 7.1mm
9. no evidence for multiple cremations or animal bones

Grave 191, Find number 210

1. tb 7.5; cr 5.1; pc 2.4; gr -; ab -; rest -
2. III-V; old white, milky white, chalky, blue-grey
3. very small; 23mm
4. –
5. parietal, fibula
6. **adult o.o**.
7. medium to robust, parietal thick: **undet.**
8. Ms1: [5.4mm]
9. with body burial of an infant I

Grave 192, Find number 213

1. tb 33.6; cr 2.9; pc 15.2; gr 15.5; ab -; rest -
2. V; beige, old white
3. very small; 25mm
4. (-)
5. calotte, ulna/fibula, femur, tibia
6. **adult to mature**
7. medium to robust: **undet.**
8. Ms1: [3.0mm]; Ms43: [4.9mm]; Ms44: [3.1mm]; Ms50: 4.9mm
9. no evidence for multiple cremations or animal bones

Grave 193, Find number 214

1. tb 6.2; cr 2.3; pc 3.9; gr -; ab -; rest -
2. V; old white
3. very small; 9mm
4. –
5. calotte; long bones
6. **infants II to juvenile**
7. **undet.**
8. Ms1: 2.7mm (1.8 2.8 2.6 3.0 2.8 3.4 1.8 3.3); Ms28: 2.2mm
9. no evidence for multiple cremations or animal bones

Grave 198, Find number 220

1. tb 66.6; cr 29.5; pc 22.3; gr 14.8; ab -; rest –
2. V; beige, old white, milky white, chalky
3. very small; 34mm
4. (+)
5. occipital, parietal (ss), mandible (mandibular condyle, chin), zygomatic (lt.), pelvis, scapula, ribs, femur, tibia, fibula
6. coronal suture fused, saggital suture S3/S4 not fused: **adult o.o.**
7. gracile to medium: **(♀)**
8. Ms1: 3.4mm (3.4 3.6 3.9 3.5 3.2 2.9 3.9); Ms50 5.9mm
9. no evidence for multiple cremations or animal bones

Grave 202, Find number 226 (,#)*

1. tb 664.5; cr 31.9; pc 85.6; gr 535.0; ab 13.0; rest 29.5
2. III-V; beige, old white, grey, black, some unburned
3. very small; 30
4. +
5. teeth, orbit. parietal, temporal (mastoid process), occipital, vertebrae (atlas), ribs (burn stage I), radius, femur, fibula
6. suture not fused: **juvenile to early adult**
7. very gracile mastoid process: ♀
8. Ms1: 3.2mm (3.1 4.1 3.3 3.9 2.3 2.0); Ms33: 2.3mm; Ms44: 4.0mm
9. no evidence for multiple cremations or animal bones, possible osteoporosis

Grave 206, Find number 229,1 (#)

1. tb 228.9; cr 5.9g; pc 123.0; gr 100.0; ab -; rest -
2. V; beige, old white, milky blue, chalky, some blue/grey
3. very small; 25mm
4. (+)
5. calotte, mandible (coronoid process), zygomatic, vertebrae, humerus, radius, ulna (prox. epiphysis), femur, fibula, tibia, talus and metatarsal
6. thickness of calotte: **late juvenile**
7. robust for the population (possibly a young man): **undet.**
8. Ms1: 2.7mm (2.4 2.9 3.0 4.3 1.8 3.1 2.6 2.3); Ms19: 1.5mm; Ms28: 2.0mm; Ms50: 8.5mm
9. no evidence for multiple cremations or animal bones

Grave 209, Find number 235,1 (,#)*

1. tb 974.0g; cr 128.0g; pc 260.0; gr 586.0; ab -; rest -
2. V; beige, old white
3. very small; 49mm
4. +
5. cranial base, pars petrosa (rt. and lt.), occipital (asterion), parietal (ss), mandible (incisor or canine region), coronoid process (rt.), frontal (orbit), molar M3, upper incisor and canine, rib and vertebra (vc), humerus (prox. epiphysis), ulna, wrist bone, tibia, fibula, femur, talus
6. M3, tooth ware, epiphysis fused, vertebral disk fused, and saggital suture fused, lambdoidal suture not fused: **late adult** (**30-40 yrs**)
7. upper edge of orbit sharp, angle of meatus acusticus internus steep, coronoid process gracile, teeth are small to medium in size: ♀
8. to do
9. no evidence for multiple cremations or animal bones

Grave 210, Find number 237

1. tb 34.0g; cr 1.3g; pc 17.6g; gr 15.1g; ab -, rest -
2. IV-V; milky white, chalky, white/old white
3. very small; 15mm
4. (-)
5. calotte, ulna/radius, femur, fibula
6. **infant II or older**
7. gracile for the population: **undet.**
8. Ms1: 2.6mm (2.6 2.1 2.8 3.0)
9. no evidence for multiple cremations or animal bones

Fellbach-Oeffingen "Obere Tauber"

Find number 136

10. tb 2.5; cr -; pc 2.5; gr -; ab -; rest -
11. IV-V; beige, old white
12. very small; 12mm
13. –
14. femur; tibia
15. **infant II o.o.**
16. **undet.**
17. –
18. collected from the surface

Find number 137

1. tb 6.5; cr 1.3; pc 5.2; gr -; ab -; rest -
2. IV-V; beige, old white
3. small; 30mm
4. –
5. calotte bones unburned, femur, tibia
6. **juvenile o.o**.
7. **undet.**
8. –
9. collected from the surface

Find number 139

1. tb 3.0; cr -; pc 3.0; gr -; ab -; rest -
2. IV-V; beige, old white, milky white
3. very small; 11mm
4. –
5. femur, tibia
6. **juvenile o.o.**
7. **undet.**
8. –
9. collected from the surface

Find number 170

1. tb 3.0; cr -; pc 3.0; gr -; ab -; rest -
2. V; beige, old white
3. very small; 25mm
4. –
5. undet. Fragments
6. **undet.**
7. **undet.**
8. –
9. collected from the surface

Find number 172

1. tb 2.4; cr -; pc -; gr -; ab 2.4; rest -
2. –
3. –
4. –
5. –
6. –
7. –
8. –
9. unburned animal bones

Complex 32, Grave 25, Find number 30

1. tb 0.5; cr 0.5; pc -; gr -; ab -; rest -
2. V; beige, old white
3. very small; 16mm
4. –
5. cranial fragments
6. **juvenile o.o.**
7. **undet.**
8. –
9. with body burial of an adult female

Complex 34, Grave 27, Find number 32

1. tb 8.9; cr 8.9; pc -; gr -; ab -; rest -
2. V; beige, old white
3. very small; 26mm
4. –
5. cranial fragments
6. **juvenile o.o.**
7. **undet.**
8. –
9. with body burial of an adult male

Complex 36, Grave 28, Find number 33

1. tb 0.9; cr -; pc 0.9; gr -; ab -; rest -
2. IV; milky white, chalky
3. very small; 16mm
4. –
5. humerus, tibia
6. **undet.**
7. **undet.**
8. –
9. with body burial, age and sex unknown

Complex 38, Grave 32, Find number 42 (*)

1. tb 13.8; cr 2.5; pc 11.3; gr -; ab -; rest -
2. III/V; beige, old white, grey
3. small; 28mm
4. (-)
5. calotte, teeth (canine, incisor), vertebra (atlas), tibia (prox. epiphysis)
6. tooth roots closed: **juvenile o.o.**
7. **undet.**
8. –
9. with body burial of an adult male

Complex 47, Grave 38, Find number 51 (*)

1. tb 1.9; cr 0.5; pc 0.5; gr -; ab 0.9; rest -
2. V; old white, milky white, chalky
3. very small; 11mm
4. –
5. tooth (canine, C3?)
6. tooth root closed: **infant II o**.**o**.
7. **undet.**
8. –
9. with body burial of an adult, sex unknown

Complex 51, Grave 45, Find number 58

1. tb 0.5; cr 0.5; pc - gr -; ab -; rest -
2. V; old white
3. small; 17mm
4. –
5. calotte fragments
6. **juvenile o**.**o**.
7. **undet.**
8. –
9. with body burial of infant II or juvenile

Complex 52, Grave 47, Find number 71

1. tb 0.9; cr 0.4; pc 0.5;gr -; ab -; rest -
2. V; old white
3. very small; 15mm
4. –
5. calotte fragments, long bone fragments
6. **infant II o.o.**
7. **undet.**
8. –
9. with body burial of an adult male

Complex 61, Find number 84

1. tb 1.3; cr -; pc 1.3;gr -; ab -; rest -
2. V; old white
3. very small; 15mm
4. –
5. humerus
6. **juvenile o.o**.
7. **undet.**
8. –
9. no evidence for multiple cremations or animal bones

Complex 62, Find number 74, 75, 117#

1. tb 11.6; cr 4.6; pc 6.3;gr -; ab -; rest 0.7
2. IV-V; beige, old white, milky white, chalky, blue-grey
3. very small; 20mm
4. (-)
5. teeth, occipital (sl), frontal (orbit), humerus, femur
6. **early juvenile to mature**
7. sharp orbit: **(♀)**
8. Ms1: 2.8mm (3.3 2.4 2.6); Ms28: 1.6mm
9. no evidence for multiple cremations; some unburned animal bones

Complex 63, Grave 52, Find number 73 (#)

1. tb 13.8; cr 7.2; pc 6.6;gr -; ab -; rest -
2. IV-V; old white, milky white, chalky
3. very small; 37mm
4. (-)
5. temporal, parietal, tooth (PM/M), femur, tibia
6. tooth roots closed: **adult**
7. teeth gracile: **undet.**
8. –
9. no evidence for multiple cremations or animal bones

Complex 68, Grave 70, Find number 110

1. tb 0.1 cr -; pc -;gr -; ab -; rest -
2. V; old white
3. very small; 5mm
4. –
5. undet. fragments
6. **undet.**
7. **undet.**
8. –
9. with body burial of an adult male

Complex 74, Grave 61, Find number 100#

1. tb 3.6 cr 2.3; pc 1.3;gr -; ab -; rest -
2. III-IV; milky, blue-grey, grey
3. very small; 20mm
4. –
5. tooth, mandible, humerus, femur (linea aspera), tibia
6. **juvenile o.o**.
7. gracile for the population: **(♀)**
8. Ms1: 4.7mm; Ms43: [4.0mm]
9. with body burial of an adult, probably male

Complex 75, Find number 118

1. tb 2.3; cr -; pc 2.3;gr -; ab -; rest -
2. V; beige, old white
3. very small; 30mm
4. –
5. humerus
6. **juvenile o.o.**
7. gracile for the population: **(♀)**
8. Ms28: 2.4mm
9. no evidence for multiple cremations or animal bones

Complex 77, Grave 60, Find number 93, 94, 95, 96, and 97 (*)

1. tb 28.9; cr 4.1; pc 24.8;gr -; ab -; rest -
2. III/V; beige, old white, grey
3. very small; 31
4. +
5. teeth (premolar/molar, incisor, deciduous molar), mandible, pars petrosa, temporal, ribs, pelvis, humerus, radius, ulna, phalanges (tuft), femur (prox. epiphysis)
6. incisor root closed, molar in alveolar, deciduous tooth, tuft epiphysis not fused: **juvenile 10-16**
7. pars petrosa flat angle: ♂
8. Ms28: 1.8-2.0mm
9. with body burial of an adult female

Complex 80, Find number 119

1. tb 0.2; cr -; pc 0.2;gr -; ab -; rest -
2. V; beige, old white
3. very small; 10mm
4. –
5. ribs
6. **infant o.o.**
7. **undet.**
8. –
9. no evidence for multiple cremations or animal bones

Complex 81, Grave 66, Find number 108 (*)

1. tb 1.0; cr 0.6; pc 0.4;gr -; ab -; rest -
2. IV; milky white, chalky
3. very small; 13mm
4. –
5. tooth (canine), radius
6. tooth root closed: **infant II o.o**.
7. **undet.**
8. –
9. with body burial of an infant

Complex 86, Grave 75, Find number 125, 126

1. tb 2.6; cr 0.4; pc 2.2;gr -; ab -; rest -
2. V; old white
3. very small; 16mm
4. –
5. calotte fragments, tibia
6. **juvenile o.o.**
7. **undet.**
8. Ms50: 4.9mm
9. with body burial of an adult male

Complex 89, Grave 83, Find number 133

1. tb 0.9; cr -; pc 0.9;gr -; ab -; rest -
2. III; blue-grey, grey
3. very small; 19mm
4. –
5. humerus
6. **juvenile o.o.**
7. **undet.**
8. Ms28: [2.5-2.9]
9. with body burial of an adult female

Complex 94, Grave 85, Find number 148, 149

1. tb 4.0; cr 1.3; pc 2.7;gr -; ab -; rest -
2. III-V; old white, milky white, chalky, blue-grey
3. very small, 23mm
4. (-)
5. mandible (mandibular condyle lt.), tibia, metacarpal/metatarsal (epiphysis)
6. **juvenile o.o.**
7. medium to robust for the series: **(♂)**
8. Ms16: 8.8mm; Ms17: 18.9mm; Ms50: 8.4mm
9. with body burial of an adult female

Complex 96, Grave 79, Find number 141

1. tb 0.4; cr ; pc 0.4;gr -; ab -; rest -
2. IV-V; old white
3. small; 17mm
4. –
5. long bone fragments
6. **infant II o.o.**
7. **undet.**
8. –
9. with body burial of an adult, probably female

Complex 101, Grave 86, Find number 150

1. tb 0.7; cr -; pc -;gr 0.7; ab -; rest -
2. V; beige, old white
3. very small; 14mm
4. –
5. humerus
6. **undet.**
7. **undet.**
8. –
9. with body burial of a late juvenile or of an adult female

Complex 102, Grave 87, Find number 159, 160, and 161

1. tb 23.9; cr 13.3; pc 4.7;gr 5.9; ab -; rest -
2. III-V; beige, old white, milky white, chalky, blue-grey, grey
3. small; 38mm
4. (-)
5. tooth, occipital (rt.), parietal (rt.), vertebra, ribs, humerus, radius, fibula
6. **juvenile o.o.**
7. **undet.**
8. Ms1: 3.9mm; Ms33: 1.9mm
9. with body burial of an infant

Complex 103, Find number 155, 156 (#)

1. tb 19.2; cr 1.4; pc 17.8;gr -; ab -; rest -
2. V; old white
3. small; 58mm
4. –
5. calotte, humerus, femur (linea aspera), tibia
6. **juvenile o.o.**
7. gracile for the population: **(♀)**
8. Ms43: 4.9-5.1mm 4.0-4.5mm; Ms44: 3.0-3.5mm
9. no evidence for multiple cremations or animal bones

Complex 105, Grave 92, Find number 157 (#)

1. tb 12.4; cr 2.5; pc 7.3;gr 2.6; ab -; rest -
2. IV-V; old white, blue-grey
3. very small; 20mm
4. (-)
5. occipital, radius, femur
6. **late juvenile o.o**.
7. **undet.**
8. Ms44: 4.1mm
9. no evidence for multiple cremations or animal bones

Complex 106, Grave 89, Find number 152, 153

1. tb 19.4; cr 4.9; pc 7.8; gr 7.7; ab -; rest -
2. IV-V; beige, old white, grey
3. very small: 24mm
4. (-)
5. pars petrosa (lt.), calotte, tooth (enamel), vertebra (vc), ulna, radius, tibia
6. **juvenile o.o**.
7. ♀
8. Ms1: 1.8mm; Ms28: 1.9mm
9. with body burial of a female, probably juvenile or older

Complex 107, Grave 90, Find number 176

1. tb 220.5; cr 28.0; pc 52.2;gr 140.3; ab -; rest -
2. IV-V; old white, milky white, chalky, blue-grey
3. small; 32mm
4. (+)
5. pars petrosa (rt.), maxilla, teeth, temporal, parietal (sl), vertebra, scapula, humerus (prox. epiphysis), ulna/radius, femur (prox. epiphysis), tibia
6. epiphyses fused, cranial suture not fused, vertebral body fused: **adult o.o**.
7. pars petrosa flat, robust: **(♂)**
8. –
9. no evidence for multiple cremations or animal bones

Complex 112, Grave 97, Find number 168, 175, and 179#

1. tb 61.7; cr 2.0; pc 25.4;gr 22.4; ab 11.9; rest -
2. (III)-V; old white, blue-grey, black
3. very small; 27mm
4. (-)
5. occipital (sl), teeth, mandible (mandibular process), parietal (ss), humerus, ulna/radius, femur
6. saggital suture not fused: **infant II to adult**
7. **undet.**
8. Ms1: 2.3mm; Ms19: 2.2mm; Ms28: [2.6mm]
9. with body burial of an adult, sex unknown

Complex 115, Grave 101, Find number 180#

1. tb 21.5; cr -; pc 2.3; gr 19.2 (unburned); ab -; rest -
2. V; beige, old white
3. very small; 24mm
4. –
5. humerus; parietal, ribs, femur, phalanges, tibia unburned
6. **juvenile o.o**.
7. **undet.**
8. –
9. with body burial of an infant

Complex 117, Find number 173

1. tb 0.8; cr -; pc 0.8; gr -; ab -; rest -
2. V; beige, old white
3. medium; 24mm
4. –
5. long bone fragments
6. **infant I to II**
7. **undet.**
8. –
9. no evidence for multiple cremations or animal bones

Wandersleben

Complex 1, Inventory number 402/81

1. tb 64.7; cr 12.1; pc 52.6; gr -; ab -; rest -
2. III-V; beige, old white, grey
3. very small; 43mm
4. (–)
5. calotte (suture), ribs, humerus, radius, ulna, phalange I, femur, tibia
6. suture not fused inside or outside: **juvenile o.o**.
7. medium to robust: **undet.**
8. Ms1: 3.7mm (2.7 4.2 4.0 3.5 3.9 3.7); Ms28: 2.6mm; Ms50: 8.2mm
9. cremation at the bottom of vessel

Complex 2, Inventory number 406, 408, 409 and 410/81

1. tb 161.9; cr 42.0; pc 119.9; gr -; ab -; rest -
2. III-V; beige, old white, blue-grey
3. very small; 38mm
4. (+)
5. mandible, parietal (suture), occipital (suture), frontal, pars petrosa, clavicle, ribs, pelvis, radius, ulna, phalange femur, tibia
6. sutures not fused inside and outside: **juvenile o.o**.
7. gracile: **undet.**
8. Ms1. 3.4mm (4.1 2.5 3.0 2.1 3.0 3.3 2.7 3.0 3.2 3.7 5.6. 4.4 3.5 3.2); Ms43: [9.0mm]; Ms50: 9.4mm 6.6mm
9. cremation

Complex 3, Inventory number 589/81

1. tb 10.0; cr 0.3; pc 9.7; gr -; ab -; rest -
2. V; old white
3. very small; 35mm
4. –
5. calotte, humerus, tibia
6. **infant**
7. gracile to medium: **undet.**
8. Ms28: 2.3mm; Ms50: 4.9mm
9. concentration of pottery shards

Complex 4, Inventory number 413, 414 and 417/81

1. tb 66.5; cr 16.4; pc 50.1; gr -; ab -; rest -
2. II-V; beige, old white, milky-blue, grey, grey, black
3. small; 41mm
4. (+)
5. parietal, occipital, mandible, ribs, humerus, radius (prox. epiphysis), femur, tibia
6. **juvenile o.o**.
7. medium: **undet.**
8. Ms1: 4.7mm; Ms32: 18.5mm; Ms50: 7.6mm
9. cremation in vessel

Complex 5, Inventory number 420/81

1. tb 25.7; cr 14.9; pc 10.8; gr -; ab -; rest -
2. III-V; beige, old white, milky white, chalky, grey
3. very small; 37mm
4. –
5. pats petrosa, parietal (ss), ribs, humerus, radius
6. saggital suture fused inside: **late adult o.o.**
7. gracile to medium robustness: **undet.**
8. Ms1: 3.1mm (4.0 4.3 2.0 2.5 3.1 3.6 2.2 3.2 3.3)
9. cremation

Complex 6, Inventory number 425/81

1. tb 21.1; cr 5.0; pc 16.1; gr -; ab -; rest -
2. V; beige
3. very small; 38mm
4. (+)
5. calotte (suture), ribs, long bone fragments
6. **infant I**
7. gracile: **undet.**
8. Ms1: 1.7mm (2.2 1.4 1.2 2.1)
9. cremation in vessel W26, together with late adult cremation 430/81

Complex 6, Inventory number 430/81

1. tb 53.2; cr 8.0; pc 45.2; gr -; ab -; rest -
2. II/V; beige, old white, blue-grey
3. very small; 36mm
4. (–)
5. parietal, pars petrosa, calotte (suture), humerus, radius, ulna, femur tibia
6. saggital suture fused inside and outside: **late adult o.o.**
7. **undet.**
8. Ms1: 3.8mm; Ms28: 1.7mm; Ms43: 7.3-7.8mm
9. cremation together with cremation of infant 425/81

Complex 8, Inventory number 434, 437, 438, 439 and 440/81

1. tb 208.1; cr 63.0; pc 145.1; gr -; ab -; rest -
2. III-V; beige, old white, milky white, blue-grey, grey
3. small; 56mm
4. +
5. occipital (2x sl), temporal, parietal (ss), teeth (premolar bottom right, incisor), zygomatic (suture frontozygommatica), maxilla, frontal (orbit), vertebra (vc), ribs, scapula, humerus, radius, femur, tibia, fibula
6. lambdoidal suture fused inside, beginning to fuse outside, saggital suture not fused, vertebral body fused, tooth roots closed: **adult to mature**
7. edge of orbit sharp, medium robustness: **(♀)**
8. Ms1: 4.2mm (2.9 3.2 3.5 4.3 4.5 5.0 3.8 4.7 3.6 5.3 3.8 5.2 4.6 4.5); Ms9: 9.9mm; Ms43: 6.4mm; Ms50: 9.4mm
9. cremation , two calotte pieces from the two vessels could be fit together.

Complex 9, Inventory number 443/81

1. tb 28.6; cr 8.7; pc 19.9; gr -; ab -; rest -
2. (III)-V; beige, old white, grey
3. very small; 46mm
4. –
5. calotte, radius (BSIII), femur
6. **undet.**
7. **undet.**
8. Ms33: 1.6mm
9. cremation next to an inside vessel

Complex 10, Inventory number 457/81

1. tb 4.1; cr -; pc 4.1; gr -; ab -; rest -
2. IV-V; old white, milky white, light grey
3. very small; 23mm
4. –
5. long bone fragments
6. **undet.**
7. **undet.**
8. –
9. cremation

Complex 11, Inventory number 462/81

1. tb 122.3; cr 54.5; pc 67.8; gr -; ab -; rest -
2. V; beige, old white
3. small; 50mm
4. (–)
5. occipital, parietal (ss), calotte (sc), mandible, humerus, radius, femur, tibia
6. coronal and saggital suture fused: **adult to mature**
7. medium to robust: **undet.**
8. Ms1: 4.5mm (5.2 2.9 4.3 4.0 5.1 4.9 4.5 4.4 5.0 4.3); Ms28: 2.4mm; Ms43: 7.5mm; Ms50: 9.2-9.5mm
9. cremation next to vessel

Complex 12, Inventory number 474, 475 and 476/81

1. tb 235.7; cr 51.3; pc 184.4; gr -; ab -; rest -
2. IV-V; beige, old white, milky white, blue-grey
3. very small; 32mm
4. (–)
5. calotte (suture), pars petrosa (lt.), parietal (bregma), frontal (sc), occipital, humerus, radius, ulna, femur, tibia
6. bregma sutures not fused, coronal suture fused inside: **adult to mature**
7. pars petrosa flat angle, sharp entrance, medium to robust: **(♂)**
8. Ms1: 3.7mm (3.7 3.9 3.7 2.9 3.2 4.7 4.4 3.7 3.0 3.1 3.5 3.8 4.5); Ms33: 2.4mm; Ms39: 40-42mm. 50mm; Ms43: 5.1mm; Ms50: 9.4mm
9. cremation

Complex 13, Inventory number 1195/81

1. tb 17.5; cr 12.4; pc 5.1; gr -; ab -; rest -
2. V; beige, old white
3. very small; 37mm
4. –
5. occipital, parietal (ss), humerus
6. **undet.**
7. **undet.**
8. Ms1: 2.5mm (2.6 2.2 3.4 2.6 1.9); Ms28: 2.6mm
9. cremation

Complex 14, Inventory number 1202 and 1198/81

1. tb 185.9; cr 41.6; pc 144.3; gr -; ab -; rest -
2. III-V; beige, old white, milky white, chalky, grey
3. very small; 80mm
4. (–)
5. pars petrosa (rt. and lt.), calotte (suture), occipital (sl), frontal (orbit), vertebra, humerus, radius, ulna, femur, tibia
6. suture not fused, lamda suture fused inside: **juvenile o.o.**
7. pars petrosa: **(♀)**
8. Ms1: 3.8mm (4.9 3.4 3.8 4.3 4.0 3.0 3.7 2.8 3.9 4.4); Ms43: 7.8mm; Ms50: 6.1mm
9. cremation with vessel 1201/81

Complex 15, Inventory number 1296 and 1269/81

1. tb 50.0; cr 17.4; pc 32.6; gr -; ab -; rest -
2. III-V; beige, old white, grey
3. very small; 35mm
4. (–)
5. parietal, cranial bas, pars petrosa, calotte (suture) humerus, ulna, ribs, femur, fibula
6. suture fused: **juvenile o.o.**
7. medium robustness: **undet.**
8. Ms1: 3.6mm (3.2 2.8 3.5 3.7 3.9 3.6 4.9)
9. cremation next to vessel

Complex 17, Inventory number 1275/81

1. tb 29.8; cr 8.2; pc 21.6; gr -; ab -; rest -
2. III-V; beige, old white, grey
3. very small; 27mm
4. (–)
5. occipital (sl), tibia
6. **undet.**
7. **undet.**
8. –
9. cremation

Complex 20, Inventory number 1282, 1284 and1286/81

1. tb 225.2; cr 113.6; pc 111.6; gr -; ab -; rest -
2. III-V; beige, old white, milky white, chalky, blue-grey
3. very small; 39mm
4. +
5. occipital (sl), pars petrosa (lt.), parietal, temporal (mastoid process), teeth (incisor, premolar, molar, upper 1st or 2nd molar), vertebra (dens axis), pelvis, scapula, humerus (prox. epiphysis), femur, tibia, talus b. BS II radius, ulna, phalange, femur (prox. epiphysis), tibia, fibula, talus
6. roots closed, humerus and femur prox. epiphysis not fused: **infant II to juvenile**
7. pars petrosa steep, entrance round: **(♀)**
8. Ms1: 3.6mm (4.5 2.8 3.2 3.0 3.0 3.5 2.4 3.5 3.8 4.7 4.4 3.8 3.8 4.4 4.8 3.3 3.4 2.9); Ms28: 3.7mm 2.5mm; Ms33: 2.7mm 1.5mm; Ms48: 4.8mm; Ms50: 10.4mm
9. 2 vessels either an infant to a juvenile and a juvenile to adult, or one juvenile; cremation outside of vessel

Complex 21, Inventory number 1289 and 1299/81

1. tb 133.4; cr 21.4; pc 112.0; gr -; ab -; rest -
2. IV-V; beige, old white, milky white, chalky
3. very small; 48mm
4. (+)
5. occipital, parietal (ss), tooth, ribs, humerus, radius, ulna, femur (linea aspera), tibia
6. saggital suture fused outside: **adult**
7. medium to robust, linea aspera strong: **(♂)**
8. Ms28: 1.8mm; Ms33: 1.9mm; Ms43: 10.1mm; Ms44: 4.4mm; Ms50: 6.9mm
9. cremation in vessel

Complex 22, Inventory number 1292/81

1. tb 196.5; cr 69.1; pc 127.4; gr -; ab -; rest -
2. III-V; beige, old white, blue-grey
3. very small; 42mm
4. (–)
5. parietal (ss), frontal (sc, orbit), pars petrosa, temporal (mastoid process), humerus, femur
6. coronal suture not fused: **juvenile to adult**
7. edge of orbit sharp: **(♀)**
8. Ms1: 3.8mm (3.2 2.6 4.4 4.1 4.2 4.5 3.9 2.2 4.4 4.8)
9. cremation

Complex 24, Inventory number 112, 113 and 114/82

1. tb 196.6; cr 48.4; pc 148.2; gr -; ab -; rest -
2. III-V; beige, old white, blue-grey, black
3. very small; 42mm
4. (+)
5. calotte, frontal (sc), pars petrosa (lt.), mandible, vertebra, pelvis, ribs, humerus, radius, ulna, femur, tibia
6. **juvenile o.o.**
7. gracile, pars petrosa steep angle, round entrance: **(♀)**
8. Ms1: 3.0mm (2.9 4.0 3.1 4.0 3.7 3.2 2.9 2.3 2.4 1.7 2.5 3.1); Ms28: 2.6mm; Ms33: 2.4mm; Ms50: 7.3mm
9. cremation in vessel

Complex 26, Inventory number 123/82

1. tb 42.2; cr 24.5; pc 17.7; gr -; ab -; rest -
2. IV-V; beige, old white, milky white, chalky, blue-grey
3. very small; 28mm
4. (+)
5. calotte, pars petrosa (lt.), ribs, long bone fragments
6. very gracile: **infant II**
7. pars petrosa steep angle: **(♀)**
8. Ms1: 1.7mm (1.4 1.4 1.2 1.3 2.0 1.1 1.4 1.8 3.0 2.2)
9. cremation

Complex 27, Inventory number 124/82

1. tb 219.5; cr 35.9; pc 183.6; gr -; ab -; rest -
2. III-V; beige, old white, grey
3. very small; 47mm
4. (+)
5. mandible (mandibular condyle, piece 41-44), occipital, parietal (ss), zygomatic, teeth (incisor and molar), ribs, pelvis, vertebra, humerus, radius, ulna, femur
6. roots closed: **infant II o.o.**
7. gracile: **undet.**
8. Ms1: 3.8mm (5.9 4.0 3.0 3.1 3.9 2.7); Ms17: 12.1mm; Ms18: 7.2mm; Ms28: 2.2mm; Ms33: 1.6mm
9. cremation

Complex 28, Inventory number 127/82

1. tb 140.5; cr 26.7; pc 113.8; gr -; ab -; rest -
2. V; beige, old white
3. small; 39mm
4. +
5. occipital (emenetia cruciform), parietal (ss), pelvis, vertebra, ribs, humerus (prox. epiphysis), ulna (distal), phalanges, patella (rt.)
6. saggital suture not fused: **juvenile o.o.**
7. gracile to medium, occipital muscle attachments heavy: **(♀)**.
8. Ms1: 2.7mm (2.4 2.2 2.1 4.1 3.0 2.7 1.8 3.2 2.1 3.0); Ms27 or 39: 40mm; Ms45: 29.1mm; Ms46: 28mm; Ms47: 13.8mm
9. cremation

Complex 29, Inventory number 129/82

1. tb 47.2; cr 6.0; pc 41.2; gr -; ab -; rest -
2. V; beige, old white
3. very small; 39mm
4. (+)
5. calotte, ribs, humerus, ulna, radius, tibia
6. **undet.**
7. **undet.**
8. Ms1: 3.2mm (3.4 2.5 3.3 2.9); Ms33: 2.4mm; Ms50: 6.6mm
9. cremation

Complex 30, Inventory number 132, 133, 134 and 135/82

1. tb 112.6; cr 17.0; pc 95.6; gr -; ab -; rest -
2. III-V; beige, old white, milky white, grey
3. very small; 45mm
4. (+)
5. calotte (suture), vertebra (vc), ribs, scapula, humerus, radius, ulna, metacarpals, femur, tibia, calcaneous, metatarsal (proximal) b. occipital (from child), pelvis
6. vertebral corpus fused: **late juvenile o.o. (+ infant)**
7. gracile to medium: **undet.**
8. Ms1: 4.4mm
9. cremation in vessel, probably an adult together with an infant

Complex 31, Inventory number 136 and138/82

1. tb 103.9; cr 46.5; pc 57.4; gr -; ab -; rest -
2. IV-V; beige, old white, milky white, chalky, blue-grey
3. very small; 55mm
4. (–)
5. occipital (sl), parietal (sl), humerus, radius, ulna, tibia, fibula
6. lambdoidal suture not fused: **adult to mature**
7. muscle markings strong, robust: **undet.**
8. Ms1: 4.3mm (3.8 4.0 6.4 5.7 3.4 4.2 2.6); Ms28: 1.8mm; Ms33: 1.9mm; Ms50: 7.0mm
9. cremation

Complex 32, Inventory number 140/82

1. tb 0.4; cr -; pc 0.4; gr -; ab -; rest -
2. IV; milky white
3. very small; 15mm
4. –
5. long bone fragments
6. **undet.**
7. **undet.**
8. –
9. cremation

Complex 34, Inventory number 142 and 144/82

1. tb 18.4; cr 3.7; pc 14.7; gr -; ab -; rest -
2. II-IV; milky white, chalky, blue-grey, grey
3. very small; 34mm
4. –
5. calotte, pars petrosa, humerus, radius
6. **undet.**
7. **undet.**
8. –
9. cremation

Complex 36, Inventory number 145 and 148/82

1. tb 61.8; cr 15.6; pc 46.2; gr -; ab -; rest -
2. IV-V; beige, old white, milky white, light grey
3. very small; 36mm
4. (+)
5. calotte, parietal (ss), ribs, humerus, ulna, femur
6. **juvenile o.o.**
7. gracile: **undet.**
8. Ms1: 3.4mm (4.1 4.3 2.7 2.4 3.4); Ms28: 2.1mm
9. cremation outside of vessel

Complex 38, Inventory number 154/82

1. tb 9.4; cr 8.9; pc 0.5; gr -; ab -; rest -
2. IV-V; beige, old white, blue-grey
3. very small; 37mm
4. –
5. occipital, pars petrosa, calotte (suture)
6. **infant I**
7. gracile, pars petrosa steep angle, entrance round: **(♀)**
8. Ms1: 1.9mm (2.2 1.7 2.2 1.7)
9. cremation

Complex 39, Inventory number 155/82

1. tb 5.4; cr 1.4; pc 4.0; gr -; ab -; rest -
2. IV-V; beige, old white, milky, light grey
3. very small; 24mm
4. –
5. occipital, femur
6. **undet.**
7. **undet.**
8. –
9. cremation

Complex 43, Inventory number 170 and 171/82

1. tb 9.9; cr 3.4; pc 6.5; gr -; ab -; rest -
2. V; beige, old white
3. very small; 36mm
4. (–)
5. parietal, rib, femur
6. **juvenile o.o.**
7. **undet.**
8. Ms1: 4.4mm; Ms43: 4.5-6.2mm
9. cremation

Complex 44, Inventory number 173 and 174/82

1. tb 29.8; cr 3.7; pc 26.1; gr -; ab -; rest -
2. III-V; beige, old white, milky white, chalky, blue-grey
3. very small; 27mm
4. (–)
5. calotte, vertebra (dens axis), humerus, femur, tibia
6. **undet.**
7. gracile: **undet.**
8. Ms50: 5.0mm
9. cremation next to vessel

Complex 45, Inventory number 174 and 177/82

1. tb 226.1; cr 68.1; pc 158.0; gr -; ab -; rest -
2. IV-V; beige, old white, milky white, light grey
3. small; 39mm
4. (+)
5. mandible (mandibular condyle), calotte (suture), parietal, pars petrosa (rt.), maxilla (spina nasalis), tooth (bottom 2nd molar), ribs, humerus (proximal), radius, ulna, femur
6. **infant II**
7. pars petrosa steep, entrance round: **(♀)**
8. Ms1: 2.7mm (2.0 2.7 3.1 3.3); Ms17: 13.4mm; Ms18: 7.9mm; Ms28: 1.9mm; Ms33: 1.7mm 1.4mm
9. 2 sub-adult cremations because in two vessels?

Complex 46, Inventory number 183 and 666/82

1. tb 3.0; cr 3.0; pc -; gr -; ab -; rest -
2. IV-V; beige, old white, milky white, chalky
3. very small; 21mm
4. –
5. calotte fragments
6. **undet.**
7. **undet.**
8. Ms1: 2.9mm (2.8 2.1 1.6 1.7 1.9)
9. cremation next to vessel

Complex 47

1. tb 162.7; cr 87.8; pc 74.9; gr -; ab -; rest -
2. II-V; beige, old white, milky white, blue-grey, grey, black
3. small; 70mm
4. (+)
5. parietal (ss), occipital, mandible, ribs, vertebra (facies articularis), ulna, radius, femur, tibia, talus
6. saggital and lambdoidal sutures not fused: **juvenile to adult**
7. **undet.**
8. Ms1: 3.3mm (2.5 2.9 3.5 4.7 2.6 4.3 3.8 3.6 2.6 2.9); Ms28: 1.6mm; Ms33: 1.3mm; Ms50: 4.3mm
9. cremation between two vessels

Complex 48, Inventory number 190 and 191/82

1. tb 3.2; cr 1.7; pc 1.5; gr -; ab -; rest -
2. IV-V; beige, old white
3. very small; 21mm
4. (–)
5. calotte, ribs, long bone fragments
6. **juvenile o.o.**
7. **undet.**
8. Ms1: 5.4mm
9. cremation

Complex 49, Inventory number 194 and 196/82

1. tb 71.0; cr 12.4; pc 58.6; gr -; ab -; rest -
2. V; beige, old white
3. small; 38mm
4. (–)
5. occipital (sl), ribs, radius, femur/tibia
6. lambdoidal suture not fused: **juvenile o.o.**
7. medium to robust: **undet.**
8. Ms28: 1.3mm; Ms50: 7.2mm
9. cremation, 2 individuals?

Complex 50, Inventory number 198/82

1. tb 34.6; cr 34.6; pc -; gr -; ab -; rest -
2. III-V; beige, old white, blue-grey, grey
3. very small
4. –
5. temporal (mastoid process), occipital (linea nuchalis), calotte (suture
6. suture not fused: **juvenile to mature**
7. robust: **(♂)**
8. –
9. cremation

Complex 53, Inventory number 204, 205, 206 and 207/82

1. tb 59.7; cr 12.4; pc 47.3; gr -; ab -; rest -
2. II-V; beige, old white, milky white, chalky, grey
3. very small; 32mm
4. (+)
5. calotte, parietal (ss), humerus, phalange (distal), ribs
6. **juvenile o.o.**
7. **undet.**
8. Ms1: 4.0mm (3.6 2.8 3.0 5.3 5.0 4.4 3.3 4.2 3.7 4.2)
9. cremation next to ceramic shards

Complex 54, Inventory number 208 and 210/82

1. tb 20.0; cr 6.0; pc 14.0; gr -; ab -; rest -
2. III-V; beige, old white, milky white, blue-grey, grey
3. very small; 20mm
4. (–)
5. calotte, parietal (ss), humerus
6. saggital suture fused inside: **adult o.o.**
7. **undet.**
8. Ms1: 4.2mm (BSIII) (3.6 4.2 4.1 5.0 3.6 5.2)
9. cremation in vessel

Complex 55, Inventory number 212/82

1. tb 87.9; cr 16.1; pc 71.8; gr -; ab -; rest -
2. III-V; beige, old white, milky, light grey, blue-grey
3. very small; 31mm
4. (–)
5. calotte fragments, humerus, radius, femur, tibia
6. **undet.**
7. **undet.**
8. Ms1: 2.8mm (2.4 2.3 2.3 3.2 2.6 4.8 2.7 2.2 2.3 2.7); Ms28: 1.9; Ms50: 7.1mm
9. cremation

Complex 56, Inventory number 215/82

1. tb 1.0; cr -; pc 1.0; gr -; ab -; rest -
2. IV; old white, milky white
3. very small
4. –
5. long bone fragments
6. **undet.**
7. **undet.**
8. –
9. cremation with ceramic shards

Complex 57, Inventory number 219/82

1. tb 1.2; cr -; pc 1.2; gr -; ab -; rest -
2. V; beige, old white
3. very small
4. –
5. long bone fragments
6. **undet.**
7. **undet.**
8. –
9. cremation

Complex 62, Inventory number 233/82

1. tb 390.0; cr 74.2; pc 315.8; gr -; ab -; rest -
2. III-V; beige, old white
3. very small; 21mm
4. +
5. parietal (ss), occipital (sl), mandible (with alveolar 7 or 8), teeth (premolar, molar), vertebra, ribs, radius, ulna, femur, tibia, fibula
6. saggital suture fused inside and outside, lamda suture not fused, vertebral corpus fused, tooth roots closed: **mature**
7. gracile: **undet.**
8. Ms1: 3.4mm (3.0 3.4 3.3 3.1 3.4 3.8 3.4 3.6 3.9 2.9 3.0); Ms33: 2.0mm; Ms43: 9.1mm; Ms50: 10.8mm
9. cremation

Complex 73, Inventory number 225 and 230/82

1. tb 166.4; cr 42.8; pc 123.6; gr -; ab -; rest -
2. IV-V; beige, old white
3. small; 46mm
4. +
5. parietal (bregma, ss), occipital (sl), zygomatic, tooth (molar), ribs, vertebra (vc), pelvis (incisura ischiatica lt.), humerus, ulna, radius, femur, tibia
6. molar very small, bregma sutures not fused, saggital suture not fused, lambdoidal suture not fused: **juvenile to mature**
7. pelvis, incisura isiadica arcus compose: **(♀)**
8. Ms1: 4.3mm (4.1 4.7 3.6 4.2 4.1 3.8 5.4 4.0 4.1 4.8); Ms27: 40-42mm
9. cremation between two vessels

Complex 75, Inventory number 236/82

1. tb 213.4; cr 30.2; pc 183.2; gr -; ab -; rest -
2. V; beige, old white
3. small; 46mm
4. +
5. calotte (suture), mandible, teeth (premolar, 3rd molar), ribs, pelvis, radius, ulna, phalange, tibia, fibula, talus
6. 3rd molar and premolar roots closed, suture fused inside: **adult**
7. **undet.**
8. Ms1: 2.7mm (2.7 3.3 1.9 2.2 4.0 3.7 2.6 2.0 2.8 2.5); Ms33: 1.9mm
9. cremation

Complex 82, Inventory number 241/82

1. tb 79.5; cr 24.0; pc 55.5; gr -; ab -; rest -
2. II-V; beige, old white, milky white, blue-grey
3. small; 25mm
4. +
5. cranial base, temporal (mastoid process), parietal (ss), occipital, zygomatic, clavicle (lt.), ribs, vertebrae, humerus, ulna, femur, metatarsus
6. saggital suture not fused: **juvenile o.o.**
7. **undet.**
8. Ms1: 2.6mm (2.0 2.7 3.1 2.7 2.9 2.5 2.5 2.8 2.6 2.6); Ms28: 2.5mm
9. cremation

Complex 83, Inventory number 245/82

1. tb 403.5; cr 42.1; pc 361.4; gr -; ab -; rest -
2. II-V; beige, old white, milky, blue-grey, grey, black
3. very small; 38mm
4. +
5. pars petrosa, teeth (canine, premolar, molar), temporal (fossa articularis rt.), parietal (ss), occipital, mandible, maxilla, pelvis (acetabulum), vertebrae, ribs, humerus (prox. epiphysis), radius (prox. epiphysis), phalange, femur (prox. epiphysis), tibia (prox. epiphysis), talus
6. tooth roots closed, lambdoidal suture not fused: **juvenile to mature**
7. medium to robust: **undet.**
8. Ms1: 3.4mm (2.7 3.8 4.2 4.5 4.4 2.4 2.5 3.9 2.8 3.8 3.5 3.8 3.8 3.2 2.6 2.6 3.1 3.5 3.4 4.1); Ms26: 1.8mm; Ms27: 42mm; Ms28: 1.8-2.4mm; Ms32: 11.7mm; Ms33: 1.8mm 2.1; Ms39: 44-46mm; Ms44: 8.5mm; Ms50: 8.4mm
9. cremation

Complex 85, Inventory number 253 and 254/82

1. tb 59.1; cr 29.1; pc 30.0; gr -; ab -; rest 0.5
2. III-V; beige, old white, blue-grey
3. small; 56mm
4. (–)
5. parietal (bregma), occipital, humerus, radius, phalange (distal), femur (linea aspera), tibia
6. distal epiphysis of phalange fused, bregma fused: **juvenile to mature**
7. medium to robust: **(♂)**
8. Ms1: 5.2mm (5.8 5.1 4.7); Ms33: 3.0mm; Ms43: 7.5-8.4mm
9. cremation buried above a body burial

Complex 86, Inventory number 254 and 260/82

1. tb 16.2; cr 12.1; pc 14.1; gr -; ab -; rest -
2. V; beige, old white, milky white
3. small; 43mm
4. (–)
5. parietal, frontal, pars petrosa (lt.), calotte (suture), ribs, humerus, radius, femur
6. radius: **infant II**
7. gracile, pars petrosa entrance round: **undet.**
8. Ms33: 1.5mm 2.1mm
9. cremation with vessel

Complex 87, Inventory number 264/82

1. tb 18.2; cr 6.4; pc 11.8; gr -; ab -; rest -
2. III-V; beige, old white, milky white, chalky, light grey, blue-grey, grey
3. small; 31mm
4. –
5. occipital (sl), radius, ulna, femur
6. **undet.**
7. **undet.**
8. –
9. cremation

Complex 88, Inventory number 266/82

1. tb 3.4; cr -; pc 3.4; gr -; ab -; rest -
2. IV; milky white
3. medium; 36mm
4. –
5. humerus
6. **undet.**
7. medium: **undet.**
8. –
9. cremation 1 piece

Complex 90, Inventory number 286/82

1. tb 340.2; cr 14.7; pc 325.5; gr -; ab -; rest -
2. III-V; beige, old white, milky white, blue-grey
3. very small; 39mm
4. (+)
5. parietal, occipital, vertebrae, ribs, humerus, radius (prox. epiphysis), phalange, femur, tibia (prox. epiphysis)
6. tibia epiphysis not fused, vertebral corpus fused: **juvenile to early adult**
7. **undet.**
8. Ms1: 2.8mm (3.3 2.8 2.4 2.6 2.1 3.1 3.4 3.3 2.4); Ms27: 3.8mm; Ms28. 3.4mm; Ms32: 16.3mm; Ms33 3.3mm 4.0mm; Ms50: 8.6mm 11.5mm
9. cremation

Complex 91, Inventory number 275, 276 and 277/82

1. tb 14.1; cr 6.2; pc 7.9; gr -; ab -; rest -
2. V; beige, old white
3. very small; 25mm
4. –
5. temporal (tuberculum articulare), frontal, calotte (suture), facial skeleton (undet.), vertebrae, humerus,
6. suture fused inside: **juvenile o.o.**
7. gracile to medium: **undet.**
8. –
9. cremation

Complex 93, Inventory number 281/82

1. tb 4.6; cr -; pc 4.6; gr -; ab -; rest -
2. III-IV; milky white, chalky, blue-grey
3. small; 28mm
4. –
5. humerus
6. **undet.**
7. **undet.**
8. Ms28: 2.9-3.5mm
9. cremation 2 pieces

Complex 94, Inventory number 283/82

1. tb 12.4; cr 10.8; pc 1.6; gr -; ab -; rest -
2. (II)-V; beige, old white, milky white, chalky, blue-grey, grey, (dark brown)
3. medium; 47mm
4. (–)
5. parietal (BS II), pars petrosa, ribs
6. **undet.**
7. pars petrosa round, smooth: **undet.**
8. –
9. cremation 2 pieces

Complex 97, Inventory number 290/82

1. tb 6.8; cr -; pc 6.8; gr -; ab -; rest -
2. III-V; beige, old white, black
3. very small
4. –
5. tibia
6. **undet.**
7. **undet.**
8. Ms50: 7.9mm
9. cremation 4 pieces

Complex 98, Inventory number 291 and 292/82

1. tb 145.2; cr 36.5; pc 108.7; gr -; ab -; rest -
2. III-V; beige, old white, milky white, chalky, blue-grey, grey
3. small; 46mm
4. (+)
5. calotte (suture), occipital, parietal (ss), spina mentalis, tooth (molar), pars petrosa (rt.), ribs, pelvis, vertebrae, humerus (prox. epiphysis), radius, ulna, lunate, phalange, femur (prox. epiphysis), fibula
6. tooth root not closed: **infant II to juvenile**
7. medium robustness: **undet.**
8. Ms1: 3.2mm (3.8 3.4 2.2 3.2 3.8 2.4 4.4 2.2); Ms27: 40mm; Ms28: 1,8 mm 2,2mm; Ms39: 42 to 50mm; Ms44: 3.1mm
9. cremation

Complex 99, Inventory number 293, 294 and 295/82

1. b 28.7; cr 7.5; pc 21.2; gr -; ab -; rest -
2. V; beige, old white
3. very small; 43mm
4. (–)
5. calotte, parietal (suture), humerus, radius, ulna, tibia
6. **undet.**
7. gracile: **undet.**
8. Ms1: 2.7mm; Ms28: 2.5mm; Ms33: 1.9mm 2.0mm; Ms50: 7.6mm
9. cremation

Complex 101, Inventory number 604/82

1. tb 39.3; cr 10.5; pc 28.8; gr -; ab -; rest -
2. IV-V; beige, old white
3. very small; 28mm

4. (–)
5. occipital (sl), ribs, vertebrae, humerus, radius
6. lambdoidal 2 fused inside: **senile**
7. gracile to medium robustness: **undet.**
8. Ms1: 2.5mm
9. cremation next to vessel 1

Complex 103, Inventory number 639/82

1. tb 6.2; cr -; pc 6.2; gr -; ab -; rest -
2. V; old white, milky white, chalky
3. very small; 63mm
4. –
5. humerus
6. **undet.**
7. **undet.**
8. Ms28: 2.0mm
9. cremation 1 piece

Complex 104, Inventory number 610 and 611/82

1. tb 225.8; cr 80.4; pc 145.4; gr -; ab -; rest -
2. III-V; beige, old white, milky white, chalky, blue-grey, grey
3. very small; 59mm
4. \+
5. pars petrosa (2x), parietal (ss, bregma), occipital, temporal (sutura mastoidea), mandible (lingua oblique, alveolar 3rd molar), scapula, ribs, pelvis (facies articularis), humerus, radius, ulna (distal), phalange, femur, tibia, talus (2x), metatarsus (proximal)
6. saggital suture fused inside: **adult to early mature**
7. pars petrosa round entrance, sharp angle, sutura mastoidea prominent (♀?): **undet.**
8. Ms2: 4.6mm (4.3 4.1 4.2 4.8 4.8 3.8 5.0 5.8); Ms16: 16.5mm; Ms28: 3.1mm; Ms43: 8.5mm; Ms50: 8.4mm 9.5mm
9. cremation between vessel 1 and 2

Complex 107/109, Inventory number 621 and 623/82

1. tb 27.0; cr 20.1; pc 6.9; gr -; ab -; rest -
2. IV-V; old white, milky white, chalky, blue-grey, grey
3. small; 36mm
4. (–)
5. calotte (suture), occipital, ribs, humerus, femur
6. lambdoidal suture fused inside, almost fused outside: **adult o.o**.
7. medium to robust: **undet.**
8. –
9. cremation

Complex 110, Inventory number 627/82

1. tb 314.4; cr 29.0; pc 285.4; gr -; ab -; rest -
2. III-V; beige, milky white, blue-grey
3. very small; 51mm
4. (–)
5. parietal (ss), calotte, vertebrae, ribs, pelvis, humerus, radius, ulna, femur (prox. epiphysis), patella, tibia (prox. epiphysis), talus (2x)
6. epiphysis not fused, vertebral body fused: **juvenile to early adult**
7. **undet.**
8. Ms1: 4.5mm (3.9 4.0 3.4 4.2 5.2 5.6 5.3); Ms33: 3.0mm; Ms44: 36mm; Ms50: 11.4mm; Ms56: 26.2mm
9. cremation

Complex 111, Inventory number 629/82

1. tb 16.6; cr 7.3; pc 9.3; gr -; ab -; rest -
2. IV-V; beige, milky white, blue-grey
3. very small; 29mm
4. (–)
5. calotte, mandible, ribs, humerus
6. **infant I**
7. gracile: **undet.**
8. Ms1: 2.0mm (2.1 1.6 2.2 1.7 2.3 2.0 2.1 1.8); Ms28: 1.3mm
9. cremation

Complex 114, Inventory number 499/82

1. tb 12.3; cr 6.9; pc 5.4; gr -; ab -; rest -
2. V; beige
3. very small; 30mm
4. –
5. calotte and long bone fragments
6. **undet.**
7. **undet.**
8. Ms1: 3.1mm (3.2 3.7 3.5 3.2 2.6 2.6)
9. cremation outside vessel 131

Complex 118, Inventory number 635/82

1. tb 55.0; cr 9.7; pc 45.3; gr -; ab -; rest -
2. V; beige
3. very small; 33mm
4. +
5. occipital, parietal (ss), tooth (deciduous premolar), tuberculum articulare, ribs, vertebrae, humerus (proximal epiphysis), radius, femur
6. epiphysis not fused, deciduous premolar root closed: **infant I**
7. gracile: **undet.**
8. Ms33: 1.1mm; Ms44: 2.3mm
9. cremation

Complex 119, Inventory number 541/82

1. tb 569.3; cr 102.5; pc 71.8; gr 395.0; ab -; rest –
2. III-V; beige, old white, milky white, chalky, blue-grey
3. very small; 45mm
4. (+)
5. parietal, occipital (protuberancia), ribs, pelvis, vertebrae, humerus, phalange, femur (prox. epiphysis), metatarsus
6. **adult o.o.**
7. medium to robust, occipital very pronounced: **(♂)**
8. Ms1: 5.7mm (8.4 8.8 7.9 9.2 5.1 6.4 5.6); Ms28: 2.8mm; Ms32: 16.3mm
9. cremation

Complex 120, Inventory number 542/82

1. tb 37.3; cr 15.6; pc 21.7; gr -; ab -; rest -
2. III-V; beige, milky white
3. very small; 35mm
4. (–)
5. occipital (sl), parietal, radius, femur (linea aspera)
6. **juvenile o.o.**
7. medium to robust: **undet.**
8. Ms1: 3.3mm
9. cremation

Complex 127, Inventory number 547/82

1. tb 222.5; cr 36.7; pc 185.8; gr -; ab -; rest -
2. III-V; beige, old white, grey
3. very small; 33mm
4. (–)
5. parietal, mandible, ribs, vertebrae, humerus, radius, ulna, femur, tibia
6. **juvenile o.o.**
7. robust: **undet.**
8. Ms1: 5.2mm (5.8 5.9 4.7 3.7 3.7 5.5 5.6 6.2 5.6 5.8 5.7); Ms38: 2.5 Ms44: 5.4mm; Ms50: 7.7mm
9. cremation

Complex 129, Inventory number 550/82

1. tb 24.3; cr 2.9; pc 21.4; gr -; ab -; rest -
2. II/V; beige, old white, black
3. very small; 32mm
4. (–)
5. ribs, radius, femur
6. **undet.**
7. **undet.**
8. –
9. cremation

Complex 132, Inventory number 551/82

1. tb 33.9; cr 16.4; pc 17.5; gr -; ab -; rest -
2. III-V; beige, old white, milky white, blue-grey
3. very small; 39mm
4. (+)
5. occipital, pars petrosa, vertebrae, humerus, ulna
6. lambdoidal suture not fused: **juvenile o.o.**
7. **undet.**
8. –
9. cremation

Complex 133, Inventory number 486, 487, 488, 489 and 491/82

1. tb 444.1; cr 163.2; pc 280.9; gr -; ab -; rest -
2. IV-V; beige, old white, milky white, blue-grey
3. small; 50mm
4. +
5. occipital, parietal (S2/S3, parietal), frontal (crista frontalis, C1/C2), temporal, mandible (angulus mandibulare, tuberculum articulare, chin), pars petrosa (rt.) ribs, vertebrae (dens axis), scapula, pelvis (sulcus obturatum), humerus (prox. epiphysis), radius (prox. epiphysis), ulna, phalange (distal epiphysis), tuft, femur, tibia, fibula
6. all sutures not fused: **juvenile o.o.**
7. mandible round, gracile to medium, pars petrosa with sharp edge: ♀
8. Ms1: 3.7mm (3.8 3.2 4.3 3.0 3.3 4.0 3.2 4.7 4.2 3.2); Ms2: [15.9mm]; Ms27: 46mm; Ms28: 3.1 -3.6mm; Ms32: 17.3mm; Ms33: 2.9mm 2.4mm; Ms43 10.8mm 7.0mm; Ms50: 5.8mm
9. cremation from vessel 485/82 and 490/82; cranial pieces from 491/82 and 486/82 could be put together; still, maybe two adult individuals?

Complex 134, Inventory number 341/82

1. tb 11.7; cr 0.6; pc 11.1; gr -; ab -; rest -
2. III-IV; milky white, blue-grey, grey
3. very small; 27mm
4. –
5. calotte, radius, phalange, femur
6. **undet.**
7. **undet.**
8. Ms33: 1.9mm
9. cremation

Complex 147, Inventory number 559/82

1. tb 3.2; cr -; pc 3.2; gr -; ab -; rest -
2. V; beige, old white
3. small; 24mm
4. –
5. humerus, radius
6. **undet.**
7. gracile: **undet.**
8. Ms28: 2.8mm; Ms33: 2.7mm
9. cremation

Complex 148, Inventory number 560/82

1. tb 131.2; cr 28.6; pc 102.6; gr -; ab -; rest -
2. V; beige, old white
3. very small; 32mm
4. (+)
5. calotte (suture), vertebrae (vc), ribs, pelvis, humerus, radius, ulna, fibula, talus
6. vertebral corpus fused, suture fused: **juvenile o.o**.
7. gracile to medium: **undet.**
8. Ms1: 2.9mm (3.0 3.4 3.9 4.0 3.0 2.1 1.7 1.8 3.0 2.9); Ms33: 1.9mm; Ms50: 5.0mm
9. cremation

Complex 149, Inventory number 561/82

1. tb 118.9; cr 26.4; pc 92.5; gr -; ab -; rest -
2. IV-V; beige, old white, milky, blue-grey
3. very small; 43mm
4. +
5. mandible (collum), pars petrosa, vertebrae, ribs, pelvis, humerus, radius (prox. epiphysis), ulna, phalange, femur
6. **juvenile o.o.**
7. medium: **undet.**
8. Ms1: 3.6mm (2.9 3.3 2.4 4.2 3.1 3.9 5.3 4.8 3.2 2.9); Ms28: 2.5mm; Ms32: 16.0; Ms33: 1.8mm; Ms44: 4.7mm
9. cremation with ceramic shards and a wooden adze

Complex 150, Inventory number 564 and 565/82

1. tb 19.0; cr 11.8; pc 7.2; gr -; ab -; rest -
2. V; beige, old white
3. medium; 42mm
4. (–)
5. temporal (crista supramastoidea), parietal (sc), mandible (coronoid process rt.), occipital (sl), ribs, radius, phalange
6. coronal suture fused inside: **juvenile to mature**
7. gracile: **undet.**
8. Ms1. 3.8mm; Ms19: 2.0mm; Ms33: 2.4mm
9. cremation

Complex 151, Inventory number 568 and 570/82

1. tb 245.5 ; cr 36.5; pc 209.0; gr -; ab -; rest -
2. IV-V; beige, old white, milky white, blue-grey
3. small; 52mm
4. (+)
5. occipital (sl), parietal (ss), maxilla, ribs, pelvis, vertebrae, radius, ulna, femur (trochantor minor), tibia, fibula
6. lambdoidal suture not fused, saggital suture fused inside, vertebral corpus fused: **adult o.o.**
7. robust: **undet.**
8. Ms1: 3.3mm (3.0 3.4 1.7 4.7 3.8); Ms33: 1.9mm; Ms50: 8.0mm
9. cremation

Complex 152, Inventory number 485, 896, 897 and 900/81

1. tb 65.5; cr 21.2; pc 44.3; gr -; ab -; rest -
2. III/V; beige, old white, grey
3. small; 65mm
4. (–)
5. maxilla, occipital, temporal (rt. fossa mandibularis), humerus, radius, femur (proximal and distal epiphysis), tibia
6. **juvenile o.o.**
7. medium: **undet.**
8. Ms1. 4.7mm; Ms28: 3.1-3.5mm; Ms33: 2.3mm; Ms39: 52mm
9. cremation

Complex 157, Inventory number 575 and 576/82

1. tb 171.5; cr 97.3; pc 74.2; gr -; ab -; rest -
2. III-V; beige, old white, grey
3. small; 48mm
4. +
5. occipital (sl), frontal (orbit lt.), temporal, parietal, pars petrosa, mandible (mandibular process rt.), zygomatic, humerus, radius, ulna, phalange, femur (linea aspera, dist. epiphysis lt.), tibia, fibula, talus (lt.)
6. lambdoidal suture fused inside, asterion fused inside, saggital suture fused inside, bottom 2nd molar root closed: **mature**
7. medium robustness, pars petrosa entrance round, orbit sharp: **(♀)**
8. Ms1: 3.1mm (3.5 3.3 3.8 2.7 2.1 2.6 4.4 2.4 2.5 3.3 3.8 3.1); Ms43: 5.5-5.8mm 6.2mm; Ms44: 6.9mm
9. cremation inside vessel

Complex 160 (117), Inventory number 595/82

1. tb 159.8; cr 49.4; pc 110.4; gr -; ab -; rest -
2. III-V; beige, old white, milky white, blue-grey, grey
3. medium; 41mm
4. +
5. teeth (lower molars), parietal (ss, bregma), occipital, cranial base, , pelvis, vertebra (vl, vt), humerus,ulna, phalange, femur, tibia, metatarsus
6. saggital suture fused inside and outside, coronal suture fused inside, bregma fused inside, tooth roots closed: **adult to mature**
7. medium robustness: **(♂)**
8. Ms1: 4.3mm (4.5 4.3 4.7 5.0 3.1 2.7 4.2 5.1 5.1 4.3); Ms28: 1.9mm;Ms43: 6.7mm; Ms50: 6.0mm
9. cremation with vessel

Complex 160 (117), Inventory number 597 and 599/82

1. tb 135.9; cr 55.8; pc 80.1; gr -; ab -; rest -
2. IV/V; beige, old white, milky white, blue-grey, grey
3. medium; 38mm
4. +
5. mandible (coronoid process), parietal (ss,), frontal (sc), occipital, cranial base, temporal (lt. and rt.), pelvis, vertebra (atlas, axis, vt, vl), ribs, humerus, radius, phalange, femur, tibia (prox. and dist. epiphysis)
6. vertebral corpus fused, phalange epiphysis fused, saggital suture fused inside and outside, coronal suture fused inside: **adult to mature**
7. gracile to medium robustness: **(♀)**
8. Ms1: 3.5mm (4.7 4.5 3.4 2.9 3.2 3.5 3.2 4.2 3.9 3.1 4.2 4.5 4.7 4.2 3.8 3.1); Ms19: 2.4mm; Ms20: 8.2mm; Ms21: 8.8mm; Ms28: 1.9mm; Ms33: 1.3mm; Ms50: 5.6-6.0mm 7.5-8.2mm
9. cremation with vessel
1.

Complex 163, Inventory number 578/82

1. tb 57.7; cr 33.7; pc 24.0; gr -; ab -; rest -
2. V; beige, old white
3. small; 32mm
4. (+)
5. parietal (ss), occipital, mandible, vertebrae, ribs, humerus, femur, tibia
6. saggital suture fused inside: **mature**
7. medium robustness: **undet.**
8. Ms28: 2.6mm; Ms44: 4.6mm
9. cremation

Complex 164, Inventory number 580/82

1. tb 132.7; cr 19.1; pc 113.6; gr -; ab -; rest -
2. II-IV; milky white, blue-grey, grey, black
3. small; 38mm
4. (–)
5. occipital, parietal, frontal, ribs, radius, femur, tibia
6. **juvenile o.o.**
7. medium to robust: **undet.**
8. Ms1: 3.8mm (5.1 4.7 2.8 2.5 4.9 3.8 4.6 3.6 3.1 5.1); Ms28: 3.7mm; Ms33: 3.0mm; Ms43: 8.0mm; Ms50: 11.9mm
9. cremation next to two vessels

Complex 171, Inventory number 582/82

1. tb 9.0; cr 2.6; pc 6.4; gr -; ab -; rest -
2. V; beige, old white
3. very small; 26mm
4. (+)
5. calotte, pars petrosa, ribs, vertebrae (prozessus articularis), radius, ulna, femur
6. **infant I**
7. gracile: **undet.**
8. –
9. cremation

Complex 183, Inventory number 750/81

1. tb 60.9; cr 26.3; pc 34.6; gr -; ab -; rest -
2. V; beige, old white
3. very small
4. (+)
5. occipital, pars petrosa, parietal, teeth, ulna, femur, tibia
6. **infant I (2-3 yrs.)**
7. gracile: **undet.**
8. Ms1: 2.1mm (2.2 2.0 2.5 2.2 1.7 1.5 1.8 2.1 2.1); Ms28 1.1-1.5mm; Ms44: 1.8mm
9. cremation

Complex 189, Inventory number /81

1. tb 69.7; cr 32.1; pc 38.6; gr -; ab -; rest -
2. III-V; beige, old white, blue-grey, grey, black
3. small; 39mm
4. (+)
5. parietal, occipital, mandible (alveolar), pelvis, ribs, humerus, radius, ulna, femur, tibia (BS III), fibula
6. **juvenile o.o.**
7. robust: **(♂)**
8. Ms1: 4.0mm (3.6 4.4 3.8 4.4 3.8 3.9 3.8 4.6 4.2 3.2); Ms28: 2.1mm; Ms33: 2.1mm; Ms43: 6.4-9.0mm; Ms50: 8.0mm
9. cremation

Complex 190, Inventory number 807/82

1. tb 10.9; cr 5.9; pc 5.0; gr -; ab -; rest -
2. II-V; beige, old white, milky white, blue-grey, grey, black
3. very small; 25mm
4. (–)
5. maxilla, teeth (incisor or canine), occipital (sl), humerus, femur/tibia, metatarsus/metacarpal

6. tooth root closed, distal epiphysis of metacarpal/tarsal fused, lambdoidal suture fused inside: **adult o.o.**
7. undet.
8. Ms1: 3.1mm (3.8 3.1 2.0 3.6)
9. cremation

Complex 196, Inventory number 833/81

1. tb 2.7; cr -; pc 2.7; gr -; ab -; rest -
2. IV-V; old white, milky white, blue-grey
3. very small; 24mm
4. –
5. pelvis, long bone fragments
6. **juvenile o.o.**
7. **undet.**
8. –
9. cremation; more likely scatter than an individual

Complex 201, Inventory number 845/81

1. tb 119.4; cr 17.3; pc 102.1; gr -; ab -; rest -
2. IV-V; beige, old white, milky white
3. very small; 43mm
4. (+)
5. occipital (sl), vertebrae, ribs, humerus (dist. epiphysis), radius, ulna, femur, tibia
6. lambdoidal suture fused inside: **adult o.o.**
7. medium to robust: **undet.**
8. Ms27: 52mm; Ms39: 52mm; Ms43: 4.7mm
9. cremation

Complex 202, Inventory number 904/81

1. tb 18.8; cr 7.0; pc 11.8; gr -; ab -; rest -
2. V; beige, old white
3. medium; 42mm
4. –
5. calotte, occipital, humerus, radius, tibia
6. **juvenile o.o.**
7. medium: **undet.**
8. Ms1: 3.4mm (4.4 3.6 3.7 3.9)
9. cremation

Complex 286, Inventory number 693, 694 and 696/82

1. tb 213.4; cr 37.4; pc 176.0; gr -; ab -; rest -

2. III-V; beige, old white, milky white, blue-grey
3. very small; 33mm
4. (+)
5. calotte, parietal (bregma), maxilla, zygomatic (rt.), ribs, pelvis, humerus, radius, ulna, femur (dist. epiphysis), tibia
6. bregma not fused: **young adult**
7. medium robustness: **undet.**
8. Ms1: 3.4mm (4.0 4.2 2.4 2.8 2.5 4.0 4.0 4.0 3.5 3.4 2.4 3.7 4.9 3.4 3.9 3.5); Ms10: 11.4mm; Ms11: 12.9mm; Ms44: 6.0-6.5mm)
9. cremation; skull and long bones burn stage V, ribs burn stage II/IV

Complex 297, Inventory number 718/82

1. tb 9.0; cr -; pc 9.0; gr -; ab -; rest -
2. IV; milky white, light grey
3. very small; 43mm
4. –
5. tibia, fibula
6. **juvenile o.o.**
7. medium robustness: **undet.**
8. –
9. cremation

Complex 298, Inventory number 719/82

1. tb 4.5; cr 3.7; pc 0.8; gr -; ab -; rest -
2. IV-V; beige, old white, milky, light grey
3. small; 24mm
4. –
5. parietal, long bone fragments
6. **juvenile o.o.**
7. **undet.**
8. Ms1: 3.9mm
9. cremation

Complex 300, Inventory number 734/82

1. tb 115.8; cr 66.2; pc 49.6; gr -; ab -; rest -
2. II/V; beige, old white, black, dark brown
3. small; 56mm
4. (+)
5. parietal, mandible (lt.), teeth, pars petrosa (lt.), temporal (mastoid process rt.), ribs, vertebrae (facies articularis), phalange, femur
6. molar large, canine very large: **undet.**???

7. pars petrosa steep angle, entrance sharp, mentum strong: **undet.**
8. Ms1: 5.8mm (5.1 5.7 6.4 5.3 6.5 6.1)
9. cremation

Complex 302, Inventory number 743/82

1. b 26.3; cr 16.9; pc 9.4; gr -; ab -; rest -
2. II-V; beige, old white, milky, grey, dark brown
3. medium; 44mm
4. –
5. parietal, occipital (sl), temporal, par petrosa, humerus, tibia
6. lambdoidal suture not fused: **undet.**
7. **Undet.**
8. –
9. cremation

Complex 303, Inventory number 749/82

1. tb 26.0; cr 8.1; pc 17.9; gr -; ab -; rest -
2. V; beige, old white
3. very small
4. (+)
5. occipital (linea nuchalis), ribs, vertebrae, femur
6. **undet.**
7. **undet.**
8. –
9. cremation with ceramic shards from three vessels

Complex 304, Inventory number 750 and 756/82

1. tb 6.5; cr 2.1; pc 4.4; gr -; ab -; rest -
2. V; beige, old white
3. very small; 35mm
4. –
5. parietal, scapula, long bone fragments
6. **infant I - II**
7. **undet.**
8. Ms1: 2.0mm (2.2 2.7 2.5 2.2 2.1 1.0 1.2)
9. cremation

Complex 305, Inventory number 752/82

1. tb 107.4; cr 43.4; pc 64.0; gr -; ab -; rest -
2. IV-V; beige, old white, milky white
3. small; 42mm
4. (–)
5. temporal, occipital, parietal (ss), humerus, radius, femur, tibia
6. saggital suture fused inside and outside: **adult o.o.**
7. gracile to medium robustness: **undet.**
8. Ms1: 3.7mm (2.6 2.6 3.2 2.8 3.0 3.3 4.1 3.6 3.2 3.4 6.7 6.2. 4.2 4.7 4.2 4.2 2.5 2.8); Ms28: 2.0mm; Ms33: 1.2-1.8mm; Ms43: 7.3-9.5mm; Ms44: 2.4mm 4.1mm
9. cremation

Complex 306, Inventory number 754/82

1. tb 36.9; cr 12.0; pc 24.9; gr -; ab -; rest -
2. III/V; beige, old white, blue-grey
3. small; 34mm
4. (–)
5. occipital (sl), tooth (bottom right 2nd molar), humerus, femur, tibia

6. tooth root closed, lambdoidal suture fused inside: **juvenile o.o.**
7. **undet.**
8. Ms28: 2.1mm; Ms44: 3.7mm
9. cremation

Complex 309, Inventory number 758/82

1. tb 34.0; cr 10.5; pc 23.5; gr -; ab -; rest -
2. IV-V; beige, old white, blue-grey
3. very small; 29mm
4. (–)
5. parietal, occipital (linea nuchalis), tooth, femur, tibia
6. **juvenile o.o.**
7. **undet.**
8. Ms1: 4.3mm (4.8 3.0 4.1)
9. cremation

Complex 320, Inventory number 879/82

1. tb 43.9; cr 8.8; pc 35.1; gr -; ab -; rest -
2. V; beige, old white
3. small; 48mm
4. (+)
5. occipital (sl), ribs, ulna, radius/ulna, femur, tibia
6. lambdoidal suture fused inside: **juvenile o.o.**
7. **undet.**
8. Ms50: 9.1mm
9. cremation inside vessel

Complex 321, Inventory number 793/82

1. tb 1.2; cr -; pc 1.2; gr -; ab -; rest -
2. IV; milky white
3. small; 27mm
4. –
5. long bone fragments
6. **undet.**
7. **undet.**
8. –
9. cremation 2 pieces, more likely scatter than an individual

Complex 323, Inventory number 804/82

1. tb 10.1; cr 7.3; pc 2.8; gr -; ab -; rest -

2. V; beige, old white
3. very small; 29mm
4. (–)
5. parietal (ss), ribs, humerus
6. saggital suture not fused: **juvenile o.o.**
7. **undet.**
8. Ms1: 2.5mm (2.6 2.5 2.1 3.0 2.7 2.2 2.3 1.9 3.7 2.1)
9. cremation next to vessel

Complex 325, Inventory number 807/82

1. tb 2.1; cr 1.1; pc 1.0; gr -; ab -; rest -
2. II; grey, black
3. very small; 25mm
4. –
5. calotte (suture), long bone fragments
6. suture fused: **adult o.o.**
7. **undet.**
8. –
9. cremation 2 pieces

Complex 326, Inventory number 808/82

1. tb 3.1; cr 3.1; pc -; gr -; ab -; rest -
2. II; black, dark brown
3. medium; 30mm
4. –
5. occipital (sl)
6. lambdoidal suture fused inside and outside: **adult o.o.**
7. **undet.**
8. –
9. cremation 1 piece

Complex 327, Inventory number 809/82

1. tb 44.3; cr 12.4; pc 31.9; gr -; ab -; rest -
2. III-V; beige, old white, milky, light grey, blue-grey, grey, dark brown
3. small; 52mm
4. (+)
5. frontal (orbit), parietal, pars petrosa, occipital (sl), pelvis, humerus, femur, tibia
6. lambdoidal suture fused inside and outside: **late adult o.o.**
7. incisura narrow, orbital edge round, supraorbital ridge: ♂
8. Ms1: 3.6mm (3.9 3.4 3.2 4.0 3.6); Ms44: 6.5mm

9. cremation

Complex 328, Inventory number 811, 813, 815, 816, 901, 902 and 904/82

1. tb 166.3; cr 71.3; pc 95.0; gr -; ab -; rest -
2. II/III-V; beige, old white, grey, dark brown
3. small; 62mm
4. +
5. occipital (sl), temporal (asterion), parietal (ss), frontal, ribs (dens axis), radius, ulna, femur, tibia
6. lambdoidal suture not fused, asterion not fused, saggital suture fused inside: **juvenile o.o.**
7. **undet.**
8. Ms1: 3.3mm (5.4 5.4 3.6 4.6 2.4 2.5 1.9 3.7 3.7 4.3 3.4 4.2 4.4 1.4 2.5); Ms28: 2.8mm; Ms44: 6.5mm; Ms50: 10.0mm 8.4mm 7.1mm
9. cremation with vessel

Complex 329, Inventory number 818 and 823/82

1. tb 366.9; cr 133.2; pc 233.7; gr -; ab -; rest -
2. V; beige, old white
3. very small; 43mm
4. +
5. frontal (lt. orbit), zygomatic, mandible (mandibular condyle) occipital (sl), parietal, pars petrosa, maxilla, teeth (canine, molar), scapula, ribs, vertebrae, humerus, radius, ulna, phalange, femur, tibia, metatarsus
6. tooth roots closed, lambdoidal suture fused: **mature o.o.**
7. chin rounded, orbit edge, round with edge, gracile: ♀
8. Ms1: 3.0mm (3.1 3.7 3.0 3.2 3.2 3.4 2.8 2.9 3.4 3.3 3.4 2.6 2.6 1.7 2.4 2.6 2.6 3.2 3.2 2.8 4.0); Ms9: 6.0mm; Ms18: 11.4mm; Ms28: 2.4mm; Ms33: 1.5mm; Ms44: 6.2mm (BSII); Ms50: 10.7mm
9. cremation

Complex 330, Inventory number 826/82

1. tb 18.9; cr 2.6; pc 16.3; gr -; ab -; rest -
2. III-IV; milky white, chalky, blue-grey, grey
3. very small; 27mm
4. –
5. occipital, femur
6. **undet.**
7. **undet.**
8. –
9. cremation

Complex 331, Inventory number 827/82

1. tb 55.7; cr 2.9; pc 52.8; gr -; ab -; rest -
2. II/V; beige, old white, black
3. medium; 55mm
4. –
5. calotte, humerus, radius, femur, tibia
6. **undet.**
7. **undet.**
8. Ms28: 2.8mm; Ms33: 2.5mm; Ms50: 10.1mm
9. cremation

Complex 333, Inventory number 831/82

1. tb 243.7; cr 103.1; pc 140.6; gr -; ab -; rest -
2. II-V; beige, old white, milky white, blue-grey, black
3. small; 55mm
4. (+)
5. occipital, temporal (mastoid process rt., cavitas tympanica), mandible (rt.), frontal (orbit), pelvis, ribs, vertebrae, humerus, ulna, radius, femur, tibia
6. suture fused, molar root closed: **adult**
7. orbit round, medium to robust, thick bones: **(♂)**
8. Ms1. 4.2mm (3.1 4.4 2.3 4.5 5.1 4.6 4.4 3.9 6.4 3.1 3.4 5.7); Ms16: 13.0mm
9. cremation

Complex 334, Inventory number 836/82

1. tb 2.1; cr -; pc 2.1; gr -; ab -; rest -
2. V; beige, old white
3. very small; 20mm
4. –
5. pelvis, long bones
6. **undet.**
7. **undet.**
8. –
9. cremation

Complex 335, Inventory number 837, 863 and 865/82

1. tb 187.0; cr 67.3; pc 119.7; gr -; ab -; rest -
2. III/IV-V; beige, old white, milky white, blue-grey, grey
3. very small; 44mm
4. +

5. occipital (sl), pars petrosa (lt.), mandible (mandibular condyle rt.), mandible (lt.), temporal (crista supramastoidea rt.), parietal (ss), ribs, vertebrae (facies articularis), pelvis, humerus, radius, ulna, femur, tibia, talus
6. saggital suture fused inside, lambdoidal suture fused inside and outside: **late adult o.o.**
7. pars petrosa angle steep, entrance round, gracile: **(♀)**
8. Ms1: 3.7mm (5.0 2.9 3.4 3.9 4.3 3.5 2.9 3.8 4.4 4.0 2.8); Ms16: 11.4mm; Ms17: 5.8mm; Ms28: 1.8mm; Ms33: 1.9mm; Ms50: 6.6mm
9. cremation

Complex 336, Inventory number 841/82

1. tb 193.7; cr 73.6; pc 120.1; gr -; ab -; rest 7.1
2. V; beige, old white
3. very small; 41mm
4. +
5. occipital, parietal, mandible, temporal, tooth (incisor), vertebrae, ribs, humerus, radius (prox. epiphysis), phalanges, femur, tibia
6. incisor root closed: **infant II o.o.**
7. **undet.**
8. Ms1: 4.2mm (3.2 4.0 4.3 4.6 4.7 4.2 4.3.4.4 4.6 4.0); Ms32: 17.3; Ms50: 8.0mm 10.2mm
9. cremation

Complex 338, Inventory number 870/82

1. tb 68.1; cr 29.3; pc 38.8; gr -; ab -; rest -
2. II-IV; milky white, blue-grey, grey
3. small; 38mm
4. (–)
5. pars petrosa (rt. and lt.), occipital (sl), parietal, mandible, pelvis, radius, tibia
6. lambdoidal suture fused inside: **adult o.o.**
7. incisura wide, pars petrosa entrance round, angle steep: ♀
8. Ms1: 4.4mm (4.2 4.7 5.0 5.3 3.6 3.7 4.5 3.9 4.8 4.8); Ms33. 2.5mm; Ms50: 7.8-9.0mm
9. cremation

Complex 341, Inventory number 884/82

1. tb 290.4 ; cr 29.7; pc 260.7; gr -; ab -; rest -
2. IV-V; beige, old white
3. very small; 52mm
4. (–)
5. occipital, calotte (suture), vertebrae (dens axis), humerus, ulna, femur, tibia
6. **juvenile o.o.**

7. **undet.**
8. Ms1: 4.5mm (5.7 5.4 5.0 3.8 2.8); Ms28: 3.1mm; Ms43: 6.7mm; Ms50: 12.4mm
9. cremation inside vessel

Complex 342, Inventory number 888/82

1. tb 90.9; cr 30.2; pc 60.7; gr -; ab -; rest -
2. II-V; beige, old white, blue-grey, grey, black, dark brown
3. very small; 46mm
4. (+)
5. occipital (sl), parietal, mandible, pelvis, ulna, phalange, femur, tibia, fibula
6. **juvenile o.o.**
7. **undet.**
8. Ms1: 4.6mm (3.8 3.7 4.4 3.7 4.5 3.6 5.8 5.1 5.6 3.9 5.8 4.3 5.8 5.0); Ms43: 5.0-5.7mm; Ms50: 8.7mm
9. cremation

Complex 344, Inventory number 893/82

1. tb 1.3; cr -; pc 1.3; gr -; ab -; rest -
2. V; beige, old white
3. small; 21mm
4. –
5. femur
6. **undet.**
7. **undet.**
8. –
9. cremation

Arnstadt

Grave 3, Find number 26643

1. tb 4.9; cr 0.6; pc 1.0; gr 1.9; ab 1.4; rest -
2. IV-V, old white, beige
3. very small; 38mm
4. -
5. cranial fragment (orbital roof), vertebra, fibula
6. **juvenile o.o.**
7. **undet.**
8. **-**
9. Animal bones with markings from roots.

Grave 8, Find number 26655

1. tb 320; cr ; pc ; gr ; ab ; rest -
2. (III)V, old white, beige, milky white
3. small; 20mm
4. (+)
5. zygomatic, mandible, pelvis, ribs/clavicle, vertebra (vt, vl), humerus, femur, tibia, fibula, metatarsal/phalange
6. bregma not fused, saggital suture fused, not obliterated, vertebral body fused: **late adult**
7. more gracile, processus frontalis relatively wide, possibly male: **undet.**
8. Ms1: 3.3mm; Ms17: 20mm; Ms18: 6.7mm; Ms27: 42-45mm; Ms28: 3.0mm; Ms43: >6mm;

Grave 9, Find number 26661

1. tb 393.3; cr 143.8; pc 230.8; gr 76.1; ab 18.7; rest -
2. (III)V, old white, beige, milky white, blue, black
3. medium; 45mm
4. (+)
5. Mandible, frontal, tooth (upper M2), pelvis, ribs, vertebra (vc), humerus, ulna/radius, metacarpal, tibia, fibula,
6. cranial sutures not fused, metacarpal epiphysis fused, small tooth, root closed: **early adult**
7. **undet.**
8. Ms1: 4.4mm (4.5 3.9 4.3 5.2 3.5 4.4 3.8 4.0 4.4 3.8); Ms17: [16.0mm]; Ms18: 6.8mm; Ms27: 37mm; Ms28: 1.8mm; Ms33: 2.0mm; Ms39: 36-40mm; Ms44: [4.1mm]; Ms50: 11.5mm

The body burials

Grave 14

1 Complete cranium without the nasal portion, the left temporal bone is damaged. Post cranial skeleton: right clavicle, three right ribs, five left ribs, left humerus, left radius, left proximal ulna, left ilium, left femur, left tibia, left fibula, 2 cervical, three thoracic, 2 lumbar and one sacral vertebrae. The right side of the skeleton is completely missing.

2 *Age 11-13*: The synchondrosis spheno-occipitale is not fused: <20. The root of the upper and lower M1 is closed: >9. The root of the upper and lower M2 is not yet closed: <14. The epiphyses of the long bones are not yet fused, proximal nor distal: <16-18. The epiphyses of the clavicle are not fused: <20-25. The ilium has not fused to the other pieces of the pelvis: <14-16. The ends of the ribs are not ossified: <20. The body of the vertebra have not fused, the vertebral arch of the sacrum is fused: >6, <18. Length of the long bones: humerus=21.5 cm: ~11, radius=16.7 cm: ~11, femur=31.8 cm: ~11-12, tibia=25.9 cm: ~10-12, fibula=24.7 cm: ~11-12.

3 *Sex (♀)*: Margo supraorbitalis is very sharp, the glabella is weak. The superciliary arch is very weak, the mastoid process is very small. The external occipital protuberance is very weak. The mentum is average, neither weak nor strong. The mandibular angle is very smooth. The greater sciatic notch is wide and “U” shaped. However, there are some more robust features, the molars are relatively large, the long bones seem short and stocky for the age.

4 The forehead markedly protrudes forward. The individual was probably a hydrocephalus.

5 All teeth have marked hyperplasia.

6 Only bones from the left side of the skeleton were preserved.

Grave 20

1 Complete cranium without the nasal region, mandible. Post cranial skeleton: right clavicle, right scapula, acromion, cervical, thoracic, lumbar vertebra, ribs. Right humerus without the proximal epiphysis, right radius without the distal epiphysis, proximal right ulna, left radius, proximal left ulna, right and left ilium, fragmented. Right femur, right tibia, right fibula diaphysis, right talus.

2 *Age 15-35*: Endocranial sutures fused, ectocranial sutures all not fused.

3 *Sex (♀):* Glabella is weak, the superciliary arch is weak. The Margo supraorbitalis is very sharp. The mastoid process is very small, the nucal crest not pronounced. The external occipital protuberance is very weak. The frontal tuberosity is not pronounced. The mentum is very weak, the mandibular angle smooth and rounded.

Grave 21

1 Complete cranium including the facial skeleton without the zygomatic bones, mandible. Post cranial skeleton: the proximal right humerus and humerus diaphysis, distal left humerus, right ulna with the distal epiphysis missing, both clavicles, left ilium, proximal right femur, left femur diaphysis.

2 *Age 50-60*: The endocranial coronal and saggital sutures are fused and obliterated, the lambdoidal suture is fused: >40. The ectocranial coronal and saggital sutures are fused and partially obliterated, the lambdoidal suture is fused: ~50-60 o.o.. The tooth roots are all closed, upper and lower M3 complete: <35. The epiphyses are all fused: >18-20.

3 *Sex* ♀: The glabella is weak. The superciliary arch is weak, the mastoid process is very small and narrow. The external occipital protuberance is very weak. The nucal crest is weak. The mentum is very weak and the mandibular angle round and smooth. The greater sciatic notch is very wide and "U" shaped. The preauricular sulcus is very wide and deep.

Curriculum Vitae

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High School Diploma:	1996 Charlotte Latin School, Charlotte, North Carolina, USA High School Diploma with Cum Laude Advanced Placement International Diploma for Overseas Studies (International Baccalaureate)
University Education	1996 – 1999 The George Washington University, Washington DC, USA Bachelor of Arts, Degree with Cum Laude Major: Anthropology 1999 – 2003 Eberhard Karls Universität Tübingen, Tübingen, Germany Magister Artium October 2003 Major: Pre- and Protohistory/Archaeology Minors: Palaeoanthropology and Chemistry
Doctoral Studies	Nov. 2003-Oct. 2006 in Palaeoanthropology at the Institut für Ur-und Frühgeschichte, Abteilung für Ältere Urgeschichte und Quartärökologie at the Eberhard Karls Universität Tübingen, Tübingen, Germany. supervised by Prof. Nicholas J. Conard, PhD and PD Dr. Joachim Wahl February 16, 2007 PhD Examination