

Excursion guide to Pleistocene hominid sites in Central Europe

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Introduction

Geography and Geology

Germany lies between the high mountains of the Alps in the South and the North Sea (northwest) and the Baltic Sea (northeast) respectively, both of them being epicontinental seas. Whereas the highest peak of the Alps, the Mont Blanc (France and Italy), reaches an altitude of 4,708 m, the highest peak in the German part of the Alps, the Zugspitze, rises to 2,964 m. Between the Alps and the coastal plains in the North, Central Europe is traversed by a low mountain range trending from Southeast to Northwest. Geographically different names are attributed to this mountain range. It represents the remains of a mountain range, which already developed during the Palaeozoic and is prone to erosion during the Cenozoic, the so-called Variscian Mountains. Further to the North lowlands extend to the seas (Fig. 1).

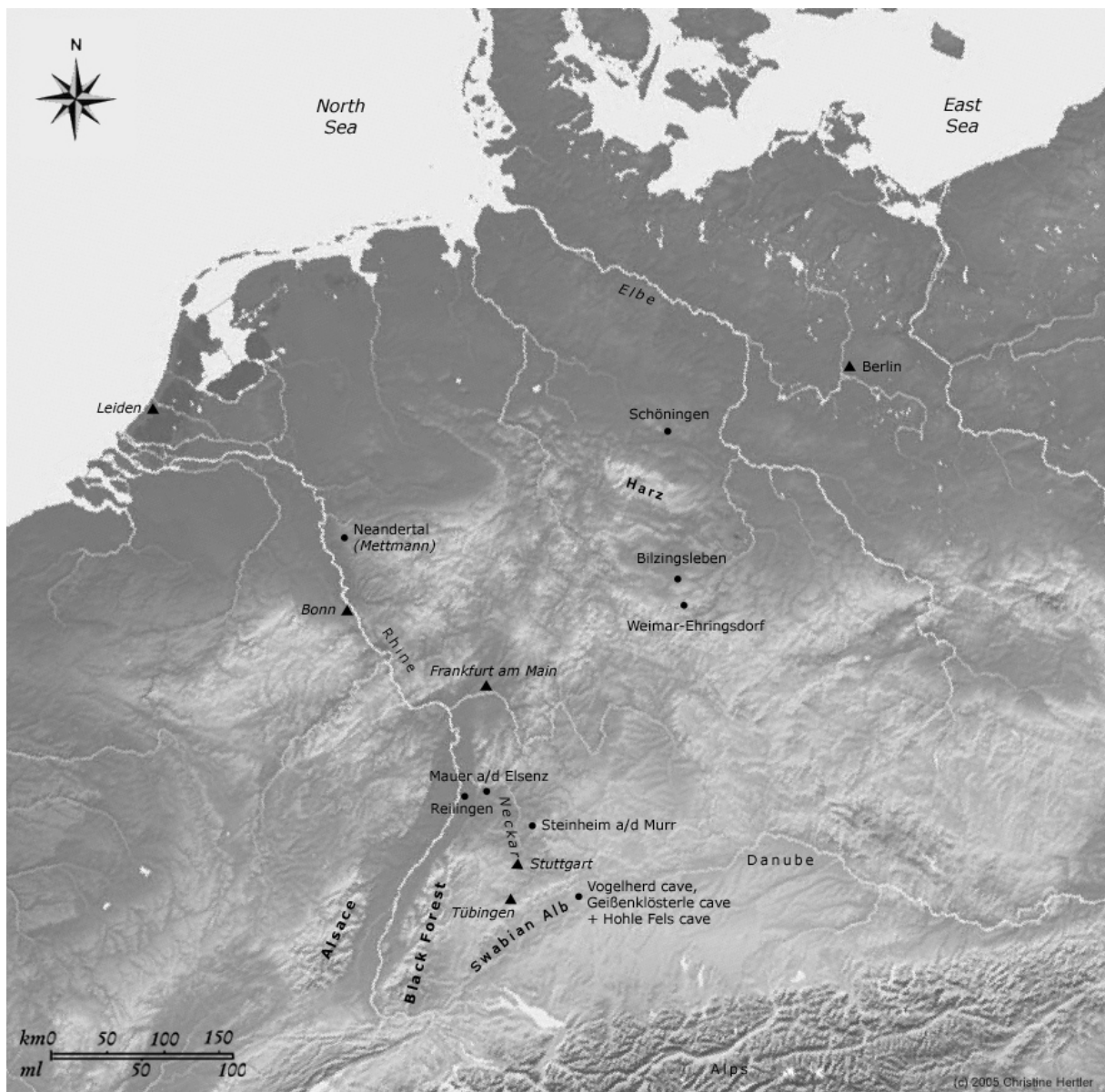


Fig. 1: Geographic map of Germany and Central Europe. Visited localities are indicated by dots, collections by triangles.



The initial development of the Variscian Mountain range during the Devonian and Carboniferous represents an important step in the geological history of Central Europe. Subsequent stretching and compression as well as the attachment of further ranges towards the Southeast caused by plate tectonics coin the geology in Central Europe and are crucial for a comprehensive understanding. During Mesozoic and Cenozoic the geological processes change dramatically, during the latter era in particular due to the uplift of the geologically quite young alpine mountain range and the opening of the North Sea.

In Central Europe the uplift of the Alps, being itself caused by a generally north directed drift of the African plate, caused the reactivation of an older tectonic system from the Miocene onward. The course of the Rhine River nowadays follows this tectonically active rift, reaching north as far as the Hessian depression. Further to the North the Rhine cuts through the eroded low mountain range, yet leaving an impressive canyon presently as deep as 90 m, the romantic Middle Rhine valley. The Rhine crosses the Lower Rhenian embayment before it finally discharges into the English Channel in the Netherlands. Since the Rhine valley provides a natural topographical connection between South and Central Europe, it serves also as a climatic corridor allowing for slightly elevated temperatures compared to adjacent areas. It was thus among the favoured whereabouts for Pleistocene hominids in Central Europe.

Pleistocene Stratigraphy

The depositional events in Central Europe during the Pleistocene are mainly determined by glacial-interglacial climatic cycles. In Europe climatic alterations led to the subsequent expansion and retreat of two main glacier systems, one of them located in the Northeast, the Scandinavian glacier complex, the other one situated in the South, i.e. the Alpine glacier complex. During glacial stages the extensions of the glacial systems reached their maxima, thereby completely covering the Alps and extending northward up to the Danube valley, where they deposited moraine loads. Concomitantly, the Scandinavian glacial system extended southward to a line leading from southern England via Central Germany to Silesia (Poland) during the Elsterian (MIS 12) and along the Elbe valley during the last glaciation (Weichselian; MIS 2-4). During each of the glaciation maxima (Fig. 2) only a more or less narrow corridor in Central Europe was left not being covered by an ice shield. This corridor provided a natural connection between the vast East European plains and Southwest Europe, i.e. France and Spain. It was extensively used by migrating animals and hominids.



Fig. 2: Maximal extension of the glacial ice shields and continental margins during the last glaciation (Würmian/Weichselian) in Central Europe; Map from Schrenk & Müller 2005



Initial subdivisions for the Middle and Upper Pleistocene were named according to the localities where glacial loads are found. In the Northern part of Central Europe the glaciations were named according to rivers (Elbe – Elster – Saale – Weichsel), where moraine deposits of the Scandinavian glacial complex are found. A separate system exists for the alpine glacial complex, named after tributaries of the Danube River, where moraine deposits occur (Günz – Mindel – Riss – Würm). However, the stratigraphic correlation between the two systems is still under dispute. Moreover, a climatic reconstruction based on oxygen isotopes in marine drilling cores revealed more climatic cycles than could be identified on the basis of moraine deposits. These glacial sediments can only partly be attributed with certainty to particular marine isotope stages (MIS in Fig. 3).

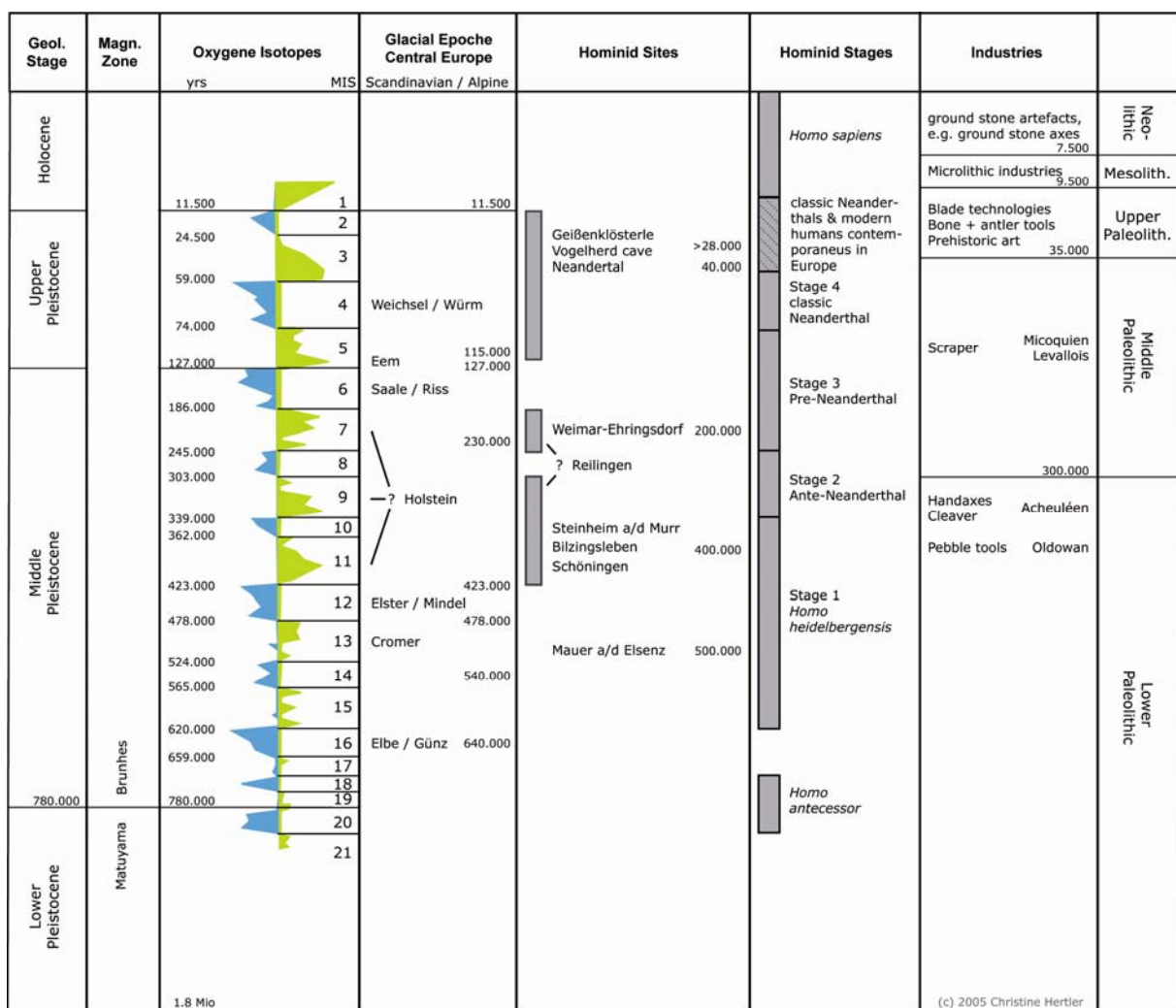


Fig. 3: Correlation between chronostratigraphy and other subdivisions of glacial and interglacial periods including hominid sites and Stone Age industries in Central Europe (after Ziegler & Dean 1998, von Koenigswald & Heinrich 1999, von Koenigswald 2002, Schmitz et al. 2002, Auffermann & Orschiedt 2002 and Rupp, pers. comm.)



Paleontology

Although Central Europe is located at the remote western margin of the vast Eurasian landmass, Pleistocene mammal communities are determined by the geographic corridor it provided between East and Southwest Europe. Rather than being a dead end in which large mammals were trapped under changing climatic and environmental conditions, Central Europe has to be regarded as a transitional zone, in which cold- and warm-adapted mammal communities prevail according to the respective climatic regime. Both types of faunal communities possess core distribution areas beyond Central Europe. Glacial faunal elements retreat to tundra steppe areas in East Europe during climatically warmer periods. Conversely, under a glacial climatic regime, characteristically warm-adapted faunal elements retreat to the Mediterranean. Replacements due to changing environmental conditions were thus the rule in Central Europe, rather than an exception. This kind of replacement reflects pulsating distribution areas.

Glacial faunas of the late Middle and Late Pleistocene are characterised by the occurrence of the woolly mammoth (*Mammuthus primigenius*). The cold-adaptation successively developed in its precursor, i.e. the Middle Pleistocene *Mammuthus trogontherii*. The woolly rhino (*Coelodonta antiquitatis*) is also considered to be a typical continental to cold-adapted species. Those species have gone extinct around the Pleistocene/Holocene boundary. Other continental or cold-adapted species, e.g. reindeer (*Rangifer tarandus*) and musk ox (*Ovibos moschatus*) are still extant in the tundra steppes of Baltic and/or Siberian regions or in the Kazakhian steppe like the Saiga (*Saiga tatarica*). Saiga and musk ox are only present in Central Europe during extreme cold periods. All cold-adapted large mammals are characterised by specific adaptations for cold and dry climate, e.g. large body size, a thick fur in particular caused by woolly hair and specialisations in their respiratory apparatus.

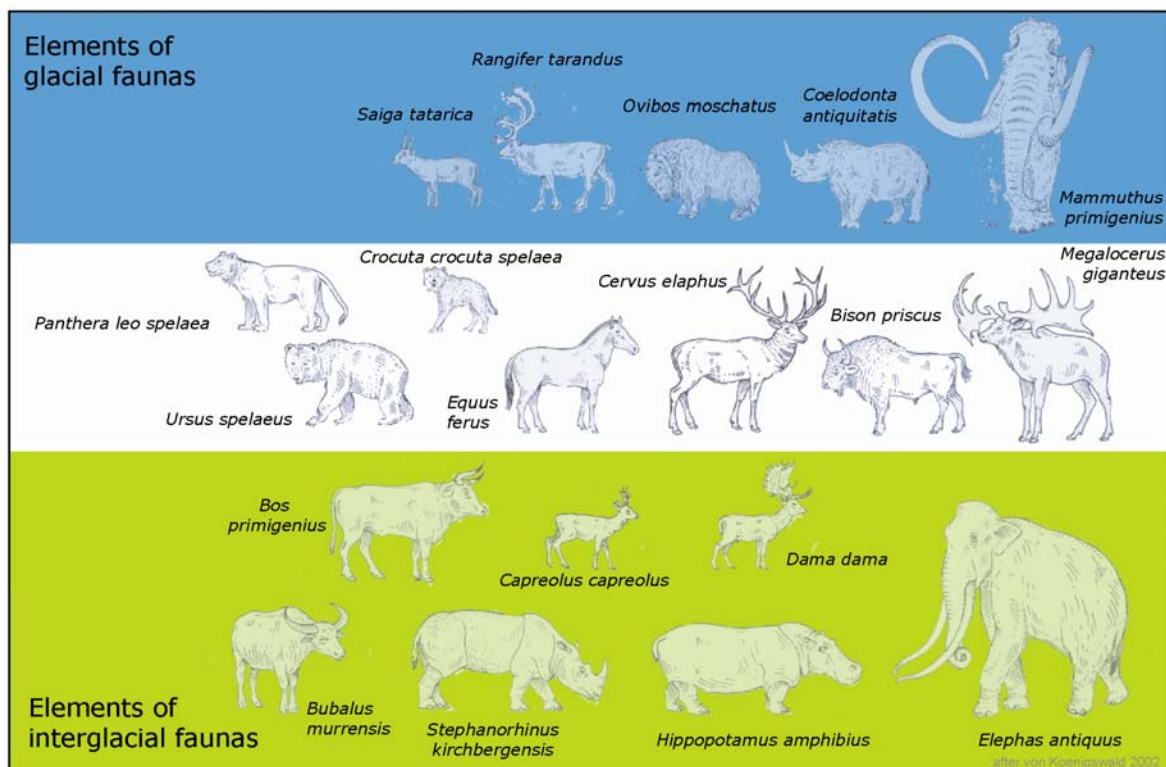


Fig. 4: Typical glacial and interglacial faunal elements with characterising species (after von Koenigswald 2002); for a more detailed listing of species viz. Tab. 1.



During interglacials the above mentioned species are replaced by corresponding warm-adapted forms, e.g. the straight-tusked elephant (*Elephas (Palaeoloxodon) antiquus*), roe and fallow deer (*Capreolus capreolus* and *Dama dama*) and aurochs (*Bos primigenius*). Occasionally, exotic species like water buffalo (*Bubalus murrensis*) and hippopotamus (*Hippopotamus amphibius*) migrated into Central Europe during the interglacials. Some of the warm-adapted species, e.g. roe deer, still occur in Central Europe. The fallow deer went extinct and was reintroduced. Although human impact directly or indirectly led to the disappearance of a large proportion of naturally occurring mammal species, recent mammal communities might be considered as reflecting (reduced) interglacial associations. Because the occurrence of certain large mammal communities rather depends on the environmental regime than on endemic evolution, it is thus difficult to establish a biostratigraphy for Central Europe solely by large mammals.

Besides these climatically quite restricted faunal elements, less selective species occur more or less permanently and can be found at most localities, i.e. feral horses (*Equus caballus*, *E. ferus*), red deer (*Cervus elaphus*), Bison (*Bison priscus*) and giant deer (*Megaloceros giganteus*). The occurrence of many large carnivores, like cave lion (*Panthera leo spelaea*), cave bear (*Ursus spelaeus*) and cave hyena (*Crocuta crocuta spelaea*) is hardly restricted by climatic conditions.

Small mammals are better suited for stratigraphic purposes. Moreover, due to short generation periods and high reproduction rates, particular small mammals display higher evolutionary rates compared with large-bodied species. They thus provide a higher chronological resolution. During the Plio- and Pleistocene arvicolid teeth underwent well documented morphological changes. One character, which is widely used as a stratigraphic tool is the ratio between distal and mesial enamel thickness in *Arvicola* (water vole) first lower molars (SDQ = “Schmelzbanddifferenzierungs-Quotient”). This index underwent significant alterations (Fig. 5).

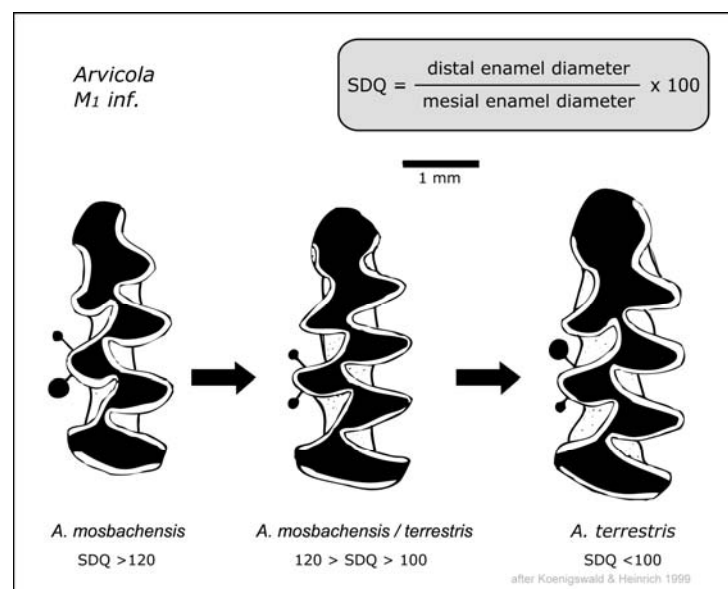


Fig. 5: Changes of enamel thickness in first lower molars of *Arvicola* (after von Koenigswald 1973 and von Koenigswald & Heinrich 1999)

Faunas containing *Mimomys savini* occur during the Lower and early Middle Pleistocene. Additionally, these assemblages are characterised by the appearance of the elephant *Mammuthus (Archidiskodon) meridionalis* and further micromammal taxa, e.g. *Talpa minor*, *Beremendia*, *Drepanosorex margaritodon*, *Mimomys pusillus* and less developed members of *Pliomys* etc.



During the early Middle Pleistocene *Mimomys savini* is replaced by the *Arvicola mosbachensis*. In the early phases of this replacement, the genus *Pliomys* and small mole species, e.g. *Talpa minor*, still occur. These faunas are called “older *A. mosbachensis* faunas”. Later on, in the “younger *A. mosbachensis* faunas” *Pliomys* species disappear completely. The *Arvicola mosbachensis* assemblages are further subdivided by at least three different immigration events of large mammals. The earliest wave runs in parallel with the *Mimomys/Arvicola* replacement and includes *Elephas antiquus*, a characteristic forest form present e.g. in Mauer. The second wave entails the arrival of the woolly rhino *Coelodonta antiquitatis* and the third wave represented in Steinheim, Schöningen and Bilzingsleben, encompasses the occurrence of the aurochs *Bos primigenius* and, occasionally, the water buffalo *Bubalus murrensis*. In the late Middle and early Upper Pleistocene a transitional faunal stage, *Arvicola mosbachensis/terrestris*, occurs which is characterised by an SDQ of approx. 100. This fauna is present in the lower travertins at Weimar-Ehringsdorf. It is then replaced in the Upper Pleistocene, in particular during the Weichsel glacial, by the *Arvicola terrestris* faunal assemblages.

Unfortunately, no micromammals were collected from Reilingen and a stratigraphic attribution based on large mammals alone is notoriously difficult, as we have seen. Reilingen is attributed to the Holstein complex, a series of several interglacials (Fig. 3 and Ziegler & Dean 1998) covering a period of roughly 250.000 years. Mauer, Bilzingsleben, Schöningen and Steinheim belong to the Middle Pleistocene *Arvicola mosbachensis* faunal stage. Due to the occurrence of *Talpa minor* and *Pliomys episcopalus* in Mauer, it belongs to the older *Arvicola mosbachensis*-Fauna. Both of the species lack in Steinheim, Bilzingsleben and Schöningen, although *Arvicola mosbachensis* occurs. These sites are thus attributed to the younger *Arvicola mosbachensis*-Fauna. In Weimar-Ehringsdorf the *Arvicola mosbachensis/terrestris*-Fauna is present. Local faunas are described in detail in the respective chapters. For a detailed listing of important species we refer to Table 1.

		Lower Pl.	Middle Pl.	Upper Pl.	Holocene	distribution
		<i>Mimomys savini</i> -Fauna	older <i>A. mosbachensis</i> -Fauna	younger <i>A. mosbachensis</i> -Fauna	<i>Arvicola mosb./terr.</i> -Fauna	<i>Arvicola terrestris</i> -Fauna
				Eem	Weich.	
Insectivora						
Soricidae	<i>Sorex (Drep.) savini</i>	■	■	■	■	■
	<i>Sorex minutus</i>	■	■	■	■	■
	<i>Sorex araneus</i>	■	■	■	■	■
	<i>Crocidura ex. gr. russula-leucodon</i>	■	■	■	■	■
Talpidae	<i>Desmana sp.</i>	■	■	■	■	■
	<i>Talpa minor</i>	■	■	■	■	■
	<i>Talpa europaea</i>	■	■	■	■	■
	<i>Petenya hungarica</i>	■	■	■	■	■
Primates						
Cercopithecidae	<i>Macaca sylvanus</i>	?	■	■	■	■
Hominidae	<i>Homo heidelbergensis</i>		■	■	■	†
	<i>Homo steinheimensis</i>		■	■	■	†
	<i>Homo erectus</i>		■	■	■	†



		Lower Pl.	Middle Pl.	Upper Pl.	Holocene	distribution
		<i>Mimomys savini</i> - Fauna	older <i>A. mosbachensis</i> - Fauna	younger <i>A. mosbachensis</i> - Fauna	<i>Arvicola mosb./terr.</i> - Fauna	<i>Arvicola terrestris</i> - Fauna
				Eem	Weich.	
archaic <i>Homo sapiens</i>						
Rodentia						
Sciuridae	<i>Spermophilus (Urocitellus) sp.</i>	?				
	<i>Spermophilus citelloides</i>					extant
	<i>Sicista ex gr. subtilis-betulina</i>		?			
Castoridae	<i>Trogotherium cuvieri</i>			???		
	<i>Castor fiber</i>					extant
Muridae/Cricetinae	<i>Cricetus cricetus</i>					extant
	<i>Allocricetus bursae</i>	?				
- / Arvicolinae	<i>Mimomys pusillus</i>					
	<i>Mimomys savini</i>					
	<i>Arvicola mosbachensis</i>					
	<i>Arvicola mosb./terrestris</i>					
	<i>Arvicola terrestris</i>					extant
	<i>Pliomys episcopalis</i>					
	<i>Pliomys lenki</i>					
	<i>Microtus arvalis-agrestis</i>					extant
	<i>Microtus (Terricola) subterraneus</i>					
	<i>Microtus oeconomus</i>					
	<i>Microtus (Stenocranius) gregalis</i>					
	<i>Lemmus lemmus</i>	?				extant elsewhere
	<i>Clethrionomys glareolus</i>					extant
	<i>Lagurus lagurus</i>					
- / Murinae	<i>Apodemus sylvaticus</i>					extant
	<i>Apodemus maastrichtensis</i>					
	<i>Apodemus flavicollis</i>					extant
Gliridae	<i>Glis glis</i>	?				extant
	<i>Muscardinus avellanarius</i>					extant
Lagomorpha						
Leporidae	<i>Ochotona pusilla</i>		?			extant elsewhere
Carnivora						
Mustelidae	<i>Meles meles</i>					extant
	<i>Martes martes</i>					extant
	<i>Lutra simplicidens</i>					
	<i>Cyrtarctos antiqua</i>		???	?	?	
Ursidae	<i>Ursus etruscus</i>					
	<i>Ursus deningeri</i>					
	<i>Ursus spelaeus</i>					†
	<i>Ursus thibetanus</i>			?		
	<i>Ursus arctos</i>					extant
Canidae	<i>Canis lupus mosbachensis</i>					†
	<i>Canis lupus</i>					extant elsewhere
	<i>Vulpes vulpes</i>		?			extant
Hyaenidae	<i>Pachycrocuta brevirostris</i>					†
	<i>Pliocrocuta perrieri</i>					†



		Lower Pl.	Mimomys savini-Fauna	Middle Pl.	older A. mosbachensis-Fauna	younger A. mosbachensis-Fauna	Upper Pl.	Arvicola mosb./terr.-Fauna	Arvicola terrestris-Fauna	Holocene	distribution
							Eem Weich.				
	<i>Crocuta crocuta spelaea</i>										†
Carnivora (cont'd)											
Felidae	<i>Panthera pardus sickenbergi</i>										extant elsewhere
	<i>Panthera leo fossilis</i>										†
	<i>Panthera leo spelaea</i>										†
Felidae	<i>Lynx issidorensis</i>										extant
	<i>Lynx lynx</i>										extant
	<i>Felis silvestris</i>										†
	<i>Homotherium sp.</i>										†
Proboscidea											
Elephantidae	<i>Mammuthus meridionalis</i>										†
	<i>Mammuthus trogontherii</i>	?									†
	<i>Mammuthus primigenius</i>				*	*	nn	*			* †
	<i>Elephas antiquus</i>				*	*	*	*			*
Perissodactyla											
Equidae	<i>Equus mosbachensis</i>										†
	<i>Equus chosarikus</i>										†
Rhinocerotidae	<i>Stephanorhinus etruscus</i>										†
	<i>Stephanorhinus hundsheimensis</i>		???								†
	<i>Stephanorhinus kirchbergensis</i>			*	*	*	*	*			* †
	<i>Stephanorhinus hemitoechus</i>										†
	<i>Coelodonta antiquitatis</i>		*	*	*	*	nn	*			* †
Artiodactyla											
Suidae	<i>Sus strozzi</i>										
	<i>Sus scrofa</i>		*	*	*	*	*	nn	*		* - extant
Hippopotamidae	<i>Hippopotamus amphibius</i>	*		*		*	*				* - extant elsewhere
Cervidae	<i>Dama rhenana</i>										
	<i>Dama clactoniana</i>										
	<i>Dama dama</i>					*	*				* - extant
	<i>Cervus elaphus</i>										extant
	<i>Megaloceros verticornis</i>										
	<i>Megaloceros giganteus</i>										
	<i>Megaloceros antecedens</i>										
	<i>Alces latifrons</i>										
	<i>Alces alces</i>						???				migrant
	<i>Rangifer tarandus</i>		*	*	*	*	nn	*	nn		* - extant elsewhere
	<i>Capreolus suessenbornensis</i>										
	<i>Capreolus capreolus</i>			*	*	*	*	Nn	*		* - extant
Bovidae	<i>Bos primigenius</i>			*	*	*	*	*	*		* - domestic
	<i>Bubalus murrensis</i>										
	<i>Bison schoetensacki</i>										
	<i>Bison priscus</i>						?				
	<i>Praeovibos priscus</i>										
	<i>Ovibos moschatus</i>		*			*	nn	*			* † - reintroduced



¹Palaeoanthropology

The oldest undisputed European hominid finds date back to 800.000 years. The hominid sites of Atapuerca in Spain and Ceprano in Italy provide evidence of an early migration wave into Europe being however restricted to the Mediterranean. Europe north of the Alps has not been settled by hominids prior to 500.000 years. The oldest hominid find in Central Europe is represented by the famous mandible collected at Mauer an der Elsenz. By then, the earliest Europeans already possess a well documented record west and east of the Alps, i. e. in France, Spain and in Southeast Europe (Fig. 6). The Mauer mandible and chronologically younger finds originating from Steinheim an der Murr and Bilzingsleben are generally correlated with interglacial faunas.

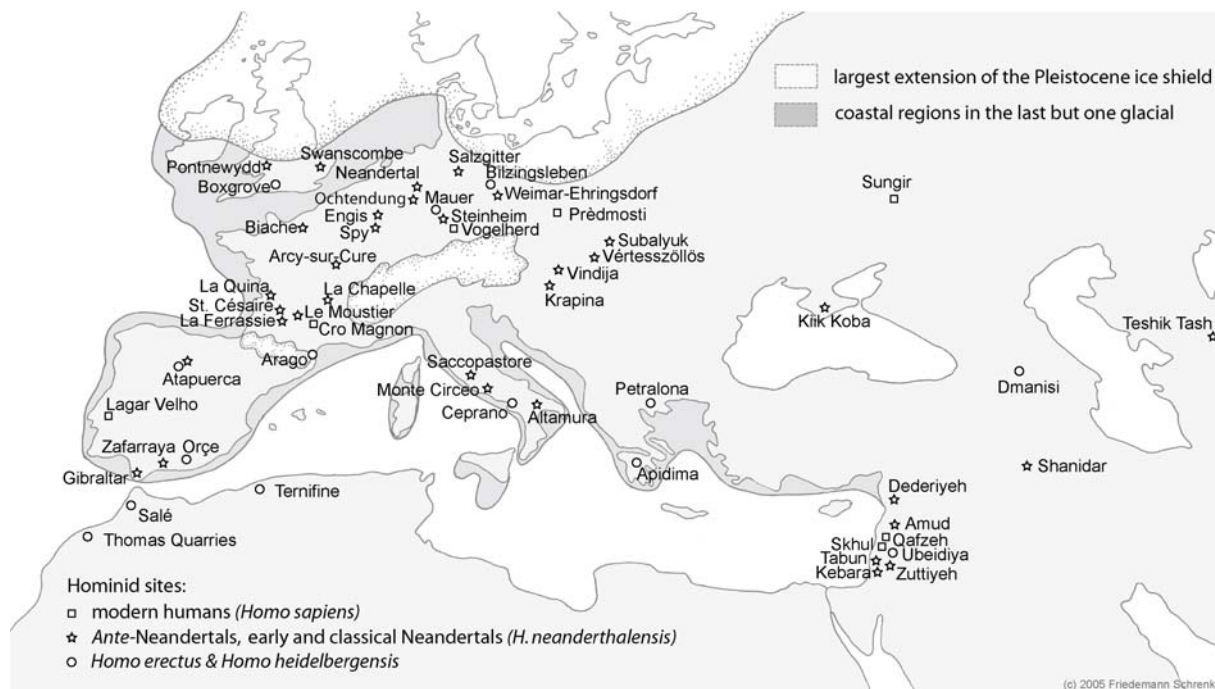


Fig. 6: Hominid sites in Europe and adjacent areas; from Schrenk & Müller 2005

These finds are attributed to separate species and/or subspecies, i. e. *Homo heidelbergensis* for the Mauer mandible, *Homo steinheimensis* for the Steinheim skull and *Homo erectus bilzinglebenensis* for the Bilzingsleben finds, but naming individuals only blurs the underlying processes. Occasionally, the early hominid finds are summarized under *Homo erectus*, but traditionally they are attributed to so-called archaic *Homo sapiens*. As the ambiguities and varieties in attribution demonstrate, these finds cannot readily be compared with finds from other parts of the world. In fact, *Homo erectus* represents the first human species leaving his African home. Initial dispersals resulted in a widely distributed species with low population densities. Species with such distribution characteristics frequently show regional differentiations – and apparently this also happened to early hominids in Central Europe (Fig. 3). The early inhabitants of Central Europe show all features characterising them

¹ **Tab. 1 (previous pages):** Composition of different Pleistocene faunal assemblages in Central Europe (after Ziegler & Dean 1998 and von Koenigswald & Heinrich 1999). Snowflakes indicate cold-adapted, leaves warm-adapted species. Please note that only stratigraphically important species are listed. A complete listing of recent mammal species in Central Europe is provided as attachment.



as, albeit somehow advanced *Homo erectus*: a low and receding forehead, low cranial vault, thick eyebrows (but no continuous torus), and large and massive mandibles.

Eventually, the early inhabitants of Central Europe developed into a form which may be considered as precursor of the classic Neanderthal. The Ante- and/or Pre-Neanderthals represent a transitional form in terms of morphology between early Europeans on one hand and the classic Neanderthal on the other. This type occurred e.g. in Weimar-Ehringsdorf. The course of the transition is restricted to Europe. Finally, this evolutionary development resulted in the origin of the classic Neanderthal, one of the best known figures in human evolution. In the course of this process, four stages are distinguished on the basis of their respective morphologies. The oldest Europeans, represented by hominids like those from Atapuerca (Gran Dolina) and Ceprano are attributed to *Homo antecessor* and did not occur in Central Europe. The Mauer mandible and the Bilzingsleben hominids represent an early form of *Homo heidelbergensis* (stage 1). In the first stage, the hominids are still quite similar to *Homo erectus* from other parts of Eurasia and Africa. Finds from Steinheim, Weimar-Ehringsdorf and Reilingen illustrate more advanced forms of *Homo heidelbergensis* and/or Ante- and Pre-Neanderthals (stages 2 and 3). Other important finds are coming from Biache, Lazaret and La Chaise in France, Saccopastore in Italy and Krapina in Croatia. Stage 2 and 3 specimens represent different transitory stages within a continuous process. The last stage 4 finally represents the classic Neanderthal, *Homo neanderthalensis*, discovered e.g. in the Neander valley proper, Spy in Belgium, Monte Circeo in Italy, and La Chapelle, La Ferrassie, Le Moustier and St. Césaire in France. Whereas the characteristic Neanderthal is morphologically well characterized and defined, transitory stages are not clearly delimited. Different attributions thus appear in the literature. The following table 2 gives you an impression which stages in human evolution we will encounter.

	stage 1	Neanderthals stages 2 + 3	stage 4	<i>Homo sapiens</i>
Upper Rhine and Neckar Valleys	Mauer a/d Elsenz	Reilingen Steinheim a/d Murr		
Thuringian Basin	Bilzingsleben	Weimar- Ehringsdorf		
northern Hercynian foreland	Schöningen			
Middle Rhine valley			Felshofer Cave in Neander valley	
Swabian Alb			Sirgenstein*, Hohle Fels* Geißenklösterle*, Hohlenstein Vogelherd*	

Tab. 2: Types of hominids occurring at the visited localities. Although caves marked with * provided indications for Neanderthal presence, no fossil remains have yet been discovered. For a full account of the hominid specimens collected from each of the localities please consult the respective chapters.

The Neanderthal skull is quite large compared with the one of his precursors. The cranial capacity is on average slightly higher than the one of modern humans (Tab. 3). However, the shape of the Neanderthal skull is completely different. Neanderthals retained a low and elongated cranial vault, and developed a thick supraorbital torus lying like a bar atop of their eye sockets. The occipital part of the skull protrudes and possesses a quite characteristic suprainiac fossa; yet due to an extended cerebellum there is no sharp bend as is the case in the *Homo erectus* skull. Neanderthals possessed broad noses and a massive zygomatic bone. The broad and low nose is accompanied by elaborated and extended nasal conchae retaining efficiently body head and humidity in a cold and dry environment. Dentition and mandibles



are massive and comparatively large. Apparently, Neanderthals used their dentition as kind of a 'third hand' for the manipulation of materials. In sum, Neanderthals may be considered as cold-adapted European version of advanced *Homo erectus*.

	Neanderthals	Modern Humans
Skull	<p>Pronounced supraorbital torus Large frontal sinus Eye sockets large and rounded Low and receding forehead long skull with rounded profile in occipital view</p> <p>Cranial capacity: 1,245-1,750 ccm, mean: 1,520 ccm</p> <p>Bulging rounded occipital (occipital bunning) Flat portion at the lambda region Occipital torus Depression above or inside the occipital torus (suprainiac fossa) Lower scale of the occipital (= nuchal planum) large Small mastoid process Canine fossa missing and inflated maxillary sinus Slight curving of the root of the zygomatic bone Large and broad nasal aperture</p>	<p>No supraorbital torus Small frontal sinus Eye sockets small and sometimes square Steep and high forehead Short and high cranial vault with orthogonal lateral walls Cranial capacity: Mean early modern humans: 1,560 ccm Recent: 1,340 ccm Less occipital bulging</p> <p>No flattening No occipital torus Rare depression in the upper scale of the occipital</p> <p>Insertion area of neck musculature small</p> <p>Large mastoid process Canine fossa present and smaller maxillary sinus Strong curving of the root of the zygomatic Smaller and narrower nasal aperture</p>
Mandible	<p>Receding or neutral chin Large mandible with wide arc Mandibular ramus widely diverging Mental foramen below the first molar Gap between the last molar and the mandibular ramus (retromolar gap) Teeth with large and wide pulpa, occasionally molars with merged roots (taurodontism) Large and shovel-shaped incisors Abrasion of the frontal teeth with outward slope</p>	<p>Protruding chin Small mandible with narrow arc Mandibular rami closer together Mental foramen below the second premolar No gap present</p> <p>Taurodontism rare</p> <p>Rarely occurring Abrasion of frontal teeth with inward slope</p>
Axial skeleton	<p>Cervical vertebrae with long and robust processes (spinal processes) Diameter of the neural channel of the cervical vertebrae large Thoracal and lumbal vertebrae with robust vertebral body Thickened ribs and less strongly bend; barrel-shaped ribcage Elongated clavícula Deep and wide trunk dimension</p>	<p>Processes of the cervical vertebrae shorter and less robust Diameter of the neural channel at the cervical vertebrae small Vertebral body of thoracal and lumbal vertebrae less robust Ribs thinner and strongly bend</p> <p>Shorter clavícula Less deep and wide trunk</p>
limbs	<p>Long bones, hand and foot bones with large muscular insertion areas Femoral shaft ventrally and radius shaft laterally bend Distal long bones (tibia and forearm) relatively short</p>	<p>Smaller muscular insertion areas</p> <p>Femoral shaft less ventrally bend, radius shaft straight Shafts of tibia and radius/ulna elongated</p>
shoulder	<p>Elongated, narrow and shallow glenoid fossa at the shoulder blade Broad shoulder blade Lateral margin of the shoulder blade with deepening (sulcus) on the dorsal side</p>	<p>Glenoid fossa shortened and deeper</p> <p>Shoulder blade less wide Early modern humans and athletes: sulcus on dorsal and ventral side; others: deepening only on ventral side</p>
hand	<p>proximal phalanx of the thumb as long as second Distal phalanges large Distal tip of phalanges large and rounded Strong muscular attachments at the phalanges Large carpal tunnel at wrist (for forced vice grip) Joint ends of the long bones robust and large Long bone shafts with thick walls</p>	<p>Proximal phalanx of the thumb 1/3 shorter Distal phalanges smaller Distal tip of phalanges smaller and pointed Weak muscular attachments Smaller carpal tunnel (weaker grip) Joint ends of the long bones smaller Less thick walls at the long bone shafts</p>



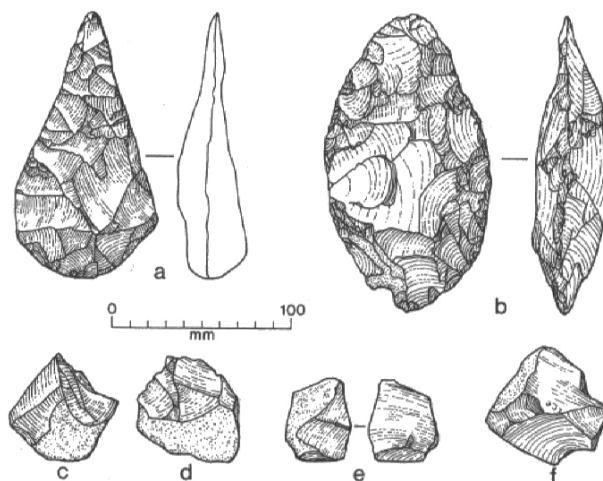
	Neanderthals	Modern Humans
Leg	Tibial shaft with rounded cross-section and without pillar along the dorsal margin (pilaster) 120° angle between femoral shaft and neck Tibia with dorsally elongated joint areas at knee joint Cross-section of tibia shaft almond-shaped Thickened patella	Tibial shaft triangular or drop-shaped; development of a dorsal pillar 124°-135° angle between femoral shaft and neck Joint areas straight Cross-section of tibia rounded Patella less thickened
Foot	Distal phalanges of the toes enlarged Hallux with relatively short distal phalanx	Distal phalanges of the toes smaller Distal phalanx of hallux elongated
Pelvis	Pubic bone elongated and thinner Anterior shift of the sacral bone Iliac bone rotated laterally Hip joint rotated laterally	Pubic bone shortened and broader (esp. in male individuals) Sacral bone situated posteriorly Iliac bone rotated medially Hip joint oriented inwardly
Body height	Europe: 155-165 cm Middle East: 155-179 cm Average: 166 cm	178 cm (average)

Tab. 3: Diagnostic features of Neanderthals; data from Auffermann & Orschiedt 2002

The migration wave of modern humans started around 40.000 years ago in southeast Europe. It can be traced through Europe taking a westward course, thereby leading to a slow replacement until the last Neanderthal disappeared approx. 10.000 years ago in the Southwest. Whether this process represents a replacement in the sense of population genetics or whether it has to be regarded as crossbreeding between Neanderthals and modern humans is still under dispute. Since 10.000 years we do not find classical Neanderthals anymore in Europe or elsewhere in the world. Whether they left traces in the European genome remains to be revealed.

Archaeology

Although Neanderthals were the first Europeans leaving traces of a specific tool culture, they were traditionally not considered as being particularly innovative in terms of tool design. However, numerous localities proved this preconception wrong. Besides Acheulean hand axes the first Europeans created the Clactonian (from Clacton-on-Sea), mode 1 artefacts (from Atapuerca) and Middle Palaeolithic artefacts (from High Lodge) (Figs. 7 and 3). A characteristic hand axe is worked bifacially, i.e. from both sides, but in a comparatively simple manner. It represents the distinctive core tool of the Lower Palaeolithic. Hand axes were produced in various sizes and from different raw materials, preferentially flint or chert yielding flakes with very sharp edges. However, if those materials were unavailable, less fine-grained rocks like basalt and quartzite were used instead. Hand axes possess pointed, oval or triangular outlines and a clear working side. In the Acheulean tool kit, hand axes are accompanied by cores and flakes tools. Raw materials were generally not transported very far from the spot where they were collected, over distances of c. 10 to 15 km.





²Sites where tools are found indicate that animals were disjointed, meat detached from bone and bone marrow prepared. However, all distinctive indications for campgrounds or sites occupied for a longer duration like hearths or windbreaks are lacking at sites older than 40,000 years. The cultural behaviour of early Europeans thus did not yield material remains allowing for an interpretation.

In the transition to the Middle Palaeolithic large hand axes are replaced by smaller and more diversified tools, i.e. prepared flakes and scrapers (Fig. 8). The so-called Levallois technique of the Mousterian industries is considered as characteristically associated with Neanderthals in Europe. The Levallois or prepared core technique is characterized by a series of manufacturing steps. A core is prepared with at least one domed surface. Then, flakes or blades are struck off (Fig. 9). The transition has traditionally been dated to happen 300,000 – 200,000 years ago, sometimes even dated to start around 400,000. The discovery of wooden spears at Schöningen with an age of at least 400,000 years demonstrates that the Neanderthal tool box was more variable and effective than expected by judging from stone artifacts alone.

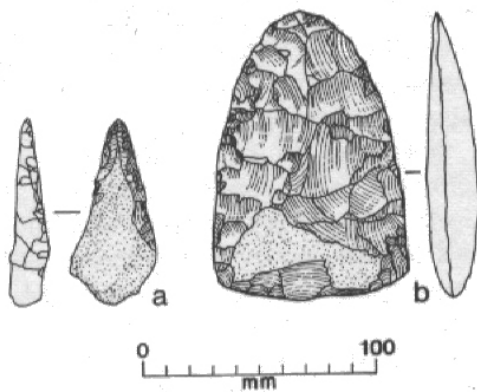


Fig. 8 (left): Tools from the later Middle Paleolithic. a Micoquian knife or hand axe; b Mousterian of Acheulean tradition knife or hand axe; from Stringer & Gamble 1994.

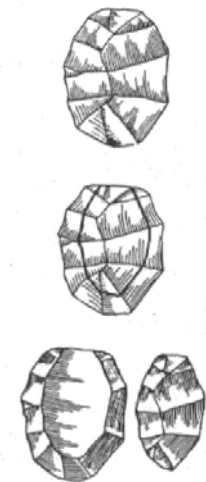


Fig. 9 (right): The Levallois technique of flint knapping: first the nodule is prepared, then a flake is struck; from Stringer & Gamble 1994.

Approx. 30,000 years ago another kind of humans arrived in Europe, *Homo sapiens*. *Homo sapiens* was equipped with a different tool box. Modern humans produced transportable pieces of art as well as rock paintings. It is still under dispute whether the Neanderthals underwent an independent innovation event (represented in the Chatelperronian known from French sites) just prior to the arrival of *Homo sapiens* or whether anatomically modern humans fathered the technological innovations by the end of the Middle Palaeolithic.

In Central Europe three successive industries can be observed, the Aurignacien (35,000-30,000 B.P.), the Gravettian (29,000-22,000 B.P.) and the Magdalenian (17,000-12,000 B.P.). The Aurignacien is characterized by the appearance of blades, bone points and pieces of art, e.g. sculptures. A small point with steep retouch of one edge represents the characteristic tool of the Gravettian. The Magdalenian finally is characterised by regular blade industries and associated with the end of the last glacial. The collections from caves at the Swabian Alb, where we will encounter the cultural remains of early humans in Central Europe are famous for their sculptures and pieces of transportable art as are caves in France for cave paintings.

² **Fig. 7 (previous page):** A lower paleolithic tool kit. a + b hand axes, a from Swanscombe, b from Boxgrove; c + d pebble choppers or cores; e flake, f chopper or core; from Stringer & Gamble 1994.



Programme

- 28.07. Arrival Frankfurt am Main
- 29.07. Joint seminar of the participants at the Johann Wolfgang Goethe University to discuss geology, stratigraphy, paleobiology and paleoanthropology of the sites
- 30.07. Field trip to Mauer an der Elsenz, visit of the Mauer Museum and field trip to Reilingen
- 31.07. Field trip to Steinheim an der Murr, visit of the Urmensch-Museum
Transfer to Stuttgart and visit of the Museum für Naturkunde with demonstration of the Reilingen skulls
Transfer to Tübingen and visit of the archeological collections at the Institute for Prehistory at the Eberhard-Karls-University in Tübingen
- 01.08. Visit of the cave sites in the Ach valley (Geißenklösterle, Hohle Fels, Sirgenstein), visit of the museums at Blaubeuren and Ulm
- 02.08. Visit of the cave sites in the Lone valley (Vogelherd and Hohlenstein-Stadel)
Transfer to Weimar
- 03.08. Visit of the locality Weimar-Ehringsdorf and the Museum for Prehistory of Thuringia
Transfer to Bilzingsleben and visit of the site
Transfer to Schöningen
- 04.08. Field trip to the opencast mining sites in the Schöningen area including visit of excavation sites at Schöningen
Transfer to Mettmann
- 05.08. Visit of the Neanderthal museum and Neander valley
Transfer to Bonn
- 06.08. Visit of the “Roots” exhibition (Rhenian state museum) with demonstration of hominids originating from the visited localities
Neanderthal workshop at Rhenian state museum
Transfer to Leiden
- 07.08. Workshop on paleobiology of Pleistocene sites in Central Europe
Visit of the Dubois collectie at Naturalis, Leiden
- 08.08. Workshop on paleobiology of Pleistocene sites in Java
Return to Frankfurt
- 09.08. Concluding seminar of the excursion participants at the JW Goethe University
- 10.08.
- 11.08. Departure from Frankfurt am Main



Excursion sites

Middle Pleistocene sites along the Upper Rhine and Neckar valleys

The sand and gravel deposits along the Upper Rhine valley and its tributaries have traditionally been exploited for building materials. Along with sand and gravel fossil remains of extinct mammals were accidentally revealed. It is thus not surprising that some of Germany's oldest known fossil sites are located in sand pits along the Rhine valley. Chronologically some of the terrestrial sediments along the Rhine valley (Fig. 10) date back to the Miocene. These deposits are particularly located on the Rheinhessian ridge between Mainz and Mannheim and indicate an older river course. Not later than Upper Pliocene and Pleistocene a continuous sedimentation in the recent Rhine valley started, which was not much influenced by Alpine Quaternary glaciations. Fig. 11 shows as an example the terraces on the left river banks (names referring to the Middle Rhine valley) forming during this process.



Fig. 10: The course of the Rhine river, separate river sections and major tributaries (from Wikipedia).

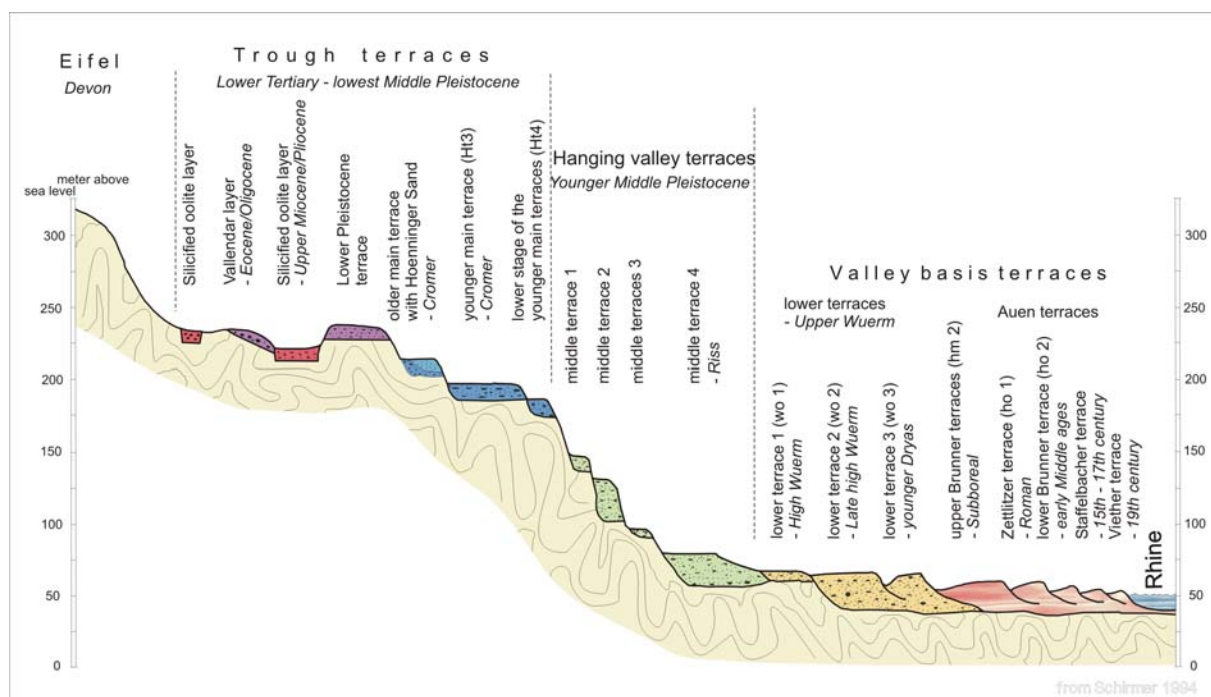


Fig. 11: Terraces at the Middle Rhine (from Schirmer 1994).



Fig 12: South German River Systems (altered after Walter 1992)

Mauer an der Elsenz

The Mauer fossil site is located on the banks of the Elsenz, a small tributary to the Neckar, close to their confluence (Fig. 12). Several sand quarries are situated here and some of them are still in use. Mauer is known as fossil locality since the 19th century, but it was not until 1907 that hominids were discovered in the deposits. As the profile in Fig. 13 shows, several fossil bearing sand horizons occur. Their chronological distance is not yet revealed, but with respect to the occurring rhinoceros species, the upper sand layer is considered younger.

Paleontology

The locality Mauer was quite prolific for fossil mammals. The species list contains 28 different species, among them the giant beaver *Trogontherium cuvieri*, two different Rhino species (*Stephanorhinus kirchbergensis* and *S. hundsheimensis*) and the straight-tusked elephant (*Elephas antiquus*). The lack of cold-adapted species like mammoth and woolly rhino, as well as the appearance of *Hippopotamus* is regarded as indicating an interglacial faunal community (Tab. 4).

In terms of biostratigraphy, the micromammal fauna entailing *Arvicola mosbachensis*, *Pliomys episcopalis* and *Talpa minor* points towards an older *Arvicola mosbachensis*-Fauna and thus Middle Pleistocene age (von Koenigswald & Heinrich 1999).

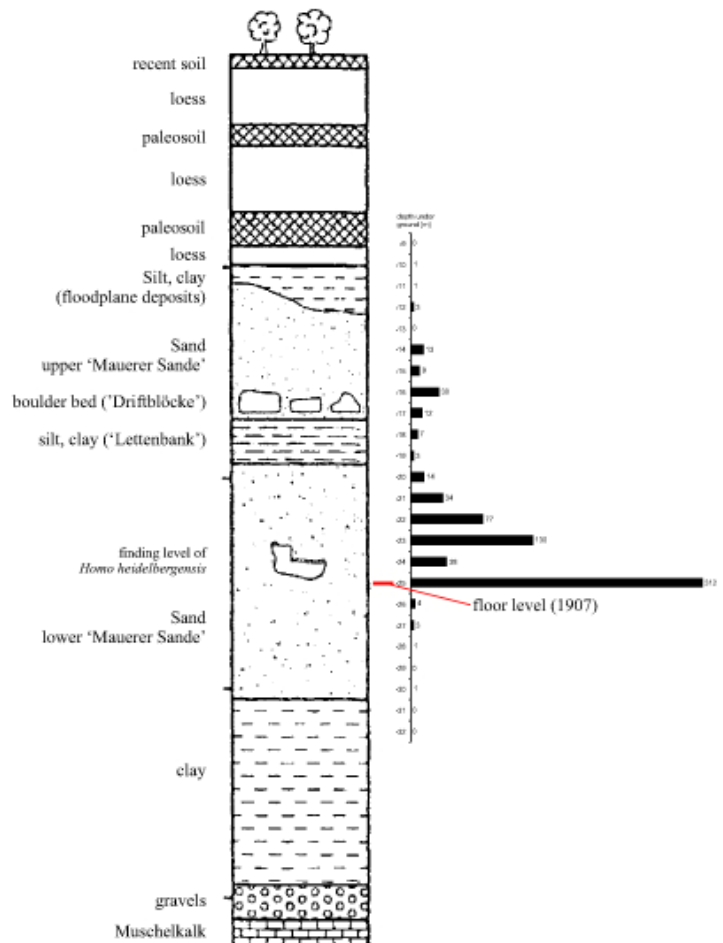


Fig. 13: Standard profile in the sand pit, after Hambach et al. 1992. The diagramme shows the vertical distribution of fossils from the Mauerer Sande (n = 693). The floor level of the pit was in 1907 around 25 m under the ground level (with kind permission of Dieter Schreiber).



Insectivora	Carnivora	Perissodactyla
<i>Talpa minor</i>	<i>Canis lupus mosbachensis</i>	<i>Equus mosbachensis</i>
<i>Talpa europaea</i>	<i>Ursus thibetanus</i>	<i>Stephanorhinus hundsheimensis</i>
Primates	<i>Ursus deningeri</i>	<i>Stephanorhinus kirchbergensis</i>
<i>Homo heidelbergensis</i>	<i>Pliocrocota perrieri</i>	
Rodentia	<i>Panthera pardus sickenbergi</i>	Artiodactyla
<i>Apodemus sp.</i>	<i>Panthera leo fossilis</i>	<i>Sus scrofa</i>
<i>Microtus arvalis-agrestis</i>	<i>Felis (Lynx) issidorensis</i>	<i>Hippopotamus amphibius</i>
<i>Arvicola mosbachensis</i>	<i>Felis cf. silvestris</i>	<i>Alces latifrons</i>
<i>Pliomys episcopalis</i>	<i>Homotherium sp.</i>	<i>Cervus elaphus</i>
<i>Castro fiber</i>	Proboscidea	<i>Capreolus capreolus priscus</i>
<i>Trogontherium cuvieri</i>	<i>Elephas antiquus</i>	<i>Bison schoetensacki</i>

Tab. 4: Species list for the Lower Mauer Sands (after von Koenigswald & Heinrich 1999)

Palaeoanthropology

The Mauer mandible has been discovered in 1907 by Daniel Hartmann, a worker at the Grafenrain sand pit. Hartmann delivered the mandible to Otto Schoetensack, then professor at the Heidelberg University, who described and published the discovery.

The mandible is comparatively large. The toothrows are slightly diverging. Molars do not increase in size from M₁ to M₃. The mandible lacks a bony chin, but displays an alveolar planum. This bony connection strengthening the symphyseal region is generally regarded as characteristic for Asian *Homo erectus*. The ascending ramus is comparatively broad. There is no retromolar gap between M₃ and ascending ramus, a feature characterising Neanderthal mandibles.

With an age of approx. 500,000 years the Mauer mandible represents the oldest known hominid from Germany. Its specific features characterize its bearer as one of the early inhabitants of Europe with close resemblance to *Homo erectus*. In terms of anatomy it is best comparable to finds from Tautavel (France) and Boxgrove (Great Britain) This group of hominids is summarized under *Homo heidelbergensis* (Stage 1).

Archaeology

Artefacts were also collected from the Grafenrain sand pit. The inventory consists of chert cores and flakes. Although the finds have been collected from the Lower Mauer Sands, they were discovered in a horizon 3 m above the mandible proper. It cannot be excluded that the artefacts originated from horizons further up in the profile, sliding down in the course of quarry activities. This casts doubts on a potential association with the hominid mandible.

Reilingen

The Reilingen fossil site is located at the right riverbank of the Rhine River in the Rhine valley proper (Fig. 12). The hominid remains have been collected from a gravel quarry site. Since the water table in this region almost reaches the surface, mining has to be executed by dredging equipment. In the course of dredging operations fossil mammal remains can be collected quite frequently. However, taking profiles at these sites is notoriously difficult and error-prone, because direct observation is impossible. The Reilingen quarry has been exploited until 1979; since then it serves as a lake for bathing in a recreation area.



Palaeontology

The composition of the fauna collected from Reilingen locality shows a mixture of older and younger Pleistocene elements, as well as warm-adapted and cold-adapted species (Tab. 5). This indicates either the presence of more than one fossil-bearing horizon at the locality or a redeposition of some elements *in situ* or during the collecting procedure.

Primates	Proboscidea	Artiodactyla
<i>Homo sp.</i>	<i>Mammuthus primigenius</i>	<i>Sus scrofa</i>
	<i>Elephas antiquus</i>	<i>Hippopotamus amphibius</i>
Rodentia	Perissodactyla	<i>Alces sp.</i>
<i>Trogontherium cuvieri</i>	<i>Coelodonta antiquitatis</i>	<i>Megaloceros giganteus ssp.</i>
Carnivora	<i>Dicerorhinus kirchbergensis</i>	<i>Cervus elaphus ssp.</i>
<i>Ursus cf. arctos</i>	<i>Dicerorhinus hemitoechus</i>	<i>Bos primigenius</i>
	<i>Equus sp.</i>	<i>Bison sp.</i>
		<i>Bos or Bison</i>

Tab. 5: Species list for Reilingen locality (data according to Ziegler & Dean 1998)

Interglacial species are straight-tusked elephant (*Elephas antiquus*), steppe rhino, *Dicerorhinus* (= *Stephanorhinus*) *hemitoechus*, wild boar (*Sus scrofa*), hippo (*Hippopotamus amphibius*), roe deer (*Capreolus capreolus*) and aurochs (*Bos primigenius*). Warm-adapted species clearly outnumber characteristically glacial ones, like mammoth (*Mammuthus primigenius*) and woolly rhino (*Coelodonta antiquitatis*). Other occurring species are ecologically unselective. Due to the fact that the deposits at Reilingen are inaccessible for screening procedures, no micromammals are known from the site hampering a stratigraphical elaboration. The occurrence of the giant beaver *Trogontherium* indicates a comparatively high age of the site. There are, however, other elements, like the Upper Pleistocene woolly mammoth (*Mammuthus primigenius*) which may be understood as evidence for a quite young age. Since the dredging procedure allows only rough associations with the profile which itself is inaccessible, ecological and chronological context of the hominid skull cannot be further revealed (Ziegler & Dean 1998).

Palaeoanthropology

The Reilingen skull consists of both of the parietals, the larger part of the right temporal and a partial occiput. It was recovered in May 1978. The cranial vault is comparatively low and elongated. It does neither show a sagittal crest, nor parasagittal depressions, but these features rarely appear in European *Homo erectus* anyway. Atop the well-marked inion, there is a well-developed suprainiac fossa, a characteristic feature of the Neanderthal skull. The upper scale of the occipital (being completely preserved) has slightly convex outlines in cross-section. This is also a characteristic Neanderthal feature. Nevertheless the broadest spot at the cranial vault is located in the region of the (evanescent) angular torus.

Overall, the cranial vault shows some resemblances with the Neanderthal skull, but has in general a quite archaic appearance. In terms of anatomy it represents certainly not a classic Neanderthal, but one of his European precursors. This intermediate position is supported by a PCA based on a large number of skull measurements by Dean et al. (1998). Dean et al. conclude on the basis of their thorough study, that the Reilingen skull is comparable to Steinheim, Bilzingsleben and Atapuerca / Sima de los Huesos in Spain. According to our four step evolutionary model, it has to be attributed to an advanced *Homo heidelbergensis* or Ante-Neanderthal (Stage 2).



Steinheim an der Murr

The Steinheim site represents a former sinuosity of the river Murr, a tributary to the Neckar River. Since the gravel deposits were exposed to local tectonic subsidence, the profile is difficult to retrieve properly in situ. The profile displays a series of gravel deposits separated by rather fine grained clay and sand horizons (Fig. 14). According to the mammal remains collected from the different layers, it is possible to attribute the Steinheim section to a series of glacial and interglacial phases, which correlate with the Holstein – Riss – Würm series.

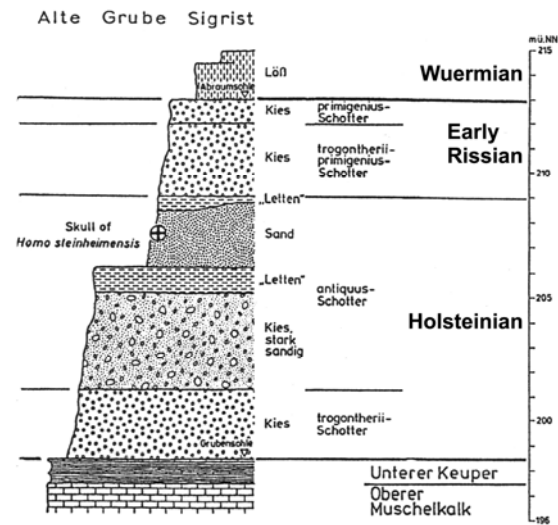


Fig. 14: Profile at the gravel pit in which the skull of *Homo steinheimensis* has been found (from Adam, Bloos & Ziegler 1995).

Palaeontology

The deposits in the profile at Steinheim show three distinct fossil bearing layers indicating a transition from glacial to interglacial environmental conditions followed by a return to glacial conditions (Tab. 6). Evidence for this transition comes from the succession in the Proboscideans; the Middle Pleistocene mammoth *Mammuthus trongontherii* is replaced by the forest-dwelling *Elephas antiquus* being again replaced by the Upper Pleistocene woolly mammoth *Mammuthus primigenius*. However, the picture is not as clear as the succession in the proboscideans suggests.

	Carnivora	Perissodactyla	Artiodactyla
trogontherii - primigenius gravels	<i>Canis lupus</i> <i>Ursus spelaeus</i>	<i>Coelodonta antiquitatis</i> <i>Equus steinheimensis</i>	<i>Cervus elaphus</i> <i>Megaloceros giganteus</i> ssp. <i>Bison priscus</i>
	Proboscidea <i>Mammuthus primigenius</i> <i>fraasi</i>		
antiquus gravels	Primates <i>Homo steinheimensis</i>	Proboscidea <i>Elephas antiquus</i>	Artiodactyla <i>Sus scrofa</i>
	Rodentia <i>Castor fiber</i>	<i>Stephanorhinus kirchbergensis</i> <i>Stephanorhinus hemitoechus</i>	<i>Capreolus capreolus priscus</i> <i>Cervus elaphus angulatus</i> <i>Megaloceros giganteus</i> <i>antecedens</i> <i>Bison cf. schoetensacki</i> <i>Bubalus murrensis</i> <i>Bos primigenius</i>
	Carnivora <i>Ursus spelaeus</i> <i>Meles meles</i>		
trogon- therii gravels	Proboscidea <i>Mammuthus trongontherii</i>	Perissodactyla <i>Stephanorhinus kirchbergensis</i> <i>Equus cf. mosbachensis</i>	Artiodactyla <i>Cervus elaphus</i> <i>Bison priscus</i>

Tab. 6: Species list of three fossil layers at Steinheim. The hominid find originates from the antiquus gravel layer (after Koenigswald & Heinrich 1999)



Few fossils are retrieved from the trogontherii gravels. The deposits are comparatively poor. *Mammuthus trogontherii* is understood as representative of a glacial environment, but *Stephanorhinus kirchbergensis* represents a warm-adapted form depending on forests. The comparatively poor enamel striation implies that it preferred smooth leaves instead of grass in its diet. The hominid remains were collected from the antiquus gravels, the deposits which provided the largest number of mammalian species. No clearly cold-adapted form is derived from this layer. Instead exotic guests like the water buffalo *Bubalus murrensis* are discovered. The upper fossil bearing layer is characterised by the appearance of the giant *Mammuthus primigenius*. The subspecies *Mammuthus primigenius fraasi* designates a transitional form between the Middle Pleistocene *M. trogontherii* and the Upper Pleistocene *M. primigenius* sensu strictu. Since no micromammals have been collected from the deposits biostratigraphic inferences cannot be substantiated.

Palaeoanthropology

The more or less complete, but damaged skull was discovered in 1933 by Karl Sigrist in his family's gravel pit. The specimen was subsequently studied by Berckhemer (1936) and treated in a monography by Weinert (1936).

The skull is damaged on its anatomically left temple. The cranial capacity amounts to approx. 1,100 ccm. Although there is still a supraorbital torus present, it is comparatively gracile and impressed above the nasal part. In the occipital part the skull is rounded and highly vaulted distinguishing this skull clearly from *Homo erectus* skulls. The skull also shows an incipient suprainiac fossa at the upper occipital scale.

In the four stage model it represents an advanced *Homo heidelbergensis* or Ante-Neanderthal (stage 1-2).



Upper Pleistocene to Holocene cave sites at the Swabian Alb

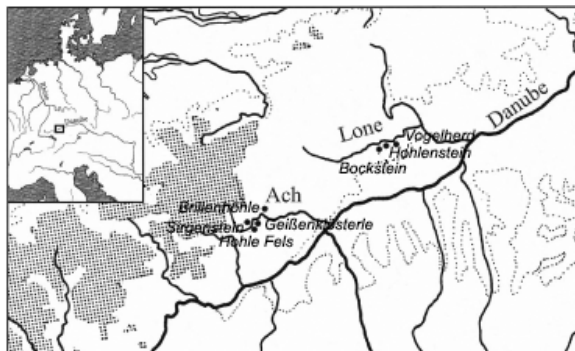
By crossing the low mountain ridge of the Swabian Alb on our way from Tübingen to Ulm we will change the river systems. We move from the valleys of the Rhine River and its tributary, the Neckar River, into the Danube valley close to its head. Whereas Rhine and Rhone systems provide a corridor to Southwest Europe, the Danube links Central Europe with the Southeast (Fig. 15). Since the Danube River discharges into the Black Sea in the East, the south eastern corridor represents one potential route for hominids on their way from the eastern Mediterranean into Central Europe.



Fig. 15: The course of the Danube River and its major tributaries (from Wikipedia).

The Malm limestone as bedrock of the Swabian Alb was deposited during the Late Jurassic in the marine regions of a Tethys basin. During Mio- and Pliocene, the mountain range of the Swabian Alb was uplifted and subsequently exposed to erosional processes. The erosion resulted in the formation of a Karst topography and the development of caves, mainly located at the eastern slopes of the Alb overlooking the Upper Danube valley (Fig. 16). Unlike the Rhine valley, the valley of the Danube River has largely been shaped by Pleistocene glaciers and their moraine loads.

During the Pleistocene some of these caves were occasionally inhabited by anatomically modern humans as well as used by Neanderthals. Those with Aurignacian and/or Gravettian horizons are shown in Fig. 16. In several caves indications for human presence date back to



the Middle Palaeolithic, thus covering a period prior to the arrival of *Homo sapiens* in Europe. Neanderthal remains have been particularly collected from the Hohlenstein-Stadel cave in the valley of the Lone. In numerous other caves in the Lone-and Ach valley, they left artefacts behind. Associated with *Homo sapiens* remarkable sculptures have been found. These sculptures have been carved from mammoth ivory by Late Pleistocene artists.

Fig. 16: Map of Southwestern Germany with principal cave sites; Ach valley: Sirgenstein, Hohle Fels, Geißenklösterle and Brillen cave; Lone valley: Bockstein, Hohlenstein, Vogelherd (from Conard & Bolus 2003).



Ach valley: Sirgenstein, Hohle Fels and Geißenklösterle caves

In the Ach as well as the Lone valley cave deposits occur which correlate with the Middle Palaeolithic, i.e. the deposits date to a period prior to 35,000 years. Although only anatomically modern human fossils have been collected from caves in the Ach valley, there are indications of Neanderthal presence in each of the caves introduced here. The presence of Neanderthals is inferred from the identification of Middle Palaeolithic archaeological horizons.

Sirgenstein cave

Several Middle Palaeolithic horizons are present at Sirgenstein cave. They did however not yield Neanderthal remains as yet. The Upper Palaeolithic deposits at Sirgenstein cave date to 27 – 30 ka BP (= kilo years before present). Hominid finds are attributed to modern *Homo sapiens* and originate from archaeological horizon VI with an age of approx. 30 ka BP (Tab. 7). Besides the older Aurignacian horizons, Gravettian horizons are also present, but hominid remains have not been collected from there. Ivory sculptures are lacking.

anatomical part	species	individual age	horizon	¹⁴ C date
left upper canine	modern <i>Homo sapiens</i>	adult	VI	c. 30,360 BP*
left lower molar	modern <i>Homo sapiens</i>	adult	VI	c. 30,360 BP*

Tab. 7: Hominid finds from Sirgenstein cave (*indirect bone date from same horizon according to Conard & Bolus 2003)

Hohle Fels cave

Several Middle Palaeolithic horizons occur, but they contain only few artefacts and are not (yet) dated. They provide nevertheless evidence for the presence of Neanderthals. The archaeologically richest deposits at Hohle Fels cave date to 27-29 ka BP and are associated with Gravettian artefacts. The sequence includes the horizons, where hominid finds have been collected from (Tab. 8). However, ongoing excavations have meanwhile reached Aurignacian horizons underlying the Gravettian (D in Fig. 17, Conard & Bolus 2003). Aurignacian horizons are likewise rich in artefacts and exceed in number the Gravettian horizons. A total of three ivory sculptures have been collected from Aurignacian horizons, namely a head sculpture possibly depicting a horse (from archaeological horizon IId), the only bird sculpture known as yet and an anthropomorphic figurine showing a human body with a felid head (both of them from archaeological horizon IV; Conard 2003b).

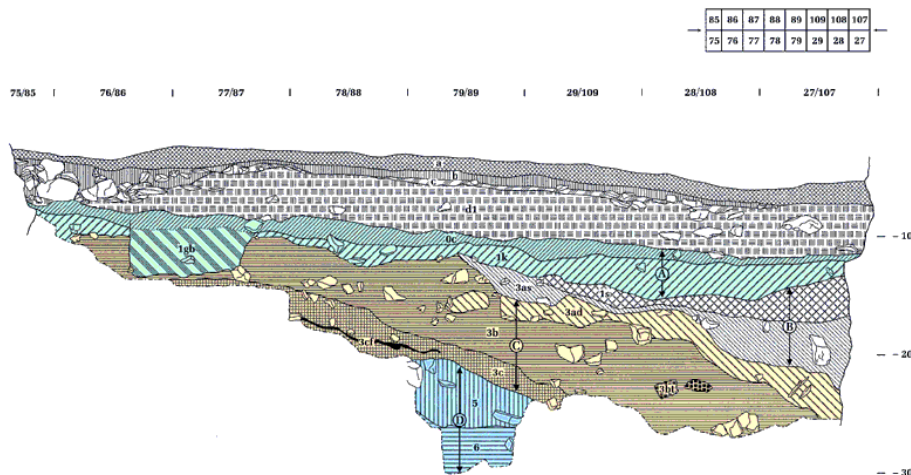


Fig. 17: Profil 2 (West) at Hohle Fels cave. **1** – recent; **A** – Holocene, Holocene faults with ceramics, from geological horizon 1k pure Magdalenian around 13.000 B.P. (geological horizons 0c-1k, archaeological horizons 0-I); **B** – Montmilch sediments and calcareous debris (geological horizons 1s-3as), probably correlated with last



glacial maximum; **C** – Gravettian (geological horizons 3ad-3d; archaeological horizons IIa-IIc), geological horizon 3cf consists mainly of burnt bone and serves as index horizon; **D** – Early Upper Palaeolithic (geological horizons 5-6, archaeological horizons III-IV) (from Urgeschichte Uni Tübingen).

anatomical part	species	individual age	horizon	¹⁴ C date
cranial fragment	modern <i>Homo sapiens</i>	young adult?	II	c. 27-29 ka BP*
right lower deciduous molar	modern <i>Homo sapiens</i>	juvenile	II	c. 27-29 ka BP*

Tab. 8: Hominid finds from Hohle Fels cave (*indirect bone date from same horizon according to Conard & Bolus 2003)

Geißenklösterle cave

Although hominid finds at Geißenklösterle cave are coming from a younger layer in the archaeological profile associated with Gravettian deposits, a series of older archaeological horizons is of higher importance. Associated Aurignacian artefacts provide ample evidence of human presence. In total the deposits span ages between 29 – 40 ka BP.

Besides Vogelherd cave in the Lone valley, Geißenklösterle cave is well-known for its ivory sculptures. Several sculptures have been collected from the upper of two Aurignacian horizons (archaeological horizon II), i.e. below those horizons providing the hominid material. Among these sculptures are a bison, a fragmentary standing bear, and an anthropogenic semi relief. The most remarkable find consists of two bone flutes. It was furthermore possible to reconstruct a third flute carved from ivory. The horizons where those artefacts have been collected from possess an age of 32 – 35 ka BP.

anatomical part	species	individual age	horizon	¹⁴ C date
right upper deciduous molar	modern <i>Homo sapiens</i>	child	II	c. 26 – 29 ka BP*
deciduous molar	modern <i>Homo sapiens</i>	?	II	c. 26 – 29 ka BP*

Tab. 9: Hominid finds from Geißenklösterle cave (*indirect bone date from same horizon according to Conard & Bolus 2003)

Lone valley: Hohlenstein (Stadel) and Vogelherd caves

The cave deposits in the Lone valley date back to the Middle Palaeolithic. Deposits related with the Neanderthals have been discovered at Hohlenstein-Stadel, Vogelherd, Bockstein and Haldenstein, the latter two unaccounted for here. Neanderthal remains have been found at Hohlenstein-Stadel. The cave deposits in the Lone valley possess a similar age and cover equivalent time spans as already outlined for the Ach valley.

Hohlenstein-Stadel cave

The cave system at Hohlenstein was excavated since the mid nineteenth century by Oskar Fraas, Robert Wetzell, O. Völzing, and E. Wagner. Hohlenstein-Stadel represents the only cave site in Baden Württemberg, where fossil remains provide evidence for presence of Neanderthals (Tab 10). The cave deposits indicate a complex stratigraphy demanding careful interpretation of the sequence in particular with reference to dating. The horizons with Aurignacian archaeological context are associated with modern *Homo sapiens*. The archaeological finds consist of blades and scrapers. Additionally, a single ivory carved sculpture has been collected from Hohlenstein-Stadel. This figurine is of special interest, because it represents an anthropomorphic body with a lion-like head.



anatomical part	species	individual sex + age	horizon	¹⁴ C date
diaphysis of a right femur	Neanderthal	male? adult	"Black Mousterian"	?
premolar	modern <i>Homo sapiens</i>	young adult	19-20 m Spit 6	31-23 ka BP*

Tab. 10: Hominid finds from Hohlenstein-Stadel cave (*indirect bone date from same horizon according to Conard & Bolus 2003).

Vogelherd cave

The Vogelherd cave was first excavated by Gustav Riek in 1931. Hominids at Vogelherd have been collected from horizons IV and V in the archaeological profile (Fig. 18). The hominid bearing deposits have been dated to 26-36 ka BP (horizon IV: 26-30 ka BP, horizon V: 31-36 ka BP according to Conard & Bolus 2003). All hominid finds were attributed to *Homo sapiens* (Tab. 11). However, recent direct dating of the specimens indicates a considerably younger age of the hominid remains proper (Conard, Grootes & Smith 2004). The archaeological context of those finds consists, among others, of Aurignacian blades and scrapers. Besides hominid remains eleven ivory sculptures have been collected from archaeological horizons IV and V listed in Tab. 12.

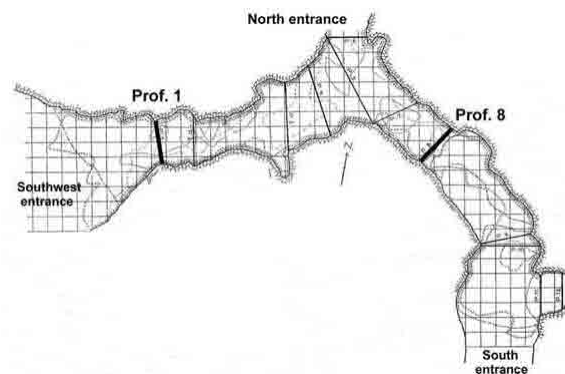
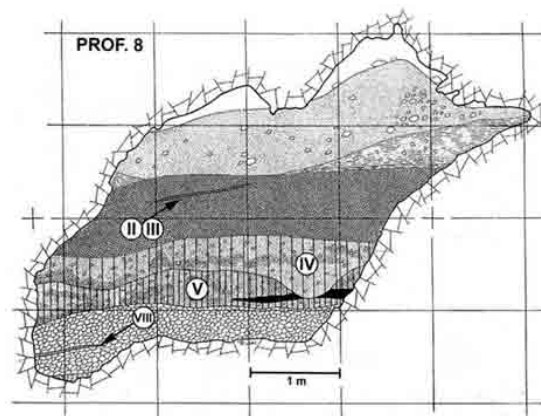
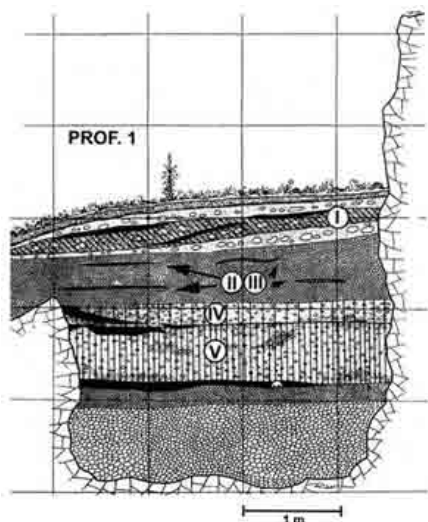


Fig. 18: Cave map (left) and profiles 1 and 8 (top, opposite page); archaeological horizon I – Neolithic; horizons II, III – Magdalenian; horizons IV, V – Aurignacian; horizons VI, VII – Middle Palaeolithic; horizon VIII – Middle Palaeolithic (bifacial); horizon IX – Middle Palaeolithic base (from Urgeschichte, Uni Tübingen).





anatomical part	species	individual sex + age	horizon	¹⁴ C date
Stetten 1 cranium incl. mandibula	modern <i>Homo sapiens</i>	male adult	V (basis)	4,900 BP
2 lumbar vertebrae	modern <i>Homo sapiens</i>	male adult	V (basis)	4,200 – 4,700 BP
Stetten 3 humerus	modern <i>Homo sapiens</i>	male	V (basis)	5,000 BP
Stetten 4 left metacarpal	modern <i>Homo sapiens</i>		V (basis)	c. 31 – 36 ka BP*
Stetten 2 cranium	modern <i>Homo sapiens</i>	male young adult	IV top	3,980 – 3,560 BP

Tab. 11: Hominid finds from Vogelherd cave. * - indirect bone date from same horizon according to Conard & Bolus 2003; all other dates were collected from direct samples according to Conard, Grootes & Smith 2004.

item	arch. horizon	item	arch. horizon
mammoth semi relief	IV	lion head	Unknown
bison sculpture	IV	mammoth sculpture	V
rhino? Sculpture	IV	horse sculpture	V
anthropomorphic sculpture	IV	reindeer / lion? sculpture	V
lion? sculpture	IV	snow leopard sculpture	V
		mammoth rear part	V

Tab. 12: Sculptures collected from Vogelherd cave (data according to Holdermann, Müller-Beck & Simon 2001)

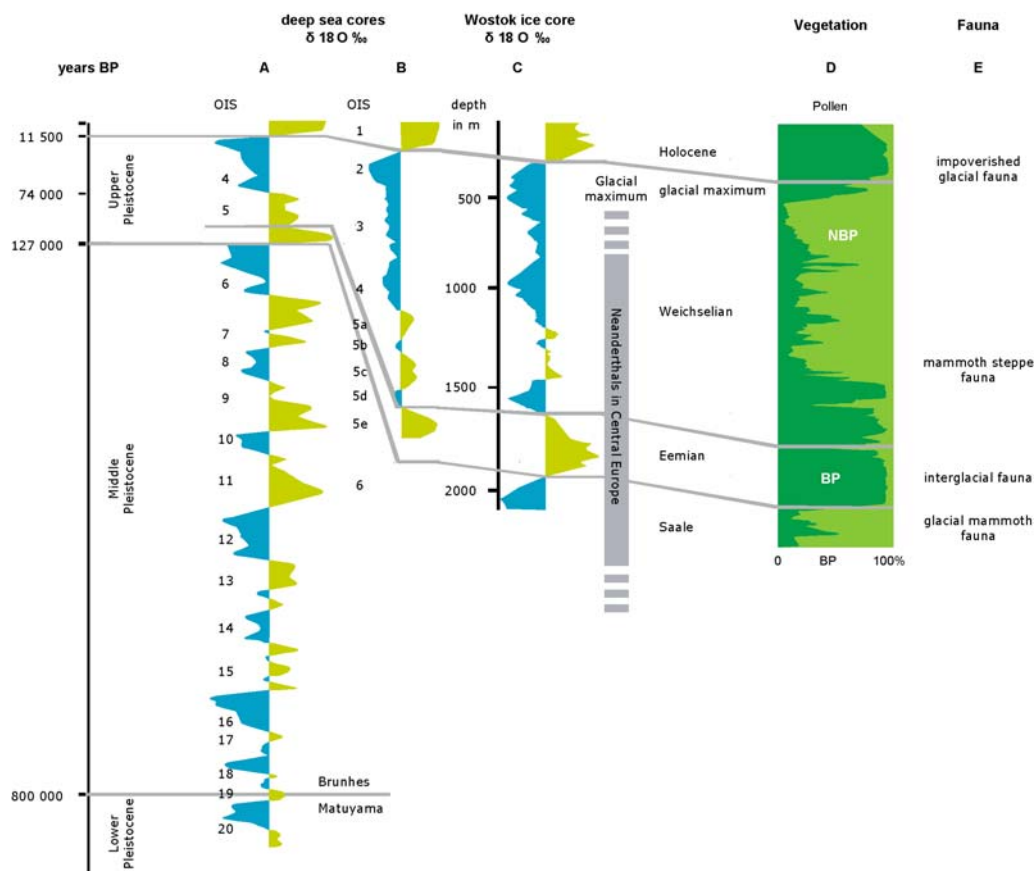


Fig. 19: Schematic drawing of climatological data during the Upper Pleistocene (altered after von Koenigswald 2002)



Middle Pleistocene sites in the Thuringian Basin

The Thuringian Basin extends between the Harz Mountains in the North and the Thuringian Slate Mountains in the Southeast, both mountain ranges being part of the Central German Variscian mountain range. The Harz Mountains are oriented north-west to southeast as are numerous associated Hercynian fault structures that occur throughout the Thuringian Basin. The bedrocks within the Thuringian Basin mainly consist of Triassic sediments having been filled with sedimentary deposits during the Cenozoic.

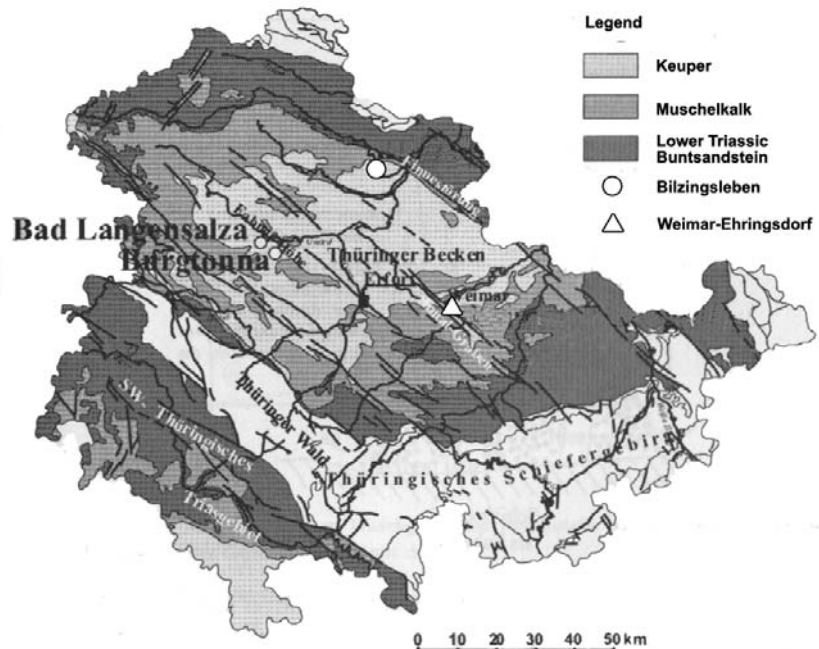


Fig. 20: Geological overview of the Thuringian basin
(from Mallick et al. 2001 after Seidel 1995)

During Pleistocene glacial periods the northeastern boundary of the Thuringian Basin was repeatedly reached by the Scandinavian glacial complex. The basin constituted a drainage region at the margin of glacial ice sheets. A large number of well-known Pleistocene fossil localities are situated in the Thuringian Basin. Among them are Untermaßfeld, Süßenborn, Weimar-Ehringsdorf, Bilzingsleben and Burgtonna. At some of these sites, Bilzingsleben and Weimar-Ehringsdorf, hominids have been found. Both of the localities date to the Middle Pleistocene Holstein complex. Bilzingsleben (MIS 11) is presumably older than Weimar-Ehringsdorf (MIS 7).

Weimar-Ehringsdorf

The deposits at Weimar-Ehringsdorf consist of a series of travertines underlain by basal fluvial gravels and flood loams from the Ilm River (Fig. 21). The overlying travertines can be roughly subdivided into two sections, so-called Lower and Upper Travertines, which are separated by a particular medium to coarse clay layer called “Pariser Boden” (Pariser soil). All sections of the profile contain mammal fossils (Tab. 12a-d).

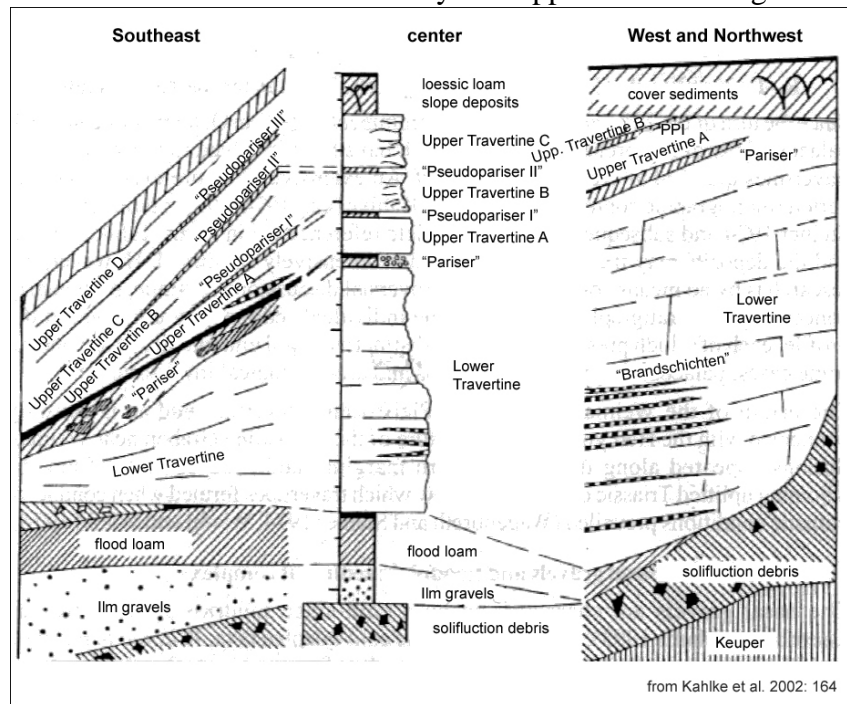
The formation of travertine at Weimar-Ehringsdorf is linked to the Hercynian structure of the Ilm Valley Graben. Along the south-western boundary fault, springs emerged from the Triassic carbonates of the upper block and under suitable climatic conditions deposited travertine. The formation of travertine nevertheless is linked with the presence of certain biological and chemical milieus, requiring e.g. the presence of carbonate minerals or streams saturated with calcium carbonate. It is moreover restricted to raised temperatures in the



environment. The deposition of travertines is thus more likely to happen under interglacial than glacial conditions. The sequence of fluvial deposits, Lower Travertine formation, deposition of the “Pariser Boden” clays and formation of the Upper Travertines thus already indicates a temperature-coupled cycle, for which the mammalian assemblages provide further evidence.

Hominid fossils and archaeological inventories originate in particular from the Lower Travertines.

Fig. 21: Profile of the travertine complex at Weimar-Ehringsdorf (from Kahlke et al. 2002)



Paleontology

The deposits at Weimar-Ehringsdorf provided rich faunal collections entailing micro- and macromammals alike. Moreover, amphibians, reptiles, molluscs and plant remains have been described. The paleontological context of the different sections can thus be considered as comparatively well known.

Only few macromammal species have been collected from the underlying Ilm gravels and/or flood loam. Woolly mammoth (*Mammuthus primigenius*) and woolly rhino (*Coelodonta antiquitatis*) occur in these deposits. The presence of two evidently cold adapted species indicates an open and continental steppe environment. This interpretation is supported by the malacofauna and flora. It is nonetheless somehow questioned through the discovery of a pond tortoise (*Emys obicularis*) requiring permanently ice free lacustrine and/or swampy habitats.

Ilm gravels + flood loam	Proboscidea	Perissodactyla
	<i>Mammuthus primigenius</i>	<i>Coelodonta antiquitatis</i>

Tab. 13a: Species list for the Ilm gravels in the Weimar-Ehringsdorf profile (after von Koenigswald & Heinrich 1999)

Different environmental conditions are preserved in the following lower section of the Lower Travertines. The presence of Merck’s rhino (*Stephanorhinus kirchbergensis*) and straight-tusked elephant (*Elephas antiquus*) indicates interglacial conditions. Besides, a remarkably diverse carnivore fauna has been collected from the Lower Travertines. The continental influence increases towards the upper boundary. The numerical proportion of *Stephanorhinus hemitoechus* rises and the occurrence of steppe pika, *Ochotona pusilla*, finally indicates an open landscape and thus the transition to rather glacial climatic conditions (Tab. 12b). The micromammals support this transition, particularly in the upper part of the Lower Travertines. Hominids have been collected exclusively from the Lower Travertines at Weimar-Ehringsdorf.



Lower Travertine (*)	Insectivora	Primates	Perissodactyla
	<i>Talpa europaea</i>	archaic <i>Homo sapiens</i> (Stage 3 Pre-Neanderthal)	<i>Stephanorhinus kirchbergensis</i>
	<i>Sorex minutus</i>	Carnivora	<i>Stephanorhinus hemitoechus</i>
	<i>Sorex ex gr. araneus</i>	<i>Meles meles</i>	<i>Equus chosaricus</i>
	<i>Crocidura ex gr. russula-leucodon</i>	<i>Martes martes</i>	Artiodactyla
	Lagomorpha	<i>? Ursus thibetanus</i>	<i>Sus scrofa</i>
	<i>Ochotona pusilla</i>	<i>Ursus arctos</i>	<i>Capreolus capreolus</i>
	Rodentia	<i>Ursus spelaeus</i>	<i>Alces latifrons</i>
	<i>Spermophilus citelloides</i>	<i>Vulpes vulpes</i>	<i>Cervus elaphus</i>
	<i>Sicista ex gr. Subtilis-betulina</i>	<i>Canis lupus</i>	<i>Dama dama</i>
	<i>Allocrietus bursale</i>	<i>Crocota crocuta</i>	<i>Megaloceros giganteus</i>
	<i>Cricetus cricetus</i>	<i>Cyruonyx antiqua</i>	<i>Bison priscus mediator ?</i>
	<i>Apodemus sylvaticus</i>	<i>Lynx lynx</i>	<i>Bison priscus ssp.</i>
	<i>Apodemus maastrichtiensis</i>	Proboscideans	
	<i>Clethrionomys glareolus</i>	<i>Elephas (Palaeoloxodon) antiquus</i>	
	<i>Arvicola mosbachensis</i>		
	<i>Microtus arvalis</i>		
	<i>Microtus agrestis</i>		
	<i>Microtus ex gr. arvalis/agrestis</i>		
	<i>Microstus oeconomus</i>		
<i>Microtus (Terricola) subterraneus</i>			
<i>Microtus (Stenocranius) gregalis</i>			
<i>Castor fiber</i>			

Tab. 13b: Species list for the Lower travertines in the Weimar-Ehringsdorf profile (after von Koenigswald & Heinrich 1999; completed after Kahlke et al. 2002). Hominid fossils exclusively originate from these layers.

The following “Pariser Boden” provided only few large mammal species, but a substantial small mammal sample. The macromammals, in particular steppe rhino (*Stephanorhinus hemitoechus*), woolly mammoth (*Mammuthus primigenius*) and giant deer (*Megaloceros giganteus*) indicate open and continental environmental conditions, at least in the lower section of the Pariser horizon. Most abundant among the micromammals are wood mouse group (*Apodemus*) and bank vole (*Clethrionomys glareolus*). Meanwhile, also numerous remains of an edible dormouse (*Glis glis*) have been described. After the bank vole, the European pine vole (*Microtus subterraneus*) represents the most common arvicolid. The relative frequencies of these animals, combined with the European hedgehog (*Erinaceus europaeus*), a white-toothed shrew (*Crocidura ex. gr. russula-leucodon*), red squirrel (*Sciurus vulgaris*), edible dormouse and bank vole, indicate again peak interglacial conditions.

„Pariser Boden“	Insectivora	Rodentia	Carnivora
	<i>Erinaceus europaeus</i>	<i>Sciurus vulgaris</i>	<i>Martes martes</i>
	<i>Talpa europaea</i>	<i>Sicista ex gr. subtilis-betulina</i>	<i>Ursus sp.</i>
	<i>Sorex minutus</i>	<i>Cricetus major</i>	<i>Crocota crocuta spelaea</i>
	<i>Sorex ex gr. araneus</i>	<i>Apodemus flavicollis</i>	<i>Vulpes vulpes</i>
	<i>Croc. ex gr. russula-leucodon</i>	<i>Apodemus sylvaticus</i>	Proboscidea
	Chiroptera	<i>Apodemus maastrichtiensis</i>	<i>Mammuthus primigenius</i>
	<i>Chiroptera indet.</i>	<i>Clethrionomys glareolus</i>	Perissodactyla
	Lagomorpha	<i>Arvicola sp.</i>	<i>St. hemitoechus</i>
	<i>Ochotona pusilla</i>	<i>Microtus agrestis</i>	Artiodactyla
	<i>Lepus sp.</i>	<i>Microtus ex gr. arvalis/agrestis</i>	<i>Sus scrofa</i>
		<i>Microtus oeconomus</i>	<i>Capreolus capreolus</i>
		<i>Microtus (Terricola) subterraneus</i>	<i>Megaloceros giganteus</i>
		<i>Microtus (Stenocranius) gregalis</i>	<i>Bos vel Bison</i>



³The Upper Travertines finally yielded a large mammal fauna, which is evidently related to glacial conditions. Characteristically interglacial forms like the straight-tusked elephant (*Elephas antiquus*) or *Stephanorhinus kirchbergensis* are completely absent. Instead, open landscape related species like the woolly mammoth (*Mammuthus primigenius*), steppe rhino (*Coelodonta antiquitatis*), elk (*Alces latifrons*) and giant deer (*Megaloceros giganteus*) appear.

Upper Travertine	Insectivora	Primates	Perissodactyla
	<i>Talpa europaea</i>	<i>Homo sapiens</i>	<i>Stephanorhinus hemitoechus</i>
	<i>Crocidura ex gr. russula-leucodon</i>	Carnivora	<i>Coelodonta antiquitatis</i>
	<i>Soricidae indet.</i>	<i>Panthera leo spelaea</i>	<i>Equus cf. taubachensis</i>
	Chiroptera	<i>Meles meles</i>	Artiodactyla
	<i>Myotis nattereri</i>	<i>Martes martes</i>	<i>Sus scrofa</i>
	Rodentia	<i>Mustela sp.</i>	<i>Bison priscus mediator</i>
	<i>Spermophilus ex gr. citellus</i>	<i>Ursus arctos</i>	<i>Capreolus capreolus</i>
	<i>Glis glis</i>	<i>Ursus spelaeus</i>	? <i>Rangifer tarandus</i>
	<i>Cricetus cricetus</i>	<i>Canis lupus</i>	<i>Alces latifrons</i>
	<i>Apodemus sylvaticus</i>	Proboscidea	<i>Cervus elaphus</i>
	<i>Clethrionomys glareolus</i>	<i>Mammuthus primigenius-trogontherii</i>	<i>Megaloceros giganteus germaniae</i>
	<i>Arvicola mosbachensis</i>	<i>Mammuthus primigenius</i>	
	<i>Microtus arvalis</i>		
	<i>Microtus (Terricola subterraneus)</i>		
<i>Microtus sp.</i>			

Tab. 13d: Species list for the Upper travertines in the Weimar-Ehringsdorf profile (after von Koenigswald & Heinrich 1999)

The whole section at Weimar-Ehringsdorf thus encompasses a series of presumably two alternating glacial-interglacial cycles. Fortunately, the rich micromammal assemblage collected from the deposits at Weimar-Ehringsdorf moreover allows a stratigraphic classification. The deposits are attributed to the *Arvicola mosbachensis/terrestris*-fauna and thus to the Upper Middle Pleistocene.

Palaeoanthropology

From Weimar-Ehringsdorf comes one of the richest collections of fossil hominids in Germany. The sample includes a fragmented juvenile skeleton including the mandible and isolated teeth (spec. G), several parietal fragments belonging to four individuals (specs. A, B, C, D), a fragmented femur (spec. E), another mandible (spec. F), a cranium (spec. H) and several isolated teeth (spec. I). The specimens have been collected during quarry activities between 1908 and 1925.

The frontal part of the skull is characterized by a continuous supraorbital torus which is slightly impressed on top of the nasals. However, a pronounced postorbital constriction is lacking. This constitutes a major difference compared to the skull fragments from Bilzingsleben. The cranial capacity of the Ehringsdorf skull H was estimated to 1,400 ccm. The skull itself is too fragmented to allow direct measurements. Elevated cranial capacity and incipient postorbital constriction distinguish it clearly from *Homo erectus*. In the frontal part the find from Weimar-Ehringsdorf is quite similar to the Steinheim skull. Nevertheless, it possesses a still higher cranial capacity. Unlike Steinheim, the occipital part of Ehringsdorf

³ **Tab. 13c (previous page):** Species list for the "Pariser Boden" in the Weimar-Ehringsdorf profile (after von Koenigswald & Heinrich 1999; completed after Kahlke et al. 2002)



spec. H is rounded and does not show an occipital torus. Instead, skull H shows an impression in the upper scale of the occipital positioning this skull closer towards classic Neanderthals. Compared to Steinheim, the hominid series from Weimar-Ehringsdorf does thus display some Neanderthal characteristics. However, the series also retains some basal features. The hominids from Weimar-Ehringsdorf are thus attributed to the third stage in Neanderthal evolution, i.e. to Pre-Neanderthals.

Archaeology

The inventories of the Lower travertines at Weimar-Ehringsdorf are still under study. However, they consist of diversified artifacts. Most of them are recognized as Mousterian core tools of Levalloisian technique.

Of particular archaeological interest are moreover so called 'hearths' (i.e. fire layers) recognizable in the Lower travertines, although human impact is unknown.

Bilzingsleben

Bilzingsleben is located at the northern margin of the Thuringian basin (Fig. 20). The deposits consist of gravel terraces of the Wipper River and travertine. According to Mania (1995a) the lower terrace system (Bilzingsleben II) represents a series of six terraces each deposited during a cold-warm cycle (Fig. 22). Gravel deposition during the cold phase is followed by deposition of sands and formation of travertines during the warm phase. This interpretation is still under discussion and other proposals with a lower number of terraces have been issued (Eissmann & Litt 1992).

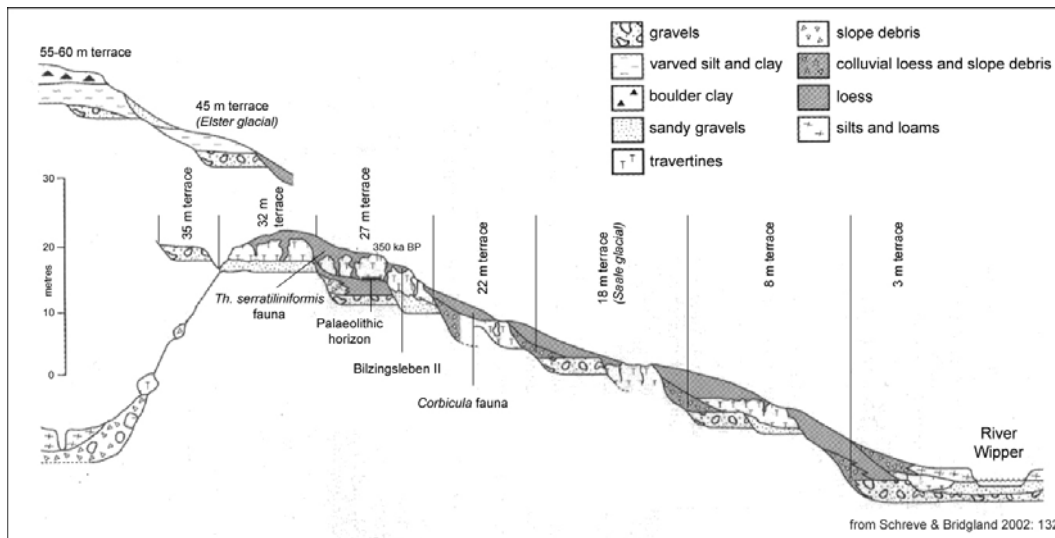
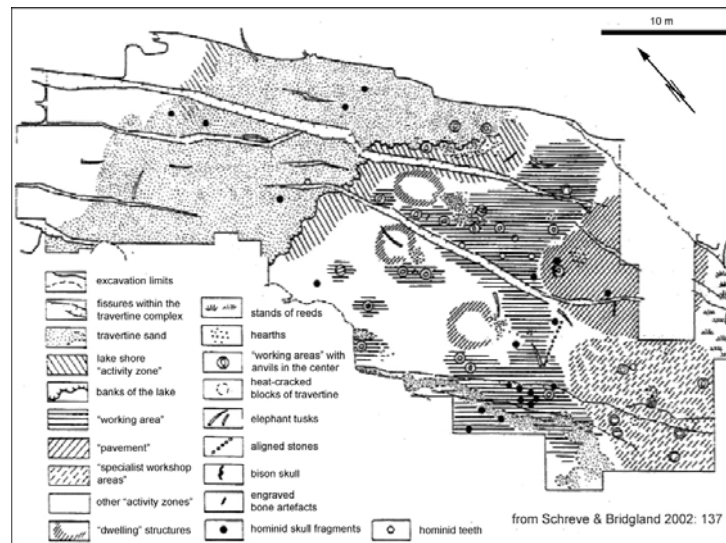


Fig. 22:
Sequence
of terraces
and
travertines
in the
Wipper
valley
(from
Schreve &
Bridgland
2002)

The 18 m terrace is correlated with the Saale glacial or MIS 6, whereas the 45 m terrace correlates with the Elster glacial (MIS 12). The hominids have been discovered at the 27 m terrace, on which we will focus here. This terrace is correlated with stage MIS 11. It has been explored on the occasion of extensive and organised excavations (Fig. 23). As recognisable in the excavation map, a sorting of the finds appears. The sorting has frequently been attributed to hominid activities. The excavation map thus depicts far-reaching interpretations. However, the anthropogenic impact has recently been questioned. According to a new proposal, the vertical and spatial distribution of the finds and deposits results from natural formation processes, e.g. mass-flows (Beck et al., in print)



Fig. 23: Excavation map from Bilzingsleben II. Whether the sequence of deposits is due to anthropogenic influence (as implied by this map) or may rather be explained by geophysical processes is presently under dispute. The area is currently subjected to new studies (from Schreve & Bridgland 2002)



Paleontology

Large collections of mammal fossils have been collected during the excavations (Tab. 14). Warm-adapted species like the straight-tusked elephant (*Elephas antiquus*) and Merck's rhino (*Stephanorhinus kirchbergensis*) dominate the assemblage and indicate interglacial conditions. Moreover, finds of macaques (*Macaca sylvanus*) clearly demonstrate the presence of closed forest and/or closed woodland. Finds of amphibians, reptiles and birds moreover indicate the occurrence of ice free open water resources e.g. like lakes.

Insectivora	Carnivora	Proboscidea
<i>Talpa sp.</i>	<i>Ursus deningeri-spelaeus</i>	<i>Elephas (Palaeoloxodon) antiquus</i>
<i>Sorex araneus</i>	<i>Panthera (Leo) spelaea</i>	Perissodactyla
<i>Crociodura ex. gr. russula-leucodon</i>	<i>Felis silvestris</i>	<i>Stephanorhinus kirchbergensis</i>
Primates	<i>Canis lupus</i>	<i>Stephanorhinus hemitoechus</i>
<i>Macaca sylvanus</i>	<i>Meles meles</i>	<i>Equus mosbachensis-taubachensis</i>
<i>Homo erectus bilzingslebenensis</i>	<i>Vulpes vulpes</i>	Artiodactyla
Rodentia	<i>Martes martes</i>	<i>Sus scrofa</i>
<i>Spermophilus (Urocitellus) sp.</i>	<i>Lutra sp.</i>	<i>Cervus elaphus</i>
<i>Glis glis</i>	Rodentia (cont'd)	<i>Megaloceros sp.</i>
<i>Muscardinus avellanarius</i>	<i>Microtus (Terricola) subterraneus</i>	<i>Dama dama clactoniana</i>
<i>Allocricetus bursae</i>	<i>Microtus oeconomus</i>	<i>Capreolus cf. suessenbornensis</i>
<i>Apodemus sylvaticus</i>	<i>Arvicola mosbachensis</i>	<i>Bison priscus</i>
<i>Apodemus flavicollis</i>	<i>Lagurus lagurus</i>	<i>Bos primigenius</i>
<i>Clethrionomys glareolus</i>	<i>Castor fiber</i>	
<i>Microtus arvalis/agrestis</i>	<i>Trogontherium cuvieri</i>	

Tab. 14: Species list for the 27 m Wipper terrace (after von Koenigswald & Heinrich 1999; completed after Schreve & Bridgland 2002)

The micromammal assemblage supports this interpretation. The presence of *Arvicola mosbachensis* and corresponding SDQ relates this fauna to the younger *Arvicola mosbachensis* fauna.

Palaeoanthropology

The hominid assemblage from Bilzingsleben consists of several fragments of two cranial vaults, a mandibular ramus without teeth and several isolated teeth. In order to reconstruct the cranial vault the skull fragments were fitted with OH9. According to the reconstruction by Vlcek (1999) the Bilzingsleben hominids are quite similar to African *Homo erectus* (OH9), *Sinanthropus* III from Zhoukoudian / China and/or *Pithecanthropus* VIII from Sangiran. It is



of course speculative to compare the overall shape and outline of the skulls, but there are nevertheless several diagnostic features substantiating Vlcek's proposal. One of the fragments for instance demonstrates a pronounced post-orbital constriction. Moreover, strong cranial superstructures can be observed, i.e. supraorbital and occipital torus structures. This set of features points to an early stage in human evolution in Central Europe. The Bilzingsleben hominids are thus attributed to the first stage of human evolution in Central Europe, i.e. to *Homo heidelbergensis*.

They possess an age comparable to the Steinheim lady and are somewhat younger than the Mauer mandible.

Archaeology

Numerous artefacts have been collected during the excavations by D. Mania. The inventory is of special interest, because it represents one of the largest early collections of Middle Pleistocene artefacts in Central Europe.

The assemblage consists mainly of chopping tools manufactured from quartzite, limestone and travertine. These chopping tools have been used for a variety of purposes, e.g. dismounting of carcasses, splitting and scraping. A second group of artifacts consists of small flint flakes. The travertine finally permitted the preservation of artefacts made from organic raw materials, e.g. bone, tusk, antler and wood.

Fortunately, another site of similar age north of the Harz Mountains, Schöningen, contributes to clarify the understanding of the inventory from Bilzingsleben.



Middle Pleistocene sites in the northern Hercynian foreland

The northern Hercynian foreland is especially characterized by its extensive brown coal deposits. These deposits have been (and still are) mined for centuries. The landscape is dominated by a series of northwest – southeast trending syn- and anticlines. During the Pleistocene the channels were filled up with glacial loads, glaciofluvial gravels and limnic deposits. The oldest Pleistocene deposits date back to the Elster glacial. Fig. 24 depicts the distribution of Holsteinian and thus younger section of the deposits.

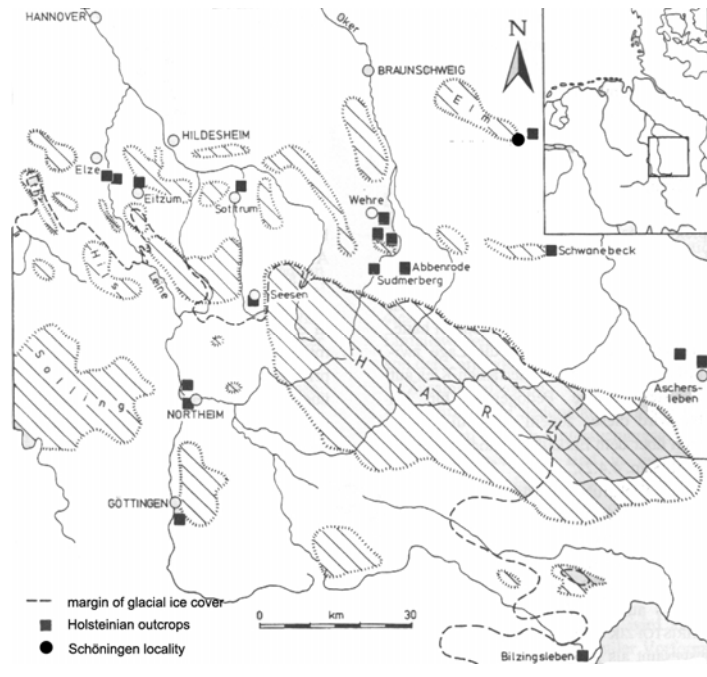


Fig. 24: Holsteinian deposits in the Harz Mountain and adjacent areas (from Feldmann 2002)

Schöningen

The locality of Schöningen is characterized by a series of six channel fillings (Fig. 25). The fillings deposited during individual glacial-interglacial cycles Schöningen I – III consist of organic silt and peat originating from lacustrine environments. These deposits date between Elster and Saale glacials. Cycle Schöningen IV is younger than the Saale glacial maximum and consists of a thick doubled soil complex. Still younger are cycle Schöningen V (Eem interglacial) and Schöningen VI (Holocene).

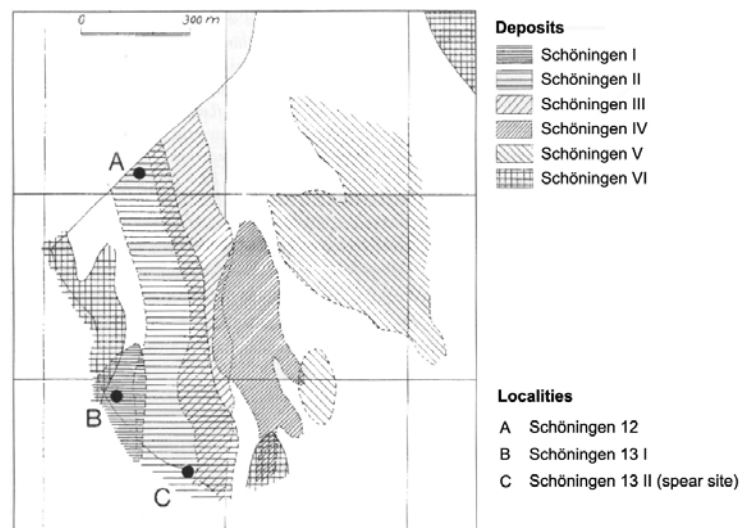


Fig. 25: Course of the Middle and Upper Quaternary depressions at Schöningen (from Thieme 1997)

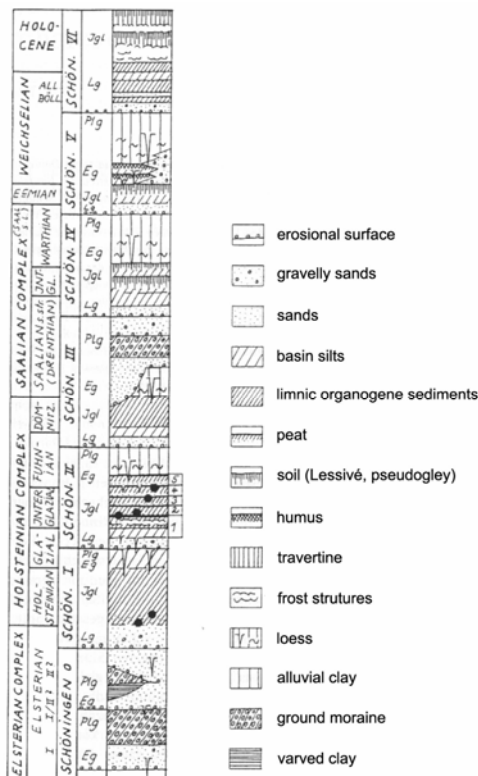


Fig. 26 shows a general stratigraphic scheme for the sequence of the Schöningen deposits. Hominid fossils were not found at Schöningen locality, but Schöningen sites 13 I and 13 II have provided numerous artefacts and mammalian fossils. Moreover, among other wooden implements eight wooden spears have been preserved more or less undamaged at Schöningen 13 II (A in Fig. 25). These spears represent the oldest wooden distance weapons known on a worldwide scale and, beyond their exceptional preservation, functionality and beauty, prove ample evidence of human presence.

Fig. 26: Stratigraphic scheme for the Middle and Upper Quaternary sequence at Schöningen locality (from Thieme 1997)

Paleontology

We focus here on the mammalian assemblage collected from site 12 (cycle Schöningen II, Fig. 25 A) summarized in Tab. 15. The occurrence of straight-tusked elephant (*Elephas antiquus*), Merck's rhino (*Stephanorhinus kirchbergensis*) and wild boar (*Sus scrofa*) indicate interglacial conditions. The abundance of horses (*Equus sp.*) as well as the occurrence of open landscape related small mammals, e.g. the lemming (*Lemmus lemmus*) characterise a generally open landscape. According to lithostratigraphic correlations (Fig. 26), the interglacial preserved at cycle Schöningen II represents a new interglacial period between Elster and Saale glacials. In order to permit identification within the Holsteinian complex, a special name has been attributed, namely Reinsdorf interglacial. The separation from the Holsteinian complex is substantiated by detailed studies of vegetation and climate.

The small mammal fauna from the Reinsdorf interglacial is characterized by the appearance of *Arvicola mosbachensis* and the giant beaver *Trogontherium cuvieri*. The SDQ corresponds to a Middle Pleistocene younger *Arvicola mosbachensis* fauna and indicates close chronological correspondence with the Bilzingsleben hominid site (MIS 11).

Insectivora	Rodentia	Proboscidea
<i>Sorex minutus</i>	<i>Trogontherium cuvieri</i>	<i>Elephas antiquus</i>
<i>Sorex sp. (araneus-Gruppe)</i>	<i>Castor fiber</i>	Perissodactyla
<i>Desmana sp.</i>	<i>Lemmus lemmus</i>	<i>Equus sp.</i>
Carnivora	<i>Clethrionomys glareolus</i>	<i>Stephanorhinus kirchbergensis</i>
<i>Ursus sp.</i>	<i>Arvicola mosbachensis</i>	Artiodactyla
<i>Mustelidae gen. et spec. indet.</i>	<i>Microtus (Terricola) subterraneus</i>	<i>Sus scrofa</i>
	<i>Microtus ex gr. arvalis/agrestis</i>	<i>Cervus elaphus</i>
	<i>Microtus agrestis</i>	<i>Capreolus capreolus</i>
	<i>Microtus oeconomus</i>	<i>Bos vel Bison</i>
	<i>Apodemus sp.</i>	

Tab. 15: Species list for the locality Schöningen 12 (after von Koenigswald & Heinrich 1999)



The locality at Schöningen 13 II-4 (Fig. 25, C) is understood as hunting ground. The remains of at least twenty butchered horses have been collected. Besides spears and numerous other flint artefacts (in particular scrapers and pointed tools), human activities are indicated by cutmarks at a large proportion of the remains. The composition of the large mammal assemblage does thus not immediately reflect the ecological frequency of the species in their natural environment. Moreover, large mammal species not representing attractive game will not appear in the collection. Middle Pleistocene hunters selected those species from the variety of large mammals representing attractive game for their purposes. Different from the large mammals, the micromammal community was not subject of human activities (or at least to a considerably smaller extent). The ecological signal from the small mammal assemblages is therefore more reliable than the one taken from large mammals. Interestingly, the excavations have also yielded several predator species, i.e. a bear and mustelids. In particular the mustelids are unlikely to constitute attractive game. The family of mustelids is characterized by the possession of scent glands which render it improbable that its representatives have been exploited by humans.

Archaeology

The inventory collected from Schöningen 13 II-4 (horse-hunting site) consists predominantly of scrapers and flint points. Waste flakes were also discovered, demonstrating that the tools have been retouched and sharpened along with their usage. Several areas at the excavation site indicate moreover the use of fire.

Furthermore, a series of eight spears have been found. The shortest one is 1.82 m long and possesses a maximal diameter of 2.9 cm. The largest one is almost 1 m longer, about 2.50 m. Its maximal diameter is 5 cm. Most of the spears have been carved from spruce trunks, a single is made of a pine trunk. The spears are sharpened at both ends. The extension of the tip carvings is asymmetrical. While the presumptive rear tip carving extends only approx. 10 cm, throwing tip carvings are generally larger and extend over 25 cm, whereas in the larger specimens it exceeds 60 cm.

These exceptional discoveries clearly show that Middle Pleistocene hominids were capable of arranging organised hunting parties. They were able to manufacture and use distance weapons with deadly precision. Ten thousands of bones belonging to at least twenty of horse individuals demonstrate that Middle Pleistocene humans in Central Europe were efficient and successful hunters.



Upper Pleistocene classic Neanderthals in the Lower Rhenian Embayment

Feldhofer Cave at Neander Valley

The Neander Valley has long been known as a recreation area for guests from the nearby Düsseldorf. The valley of the Düssel River was equipped with romantic caves and a dense forest, making it suitable as an exotic party location. Geologically, the valley consisted of Devonian limestone. In the middle of the 19th century with the beginnings of industrialisation, the limestone was mined. During these mining operations, the caves were cleared and the debris thrown out onto the valley ground. Occasionally, the bones of large and extinct mammals were found in these deposits. Nowadays, nothing is left from the original deposits, with the exception of debris mounts.

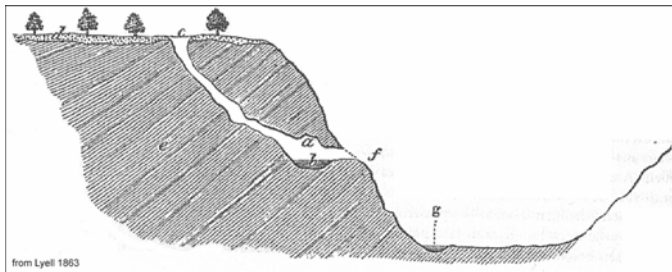


Fig. 27: Profile drawing of Feldhofer cave by Charles Lyell (1863).

a – cave, approx. 20 m above Düssel river and 35 m below plateau; b – clay deposits, in which the skeleton was discovered; c – funnel entrance to the cave from the plateau; d – sandy clay deposits on top of the plateau; e – Devonian limestone; f – cave entrance towards the Düssel valley; g – Düssel river.

These debris mounts were studied anew in 1997 and in 2000 by a team led by Ralf Schmitz and Jürgen Thissen (Schmitz et al. 2002). During the excavations new material of Neanderthals was collected. The specimens belonged to the first individual and two other ones, a female and a juvenile Neanderthal individual. This is indirect confirmation of the given location of the Feldhofer Grotto. However, since the cave deposits were not removed in the course of regular excavations and the fossil specimens collected from debris mounts, the original context of the fossil has to be considered as irretrievably destroyed in the 19th century.

Paleontology

Mammalian fossils originating from Feldhofer cave and Neander valley have not been systematically collected. An ecological and/or stratigraphical evaluation of the sample is thus impossible. Since the cave deposits proper and the surrounding limestone are completely removed from their original context, it is also impossible to check conclusions with new sampling.

Datings were carried out on the fossil remains of the Neanderthals proper. We thus know that the individuals have lived approx. 40,000 years ago. This corresponds to a warmer period (a so-called interstadial) during the Weichsel glacial. The fauna known from other sites of similar age corresponds to the cold-adapted fauna of the mammoth steppe. The mammoth steppe fauna includes woolly mammoth (*Mammuthus primigenius*), woolly rhino (*Coelodonta antiquitatis*), feral horse (*Equus ferus*), giant deer (*Megaloceros giganteus*), red deer (*Cervus elaphus*), steppe bison (*Bison priscus*) and reindeer (*Rangifer tarandus*). The cave bear (*Ursus spelaeus*) presumably retreated to higher regions in the mountains. Besides, the usual carnivores – i.e. cave lion (*Panthera leo spelaea*), cave hyena (*Crocota crocota spelaea*), wolverine (*Gulo gulo*), wolf (*Canis lupus*) and white fox (*Alopex lagopus*) were present.

In fact, the environment of the mammoth steppe is quite well known. During warmer periods, the Hengelo and/or Denekamp interstadials, light birch forests and coniferous woodland



prevailed. The environment corresponds to an open woodland type, average temperatures were temperate and the climate was rather dry.

Palaeoanthropology

Immediately upon its discovery in 1856 a fierce dispute on the interpretation of the Neanderthal skeleton started, which lasted at least for 50 years. In fact the fossil remains from the Neander valley served as paradigmatic case for the interpretation of human fossils and their acknowledgement as evidence in human evolution.

The original assemblage entails the remains of a single individual. The sample comprises of a cranial vault, a single shoulder blade, a clavicle, both humeri (one without shoulder joint), one complete and the proximal part of the opposite ulna, a radius, a partial innominate, both of the femora and five rib fragments. The anatomy follows paradigmatically the idealized Neanderthal (viz. Tab. 2). There are torus structures at the frontal and rear end of the skull. The occiput possesses a suprainiac fossa and a bulging region atop. Postcranial bones are massive and quite robust compared to modern humans. It points to the fact, that the stature of Neanderthals was sturdier and stronger. In terms of strength they easily outrivaled their contemporaries with modern anatomy.

Genetic studies which were carried out on the original Neanderthal skeleton (Krings et al. 1997, 2000, Schmitz et al. 2002) and other Neanderthal individuals (Ovchinnikov et al. 2000) were analysed in order to reveal phylogenetic relations to modern humans. Significant differences in the sequences were detected compared with the respective sequences in the present human genome. However, the results were barely unexpected. Between the compared sequences lies the considerable time span of 40,000 years. It would be more interesting to compare Neanderthal sequences with samples from contemporaneous anatomically modern humans. As yet, the interpretation of the results is inconclusive (Knight 2003, Serre et al. 2004). These questions will be discussed during the Neanderthal workshop at Bonn.

Archaeology

During the new excavations 1997/2000 Schmitz and Thissen succeeded in collecting first artefacts from the Neanderthal type site. The new finds constitute corresponding Middle Palaeolithic forms, in particular of Micoquian industries. The assemblage includes a large proportion of small rounded scrapers.



Literature

Adam, K. D. (1954): Die mittel-pleistozänen Faunen von Steinheim an der Murr (Württemberg). *Quaternaria* 1: 131-144.

Adam, K. D. (1977): Die mittelpleistozänen Schotter der unteren Murr (Baden-Württemberg) und ihre Säugetier-Faunen. *Jahresberichte und Mitteilungen der oberrheinischen geologischen Vereinigung N.F.* 59: 83-89.

Adam, K. D. (1985): The chronological and systematic position of the Steinheim skull. In: Delson, E. (ed.): *Ancestors: The Hard Evidence*. Alan R. Liss, New York, pp. 272-276.

Adam, K. D., Bloos, G. & Ziegler, R. (1995): Steinheim/Murr, N of Stuttgart – Locality of *Homo steinheimensis*. In: Koenigswald, W. v. (ed.): *Mammal Traverse. Quaternary vertebrate faunas in Central Europe*. Pfeil, München, pp. 727-728.

Auffermann, B. & Orschiedt, J. (2002): *Die Neandertaler – eine Spurensuche*. Theiss, Stuttgart, pp. 110.

Beck, M., Gaupp, R., Kamradt, I., Liebermann, C. & Pasda, C. (in print): Bilzingsleben site formation processes – Geoarchaeological investigations of a Middle Pleistocene deposit: preliminary results of the 2003-2005 excavations. *Archäologisches Korrespondenzblatt*.

Berckhemer, F. (1936): Der Urmenschenschädel aus den zwischeneiszeitlichen Fluß-Schottern. *Forschungen und Fortschritte* 12: 249-250.

Bernor, R., Fahlbusch, V. & Mittmann, H.-W. (eds.) (1996): *The evolution of western Eurasian Neogene mammal faunas*. Columbia University Press, New York, pp. 487.

Böhme, G. & Heinrich, W.-D. (1994): Zwei neue Wirbeltierfaunen aus der pleistozänen Schichtenfolge des Travertins von Weimar-Ehringsdorf. *Ethnographisch-archäologische Zeitschrift* 35(1): 67-74.

Bolus, M. & Schmitz, R. W. (2006): *Der Neandertaler*. Thorbecke, Ostfildern, pp. 192.

Conard, N. J. (2003a): Radiocarbon dating the appearance of modern humans and timing of cultural innovations in Europe: new results and new challenges. *Journal of Human Evolution* 44: 331-371.

Conard, N. J. (2003b): Palaeolithic ivory sculptures from southwestern Germany and the origins of figurative art. *Nature* 426: 830-833.

Conard, N. J. (ed.) (2006): *Woher kommt der Mensch? Attempto*, Tübingen, pp. 331.

Conard, N. J. & Bolus, M. (2003): Radiocarbon dating the appearance of modern humans and timing of cultural innovations in Europe: new results and new challenges. *Journal of Human Evolution* 44: 331-371.



Conard, N. J., Grootes, P. M., Smith, F. H. (2004): Unexpectedly recent dates for human remains from Vogelherd. *Nature* 430: 198-201.

Cunliffe, B. (ed.) (1994): *The Oxford Illustrated Prehistory of Europe*. Oxford University Press, Oxford, pp. 532.

Dean, D., Hublin, J.-J., Holloway, R. & Ziegler, R. (1998): On the phylogenetic position of the pre-Neandertal specimen from Reilingen, Germany. *Journal of Human Evolution* 34: 485-508.

Dietrich, W. O. (1912): *Elephas primigenius* Fraasi, eine schwäbische Mammutrasse. *Jahreshefte des Vereins vaterländischer Naturkunde Württemberg* 68: 42-106.

Eissmann, L. & Litt, T. (1992): The Saalian sequence in the type region (Central Germany). SEQS Discussion Meeting 19.-24.10.92 in Halle/Saale. Halle/Saale.

Feldmann, L. (2002): *Das Quartär zwischen Harz und Allertal*. Habilitationsschrift Clausthal-Zellerfeld.

Fischer, K., Guenther, E. W., Heinrich, W.-D., Mania, D., Musil, R. & Nötzold, T. (1991): Bilzingsleben IV, *Homo erectus* – seine Kultur und seine Umwelt. *Veröffentlichungen Landesmuseum für Vorgeschichte Halle* 44: 1-248.

Heinrich, W.-D. (1997): Zur Taphonomie, Paläoökologie und Biostratigraphie fossiler Kleinsäugetierfaunen aus dem mittelpleistozänen Travertinkomplex Bilzingsleben II in Thüringen. In: Mania, D. et al. (eds.): *Bilzingsleben V: Homo erectus – seine Kultur und seine Umwelt*. Ausbildung + Wissen, Bad Homburg, 121-134, 254-259.

Heinrich, W.-D. (1998a): Weitere Funde von Kleinsäugetieren aus dem Travertinkomplex Bilzingsleben II in Thüringen *Praehistoria Thuringica* 2: 89-95.

Heinrich, W.-D. (1998b): Evolutionary trends in *Trogontherium cuvieri* (Mammalia, Rodentia, Castoridae) and their implications. In: Kolfschoten, T. v. & Gibbard, P. (eds.): *The Dawn of the Quaternary*. Haarlem, 573-578.

Heller, F. (1934): Wühlmausreste aus den altdiluvialen Sanden von Mauer a.d. Elsenz. *Jahrbuch und Mitteilungen der Oberrheinischen Geologischen Vereinigung*, N.F. 23: 139-144.

Howell, F. C. (1960): European and northwest African Middle Pleistocene hominids. *Current Anthropology* 1(3): 195-232.

Kahlke, H.-D. (ed.) (1975): *Das Pleistozän von Weimar-Ehringsdorf, Teil 2*. *Abhandlungen des Zentralen Geologischen Institutes* 23: 1-596.

Kahlke, R.-D. (1995a): Die Abfolge plio/pleistozäner Säugetierfaunen in Thüringen (Mitteldeutschland). *Cranium* 12 (1): 5-18.

Kahlke, R.-D. (1995b): Ehringsdorf near Weimar – Middle to Late Pleistocene travertines. In: Koenigswald, W. v. (ed.): *Mammal Traverse. Quaternary vertebrate faunas in Central Europe*. Pfeil, München, 735-737.



Kahlke, R.-D., Maul, L. C., Meyrick, R. A., Stebich, M. & Grasselt, T. (2002): The Quaternary Sequence of the Late Middle Pleistocene to Upper Pleistocene site of Weimar-Ehringsdorf. In: Meyrick, R. A. & Schreve, D. C. (eds): The Quaternary of Central Germany. Field Guide. Quaternary Research Association, London, 163-177.

Knight, A. (2003): The phylogenetic relationship of Neandertal and modern human mitochondrial DNAs based on informative nucleotide sites. *Journal of Human Evolution* 44: 627-632.

Koenigswald, W. v. (1973): Veränderungen in der Kleinsäugerfauna von Mitteleuropa zwischen Cromer und Eem (Pleistozän). *Eiszeitalter und Gegenwart* 23/24: 159-167.

Koenigswald, W. v. (1992): Zur Ökologie und Biostratigraphie der beiden pleistozänen Faunen von Mauer bei Heidelberg. *Eiszeitalter und Gegenwart* 41: 70-81.

Koenigswald, W. v. (1997): Die fossilen Säugetiere aus den Sanden von Mauer. In: Wagner, G.A. & Beinhauer, K. W. (eds.): *Homo heidelbergensis* von Mauer, das Auftreten des Menschen in Europa. Heidelberger Verlagsanstalt, Heidelberg, pp. 215-240.

Koenigswald, W. v. (2002): *Lebendige Eiszeit*. Wissenschaftliche Buchgesellschaft, Darmstadt, pp. 190.

Koenigswald, W. v. & Heinrich, W.-D. (1999): Mittelpleistozäne Säugetierfaunen aus Mitteleuropa – der Versuch einer biostratigraphischen Zuordnung. *Kaupia* 9: 53-112.

Koenigswald, W. v. & Kolfschoten, T. v. (1996): The *Mimomys*-*Arvicola* boundary and the enamel thickness quotient (SDQ) of *Arvicola* as stratigraphic markers in the Middle Pleistocene. In: Turner, Ch. (ed.): *The early Middle Pleistocene in Europe*. Balkema, Rotterdam, 211-226.

Kolfschoten, T. v. (1993): Die Vertebraten des Interglazials von Schöningen 12B. *Ethnographisch-archäologische Zeitschrift* 34: 623-628.

Kolfschoten, T. v. (1995): Faunenresten des altpaläolithischen Fundplatzes Schöningen 12 (Reinsdorf – Interglazial). In: Thieme, H. & Maier, R. (ed.): *Archäologische Ausgrabungen im Braunkohletagebau Schöningen, Landkreis Helmstedt*. Hahnsche Buchhandlung, Hannover, pp. 85-94.

Krings, M., Stone, A., Schmitz, R.W., Krainitzki, H., Stoneking, M., Pääbo, S. (1997): Neandertal DNA sequences and the Origin of Modern Humans. *Cell* 90: 19-30.

Krings, M., Capelli, C., Tschentscher, F., Geisert, H., Meyer, S., von Haeseler, A., Grossschmidt, K., Possnert, G., Paunovic, M., Pääbo, S. (2000): A view of Neandertal genetic diversity. *Nature Genetics* 26: 144-146.

Lyell, C. (1863): *The geological evidence of the antiquity of man*. London.

Mallick, R., Frank, N., Mangini, A. & Wagner, G. A. (2001): Präzise Th/U-Datierung archäologisch relevanter Travertinvorkommen Thüringens. In: Wagner, G. A. & Mania, D.



(eds.): Frühe Menschen in Mitteleuropa – Chronologie, Kultur, Umwelt. Shaker, Aachen, pp. 77-89.

Mania, D. (1995a): The earliest occupation of Europe: the Elbe-Saale region (Germany). In: Roebroeks, W. & van Kolfschoten, T. (eds): The earliest occupation of Europe. University of Leiden, Leiden, 85-101.

Mania, D. (1995b): The influence of Quaternary climatic development on the Central European mollusc fauna. *Acta zoologica cracovensisa* 38 (1): 17-34.

Mania, D. (1997): Bilzingsleben – Ein kulturgeschichtliches Denkmal der Stammesgeschichte des Menschen. *Praehistoria Thuringica* 1: 30-80.

Mania, D. (1998): Zum Ablauf der Klimazyklen seit der Elstervereisung im Elbe-Saale-Gebiet. *Praehistoria Thuringica* 2: 5-21.

Mania, D. (2001): *Homo erectus* von Bilzingsleben, seine Kultur und Umwelt. In: Wagner, G. E. & Mania, D. (eds.): Frühe Menschen in Mitteleuropa – Chronologie, Kultur, Umwelt. Shaker, Aachen, pp. 39-61.

Mania, D., Mania, U., Heinrich, W.-D., Fischer, K., Böhme, G., Turner, A., Erd, K. & Mai, D. H. (eds.) (1997): *Bilzingsleben V: Homo erectus – seine Kultur und seine Umwelt. Ausbildung + Wissen*, Bad Homburg, pp. 265.

Meyrick, R. A. & Schreve, D. C. (eds) (2002): *The Quaternary of Central Germany (Thuringia & Surroundings)*. Field Guide. Quaternary Research Association, London, pp. 230.

Ovchinnikov, I.V., Götherström, A., Romanova, G. P., Kharitonov, V.M., Liden, K., Goodwin, W. (2000): Molecular analysis of Neanderthal DNA from the northern Caucasus. *Nature* 404: 490-493.

Rothe, P. (2005): *Die Geologie Deutschlands – 48 Landschaften im Portrait*. Wissenschaftliche Buchgesellschaft, Darmstadt, pp. 240.

Schirmer, P. (1994): *Der Mittelrhein im Blickpunkt der Rheingeschichte*. In: Koenigswald, W. v. & Boy, J. (eds.): *Erdgeschichte im Rheinland: Fossilien und Gesteine aus 400 Millionen Jahren*. Pfeil, München.

Schmitz, R. W. (ed.) (in print): *Neanderthal 1856-2006*.

Schmitz, R. W., Serre, D., Bonani, G., Feine, S., Hillgruber, F., Krainitzki, H., Pääbo, S. & Smith, F. H. (2002): The Neandertal type site revisited: Interdisciplinary observations of skeletal remains from the Neander Valley, Germany. *Proceedings of the National Academy of Sciences* 99 (20): 13342-13347.

Schoetensack, O. (1908): *Der Unterkiefer des Homo heidelbergensis aus den Sanden von Mauer*. Engelmann, Leipzig, pp. 1-63.

Schrenk, F. & Müller, S. (2005): *Die Neandertaler*. CH Beck, München, pp. 127.



Schreve, D. C. & Bridgland, D. R. (2002): The Middle Pleistocene site of Bilzingsleben. In: Meyrick, R. A. & Schreve, D. C. (eds): The Quaternary of Central Germany (Thuringia & Surroundings). Field Guide. Quaternary Research Association, London, 131-144.

Seidel, G. (1995): Geologie von Thüringen. Schweizerbart, Stuttgart, pp. 556.

Serre, D., Langaney, A., Chech, M., Teschler-Nicola, M., Paunovic, M., Mennecier, P., Hofreiter, M., Possnert, G., Pääbo, S. (2004): No Evidence of Neandertal mtDNA contribution to Early Modern Humans. *PLoS Biology* 2 (3): 0313-0317.

Steiner, W. (1976): Das neue Standardprofil des Travertinvorkommens von Ehringsdorf bei Weimar. *Zeitschrift für Geologische Wissenschaften* 4 (5): 771-780.

Stringer, C. & Gamble, C. (1993): In Search of the Neanderthals. Thames and Hudson, London, pp. 247.

Tattersall, I. (1995): The last Neanderthal. The Rise, Success, and Mysterious Extinction of Our Closest Human Relatives. Nevrumont, New York. [dt.: Neandertaler. Der Streit um unsere Ahnen. Birkhäuser, Basel, pp. 216.]

Thieme, H. (1997): Altpaläolithische Wurfspeere aus Schöningen, Nordharzvorland. In: Wagner & Beinhauer (eds.): *Homo heidelbergensis von Mauer*. Heidelberger Verlagsanstalt, Heidelberg. pp. 304-312.

Thieme, H. & Mania, D. (1993): Schöningen 12 – ein mittelpleistozänes Interglazialvorkommen im Nordharzvorland mit paläolithischen Funden. *Ethnographisch-archäologische Zeitschrift* 34: 610-619.

Thieme, H., Mania, D., Urban, B. & Kolfschoten, T. v. (1993): Schöningen (Nordharzvorland) eine altpaläolithische Fundstelle aus dem Mittleren Eiszeitalter. *Archäologische Korrespondenzblätter* 23: 147-163.

Thieme, H. & Maier, R. (eds.) (1995): *Archäologische Ausgrabungen im Braunkohlentagebau Schöningen*, Landkreis Helmstedt. Hahnsche Buchhandlung, Hannover, pp. 191.

Vlcek, E. (1993): Fossile Menschenfunde von Weimar-Ehringsdorf. *Weimarer Monographien zur Ur- und Frühgeschichte* 30: 1-222.

Vlcek, E. (1999): Der fossile Mensch von Bilzingsleben: Rekonstruktion der Schädel, zu ihrer Morphologie und taxonomisch-phylogenetischen Stellung. *Præhistoria Thuringica* 3: 11-26.

Wagner, G. E. & Beinhauer, K. W. (1997): *Homo heidelbergensis von Mauer*. Heidelberger Verlagsanstalt, Heidelberg.

Wagner, G. E. & Mania, D. (eds.): *Frühe Menschen in Mitteleuropa – Chronologie, Kultur, Umwelt*. Shaker, Aachen, pp. 163.

Walter, R. (1992): *Geologie von Mitteleuropa*. 5. Aufl., Naegle & Obermiller, Stuttgart.



Weinert, H. (1936): Der Urmenschenschädel von Steinheim. *Zeitschrift für Morphologie und Anthropologie* 35: 463-518.

Ziegler, R. & Dean, D. (1998): Mammalian fauna and biostratigraphy of the pre-Neandertal site of Reilingen. *Journal of Human Evolution* 34: 469-484.



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Fig. 17 – by unknown author in “Hohle Fels”. In: Dept. Early Prehistory and Quaternary Ecology. Processed: October 25, 2005: <http://www.urgeschichte.uni-tuebingen.de/index.php?id=65> (accessed June 13, 2006).

Fig. 18 – by unknown author in “Vogelherd”. In: Dept. Early Prehistory and Quaternary Ecology. Last update: November 29, 2005. URL: <http://www.urgeschichte.uni-tuebingen.de/index.php?id=207> (accessed June 13, 2006).

Fig. 20 – from Mallick, R., Frank, N., Mangini, A. & Wagner, G. A. (2001): *Präzise Th/U-Datierung archäologisch relevanter Travertinvorkommen Thüringens*. In: Wagner, G.



A. & Mania, D. (eds.): Frühe Menschen in Mitteleuropa – Chronologie, Kultur, Umwelt. Shaker, Aachen, pp. 77-89; there altered after Seidel (1995).

Fig. 21 – from Kahlke et al. 2002: 164; there modified after Steiner 1976

Figs. 22, 23 – from Schreve and Bridgeland 2002: 132 and 137; there modified after Mania 1995a and 1997

Fig. 24 – from Feldmann (2002): Das Quartär zwischen Harz und Allertal. Habilitationsschrift Clausthal-Zellerfeld, p. 36.

Figs. 25, 26 – from Thieme 1997, pp. 305 and 306.



Attachments: Introduction to Pleistocene Hominid Sites in Java

(From excursion guide 2005, by Yan Rizal and Christine Hertler)

Geography

Lowlands prevail in East and part of Central Java. Originally, East Java's lowlands were covered by deciduous rainforest and characterized climatically by heavy annual monsoon rainfalls and pronounced dry periods. While the climate is basically still the same, the landscape today has considerably been altered by agriculture and human settlements.

In the North between Purwodadi and Mojokerto, the lowlands are replaced by a ridge, the Kendeng hills, extending more or less in an E-W direction (Fig. 1). The highest altitude is reached at Gunung Butak between Ngawi and Jombang with 899 m. In general altitudes between 300 and 500 m occur.

In the South a series of volcanoes extends along the coast, the Southern mountains. The volcanic mountain range reaches considerable altitudes around 3,000 m. Two of them are especially important for the hominid sites in East Java, i. e. Mount Merapi (Gunung Merapi) west of Sangiran and Mount Lawu (Gunung Lawu) east of Sangiran.

All the volcanoes give rise to rivers. Among the larger ones is the Solo river (Bengawan Solo) originating on the southern slopes of Mt. Lawu. It takes a northern course and passes the Sangiran area before turning eastward. Along its course, Bengawan Solo crosses a large part of East Java, passing all famous hominid sites like Trinil, Ngawi and Ngandong, and finally discharges north of Surabaya into the Java Sea.

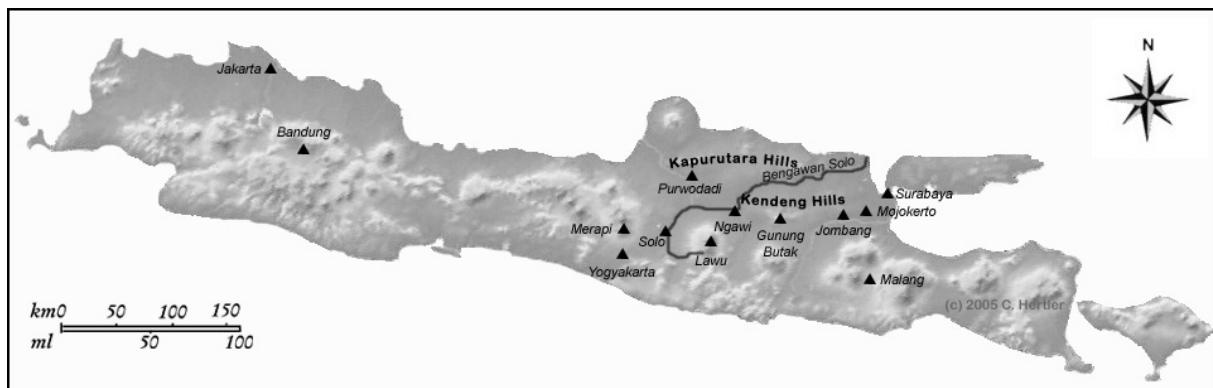


Fig. A-1: Geographic map of Java

Geology

The area is characterised by the Kendeng anticlinorium⁴ extending from the Sangiran area in Central Java in the West to the Pening area in East Java. The Kendeng anticlinorium is a mainly Miocene-Pliocene geosyncline topographically forming the Kendeng hills. It was uplifted and folded at the end of the Plio- and during the Lower Pleistocene, and peneplained until the end of Middle Pleistocene. A second uplift occurred during the Upper Pleistocene and persisted until the Holocene. The sediments are mainly non-clastic, except of the volcanic deposits and fluvial sediments formed syn- or post orogenetically by adjacent volcanoes.

The Bengawan Solo already existed in the Middle Pleistocene. Since the Upper Pleistocene, it traverses the Kendeng anticlinorium between Ngawi and Cepu. A number of terraces along its

⁴ a series of synclines and anticlines together forming an anticlinal uparched zone



course reflect the younger tectonic history of this area. To the North the Kendeng anticlinorium passes into the Rembang anticlinorium.

Stratigraphy

The Kendeng hills can be traced between Surabaya in the East and Purwodadi in the West. They consist of a number of synclines and anticlines together forming an anticlinal uparched zone (= anticlinorium). The main axes of the structures are E-W trending. The Kendeng hills were formed during the Mio-, Plio- and Pleistocene, but only the upper Pliocene and Pleistocene parts are cropping out in the area.

The Pliocene was subdivided by Duyfjes (1936) into the Lower and the Upper **Kalibeng formation**. The Lower Kalibeng formation mainly consists of marine marls with abundant *Globigerina* and other pelagic foraminifera. The Upper Kalibeng formation shows three different facies, corraligene limestone with large foraminifera in the West, marls with small foraminifera and glauconitic sands (epineritic to littoral) in the central part, while near Mojokerto in the East intercalations of diatomaceous sediments increasingly occur (brackish water).

The overlying Pleistocene is divided into the Pucangan formation at the base, the Kabuh formation in the middle and the Notopuro formation at the top. The latter may be locally developed as fluvial terrace (Tab. 1).

The **Pucangan formation**, named after a hill north of Jombang, is developed in two different facies. In its west part the anticlinorium is developed entirely as a volcanic facies, especially in the upper part of the formation. In the vicinity of Trinil the Pucangan formation is still entirely volcanic. Towards the South, near Sangiran, only the lower part still represents the volcanic facies, while the upper part is developed as limnic clay. According to Watanabe and Kadar (1985) this facies is called Sangiran formation.

The **Kabuh formation** was formed during the uplift of the Kendeng hills and the Southern mountains. Large amounts of clastics were deposited by rivers in the basin, in particular along its peripheral parts. In the central part, where the uplift started earlier, the Kabuh formation is absent. Cross-bedded sandstones and conglomerates characterize this formation. Vertebrate fossils have been found in numerous localities.

Age	Stratigraphy				Faunal level+
	Sangiran°	Trinil*	Gunung Butak*	Mojokerto*	
Holocene					
		Alluvium	Alluvium	Alluvium	recent
Pleistocene					
Upper	- terraces	-	-	-	Punung Ngandong
	Notopuro	Notopuro	Notopuro	Notopuro	unknown
Middle	Upper Bapang	Kabuh	Kabuh	Kabuh	Kedung Brubus
	Lower Bapang	Kabuh	Kabuh	Kabuh	Trinil HK
Lower	Upper Sangiran	Pucangan	Pucangan	Pucangan	Cisaat
	Lower Sangiran				Satir
Pliocene					
Upper	Upper Kalibeng	Upper Kalibeng	Upper Kalibeng	Upper Kalibeng	Sonde
Lower	Lower Kalibeng	Lower Kalibeng	Lower Kalibeng	Lower Kalibeng	small foraminifera
Miocene					
	-	?	?	?	Lepidocyclus

Tab. A-1: Stratigraphy of East Java; * after Duyfjes 1936, ° after Watanabe & Kadar 1985, + after de Vos et al. 1994



Paleontology

The Pleistocene mammal fauna in Java is composed of a rather constant set of large mammal groups encompassing several bovid and cervid species including the endemic bovid *Duboisia*, hippopotami, rhinoceros and stegodont proboscideans (Fig. 3, Tab. 2). Throughout the Pleistocene new mammal species arrive until finally the Punung fauna, i.e. the youngest fauna still considered as Pleistocene, is solely composed of species, which are either extant or at least historically known to occur in Java. The recent faunal level is described as *Pongo-Homo sapiens* fauna. A major faunal turnover seems to have occurred early in the Pleistocene. There are major differences in composition between the oldest fauna known, the Satir fauna representing the faunal level of the *Tetralophodon-Geochelone* fauna, and the composition of younger, so called *Stegodon-Homo erectus* faunas. However, the Satir fauna is insufficiently known and traces of the turnover are thus faint.

Six mammal faunal levels are distinguished in the Pleistocene of Java (de Vos et al. 1994). In sequential order, beginning with the oldest they are called Satir, Cisaat, Trinil HK, Kedung Brubus, Ngandong, and Punung fauna, respectively. The type locality of the oldest two faunas, Satir and Cisaat, is situated in the western part of Central Java, close to the town of Bumiayu. Both of them do, however, also occur at Sangiran.

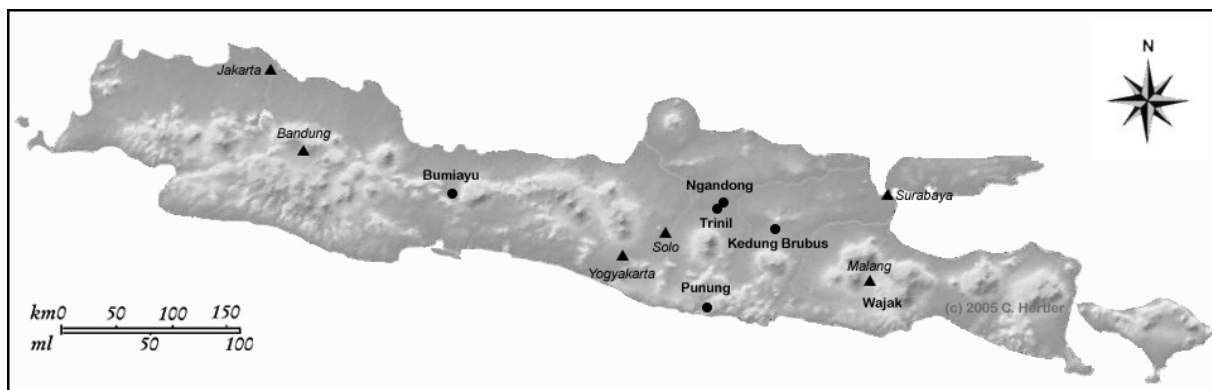


Fig. A-2: Type localities of the Pleistocene faunal levels in Java

The **Satir fauna** is poorly described. Only four species are known. Its composition clearly differs from younger faunal assemblages which are considered characteristic for the Pleistocene in Java. The Satir fauna contains a mastodont proboscidean (*Sinomastodon bumiajuensis*), a remarkably small hippopotamus (*Hexaprotodon simplex*), and the giant tortoise *Geochelone*. Besides, there are unidentified deer. Due to the occurrence of *Geochelone*, this fauna is generally understood as representing swampy or mangrove conditions.

The **Cisaat fauna** is also insufficiently known. It consists of a large cat and the well-known proboscidean *Stegodon trigonocephalus*, the fossil Sivalik hippopotamus *Hexaprotodon sivalensis*, and an endemic pig, presumably *Sus stremmi*. Different cervid (undescribed) and bovid species (undescribed) do also occur. The Cisaat fauna is commonly understood as indicating an open woodland environment.

The type locality of the **Trinil HK fauna** is Trinil in East Java. Due to Dubois' and Selenka's excavations the Trinil HK fauna is quite well known. It includes two species of small mammals, the porcupine *Hystrix (Acanthion) brachyura* and *Rattus trinilensis*, and fifteen large mammal species. Most abundant are cervids and bovids, i.e. *Muntiacus muntjak*, *Axis lydekkeri*, undescribed cervid species, the fossil water buffalo *Bubalus palaeokerabau*, feral cattle *Bibos palaesondaicus*, and the endemic antelope-like bovid *Duboisia santeng*. Besides



there are elements occurring for the first time, e.g. the Javan rhinoceros (*Rhinoceros sondaicus*), two different primate species (*Trachypithecus cristatus* and *Macaca fascicularis*), a dog species (*Mececyon trinilensis*), and an endemic tiger subspecies (*Panthera tigris trinilensis*). Small cats do also occur (*Prionailurus bengalensis*). Since the older faunal assemblages are not well known, dating the Trinil HK fauna does not provide a reliable first appearance date (FAD) for these species. The proboscidean species *Stegodon trigonocephalus* is present and represents the only proboscidean species known from this fauna. The suffix 'HK' is added to the name of the fauna to distinguish it strictly from a Trinil fauna which has been described earlier (von Koenigswald 1935), but is likely to contain species from different sites and different stratigraphic levels. Due to the occurrence of large herbivores and *Stegodon*, this fauna is considered to indicate an open woodland environment.

The **Kedung Brubus fauna** is defined on the basis of Dubois' finds from Kedung Brubus. Although his collection from Kedung Brubus contains a smaller total number of specimens compared with the collection from Trinil, the number of species indicates a well-balanced representation. Its composition may thus be considered as quite well known. This faunal level is characterized by the occurrence of a huge extinct pangolin, *Manis palaeojavanica*, as well as the simultaneous occurrence of *Stegodon* and *Elephas* among the proboscideans. The large tiger is still present and a hyaena occurs for the first time (*Hyaena brevirostris*). The only fossil otter known from Java (*Lutrogale palaeoleptonyx*) belongs to the Kedung Brubus fauna. Besides, the recent tapir (*Tapirus indicus*) and two different rhinoceros species, Javan and Indian rhino (or *Rhinoceros sondaicus* and *R. unicornis*), appear. The Sivalik hippopotamus is present and two different species of suids occur (*Sus macrognathus* and *S. brachygnathus*). The predominant part of fossils is represented by cervids and bovids. Another endemic bovid, *Epileptobos groeneveldtii*, occurs. Non-human primates and small mammals are absent in this fauna. While the latter may be due to sampling procedures, the absence of primates probably reflects a different ecological setting. Due to the occurrence of large herbivores including two different genera of proboscideans it is considered to indicate an open woodland environment. Moreover, two different species of another large grazer, the rhino, are present, while clearly forest dwelling species, e.g. monkeys or tapir are comparatively rare. This implies rather dry conditions and an open landscape.

The **Ngandong fauna** is known only from excavations carried out through the Geological survey in the early 1930ies. The collection requires re-examination, descriptions and determinations need to be checked. The composition of this fauna is therefore considered as only partially known. It consists of a number of different species already occurring in the Kedung Brubus fauna, e.g. *Stegodon* as well as *Elephas*, the tapir and the Sivalik hippopotamus. Due to the occurrence of large herbivores, it is also considered to indicate an open woodland environment.

The **Punung fauna**, presumably the latest Pleistocene fauna, contains only such species still extant today or at least known from historic reports. Since a number of primates occur, among them Orangutan, it is considered to represent a forested environment.



		Satir	Cisaat	Trinil HK	Kedung Brubus	Ngandong	Punung	uncertain	distribution
Primates									
Colobidae	<i>Presbytis (Trachypithecus) cristatus</i>			■	■				extant in Sumatra + Kalimantan
Cercopithecidae	<i>Presbytis comata</i>						■	■	extant, endemic in Java
	<i>Macaca nemestrina</i>						■		extant in Sumatra + Kalimantan
	<i>Macaca fascicularis</i>			■		■			extant
Hylobatidae	<i>Hylobates syndactylus</i>						■		extant in Sumatra
Pongidae	<i>Pongo pygmaeus</i>						■		extant in Sumatra + Kalimantan
Hominidae	<i>Homo erectus</i>			■	■				†
	<i>Homo sapiens</i>						■		
Pholidota									
Manidae	<i>Manis palaeojavanica</i>				■				† endemic
Lagomorpha									
Leporidae	<i>Caprolagus lapis</i>							■	†
Insectivora									
Soricidae	<i>Echinosorex sp.</i>						■		extant in Sumatra + Kalimantan
Rodentia									
Hystricidae	<i>Hystrix (Acanthion) brachyura</i>			■	■				extant in Sumatra + Kalimantan
	<i>Hystrix gigantea</i>							■	†
Muridae	<i>Rattus trinilensis</i>			■					†
Carnivora									
Canidae	<i>Mececyon trinilensis</i>			■					†
	<i>Megacyon merriami</i>							■	†
	<i>Cuon spec.</i>							■	
Ursidae	<i>Ursus (Helarctos) malayanus</i>						■		extant in Sumatra + Kalimantan
Mustelidae	<i>Lutrogale palaeoleptonyx</i>				■				†
	<i>Lutrogale robusta</i>							■	†
Felidae	<i>Panthera tigris ssp.</i>		?	■	■				extant in Sumatra
	<i>Panthera pardus</i>							■	extant, endemic in Java
	<i>Megantereon sp.</i>							■	†
	<i>Hemimachairodus zwierzyckii</i>							■	†
	<i>Homotherium ultimum</i>							■	†
	<i>Neofelis nebulosa</i>							■	extant in Sumatra and Java
Hyaenidae	<i>Prionailurus bengalensis</i>			■					†
	<i>Hyaena brevirostris</i>				■				†
	<i>Crocuta crocuta</i>							■	extant in Africa
Proboscidea									
Mastodontidae	<i>Sinomastodon bumiajuensis</i>	■							† endemic in Java
Stegodontidae	<i>Stegodon trigonocephalus</i>		■	■	■				† endemic in Java
	<i>Stegodon? hypsilophus</i>				?				not from type locality
Elephantidae	<i>Elephas hysudrindicus</i>								
	<i>Elephas maximus</i>						■		extant in Sunda-Land and mainland Asia
Perissodactyla									
Chalicotheridae	<i>Nestotherium cf. sivalense</i>							■	†
Tapiridae	<i>Tapirus indicus</i>				■	■			extant in Sumatra
Rhinocerotidae	<i>Rhinoceros sondaicus</i>			■	■				extant, endemic in Java
	<i>Rhinoceros unicornis</i>								extant in mainland Asia
Artiodactyla									
Suidae	<i>Sus stremmi</i>		■						†
	<i>Sus brachygnathus</i>			■					†
	<i>Sus macrognathus</i>				■	■			†
	<i>Sus sangiranensis</i>							■	?
	<i>Sus vittatus</i>								
	<i>Sus barbatus</i>							■	extant in Sumatra
Anthracotherida	<i>Merycopotamus dissimilis</i>							■	†
Hippopotamidae	<i>Hexaprotodon simplex</i>	■							†
	<i>Hexaprotodon sivalensis</i>		■		■				†



		Satir	Cisaat	Trinil HK	Kedung Brubus	Ngandong	Punung	uncertain	distribution
Artiodactyla	(cont'd)								
Cervidae	<i>Muntiacus muntjak</i>								?
	unidentified cervids								†
	<i>Axis lydekkeri</i>								
	<i>Rusa sp.</i>								
Bovidae	<i>Naemorhedus sumatrensis</i>								extant in Sumatra
	<i>Naemorhedus sivalensis</i>								† endemic in Java
	<i>Duboisia santeng</i>								†
	<i>Epileptobos groeneveldtii</i>								†
	<i>Bubalus palaeokerabau</i>								extant in Sunda-Land and mainland Asia
	<i>Bubalus sp.</i>								?
	unidentified bovids								†
	<i>Bibos palaeosondaicus</i>								extant in Sunda-Land and mainland Asia
	<i>Bos (Bibos) javanicus</i>								

Tab. A-2: Composition of different faunal assemblages in the Pleistocene from Java (after de Vos et al. 1997, van den Bergh et al. 2001, de Vos & Vu 2001)

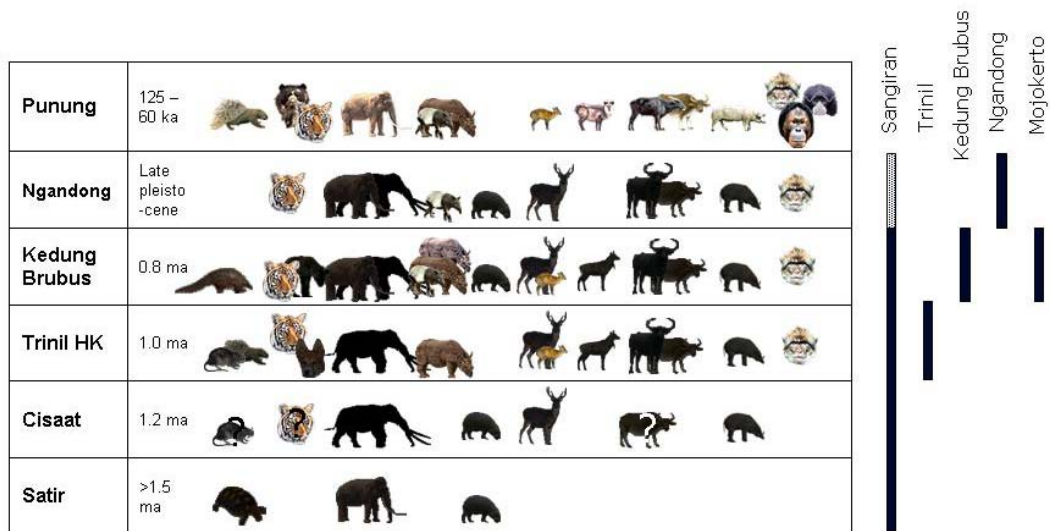


Fig. A-3: Schematic composition of mammalian faunas in the Pleistocene of Java and occurrence at different fossil sites (after de Vos et al. 1997, van den Bergh et al. 2001, de Vos & Vu 2001). Shaded animals represent fossil species; coloured animals represent extant species.

Palaeoanthropology

With very few exceptions most of the Javanese hominid sites are located in East Java (Fig. 4). Most of them are moreover situated along the banks of a single river, Bengawan Solo, like pearls on a string. Whereas the deposits at Sangiran cover a stratigraphic sequence and contain fossils of different age, only a single hominid bearing horizon is present at the other sites. The oldest among them may well be dated to >1.5 Ma. However, datings of hominid bearing deposits in Java are notoriously arguable, because either the stratigraphic origin of hominid



fossils is insufficiently known, stratigraphic correlations have changed in the meantime, or the genesis of the hominid bearing horizons proper is unknown.

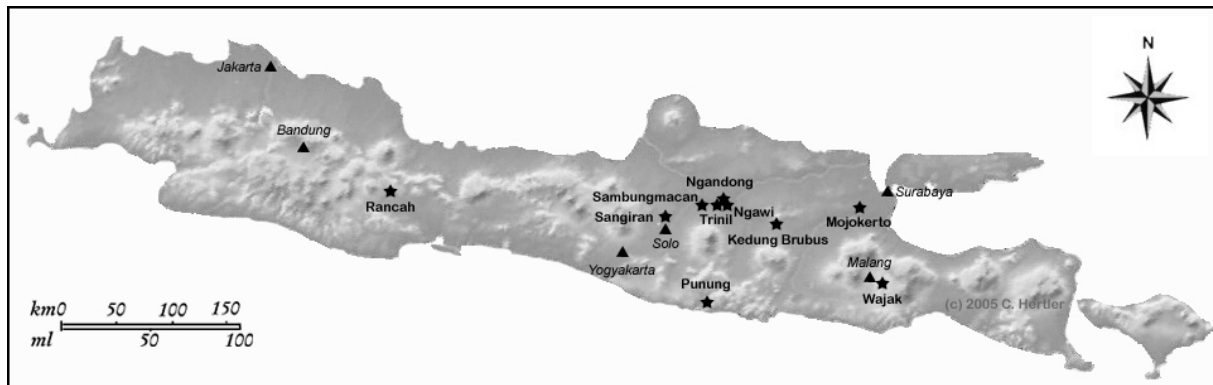


Fig. A-4: Hominid sites in Java

Although there are indications of evolution under isolated conditions during the Pleistocene, all Pleistocene hominid remains are generally believed to represent *Homo erectus*. They differ, however, considerably in age and thus in morphology.

The oldest hominid fossils in East Java are known only from Sangiran. The hominid fossils originating from the Sangiran formation are regularly plastically deformed, i.e. they cannot be used for morphological studies in a straightforward manner. The jaw fragments, due to their compactness and stability less distorted than the skulls and skull fragments, show however some basal features, e.g. extraordinary size and robusticity. The younger hominids from the Lower Bapang formation are comparable in age to those from Trinil HK. The Hauptknochenschicht at Trinil is correlated with corresponding layers at Sangiran. The Trinil skullcap hominid is thus likely to have approx. the same age as the hominid fossils from the upper hominid bearing horizon at Sangiran. The similarities between the Trinil skullcap and the Sangiran 2 calvarium support this correlation. According to correlations based on corresponding faunal levels the next younger set of hominid fossils has been found at Kedung Brubus and Mojokerto. The fossils themselves cannot be readily compared since they represent different anatomical parts (fragment of lower jaw vs. calvarium) and different developmental stages (Kedung Brubus represents a subadult or adult individual; Mojokerto a quite young child of approx. two years). The next younger hominid finds are coming from Ngandong. A series of eleven hominid skulls has been found during field campaigns of the Geological Survey. These skull fragments possess a slightly larger cranial capacity compared to the finds from Trinil and Sangiran, but the characteristic *Homo erectus* morphology is still present. A single hominid tooth has been described from Punung as yet. Since hominid specimens from younger, Holocene sites like Wajak doubtlessly belong to *Homo sapiens*, the transition from Pleistocene to Holocene represents a very interesting period in terms of human evolution. Basically, there are two possibilities for the course of hominid evolution; either this transition indicates an immigration event of *Homo sapiens* from the Asian mainland. It is then necessary to find an explanation for the disappearance of *Homo erectus* in Java (e.g. Storm 2001). Alternatively, the transition may have been accomplished by earlier *Homo erectus* under conditions of insular isolation. It would then indicate an evolutionary event on a local or regional scale, running in parallel to similar events on the mainland and/or other continents (Wolpoff 1989).

Recent Mammal Species in Central Europe and adjacent areas

order / family	name (syn.)	description	common name (engl.)	common name (dt.)	notes	present climatic retreats				
						Scandinavia + Baltic area	European part of Russia	Alps	Southeast Europe	Southwest Europe
Insectivora										
Erinaceidae	<i>Erinaceus europaeus</i>	Linnaeus, 1758	Western hedgehog	Braunbrüstigel						
	<i>Erinaceus concolor</i> <i>E. roumanicus</i> Barrett-Hamilton, 1900	Martin, 1838	Eastern hedgehog	Weißbrüstigel						
Soricidae	<i>Sorex araneus</i>	Linnaeus, 1758	Common shrew	Waldspitzmaus						
	<i>Sorex coronatus</i> <i>S. gemellus</i> Ott, 1968	Millet, 1828	Millet's shrew	Schabrackenspitzmaus	not occurring in D					
	<i>Sorex minutus</i>	Linnaeus, 1766	Pygmy shrew	Zwergspitzmaus						
	<i>Sorex alpinus</i>	Schinz, 1837	Alpine shrew	Alpenspitzmaus						
	<i>Neomys fodiens</i>	(Pennant, 1771)	Water shrew	Wasserspitzmaus						
	<i>Neomys anomalus</i>	Cabrera, 1907	Miller's water shrew	Sumpfspitzmaus						
	<i>Crocidura russula</i>	(Hermann, 1780)	Greater white-toothed shrew	Hausspitzmaus						
	<i>Crocidura suaveolens</i> <i>Crocidura leucodon</i>	(Pallas, 1811) (Hermann, 1780)	Lesser white-toothed shrew Bicoloured white-toothed shrew	Gartenspitzmaus Feldspitzmaus						
Talpidae	<i>Talpa europaea</i>	Linnaeus, 1758	Mole	Maulwurf						
Chiroptera										
Rhinolophidae	<i>Rhinolophus hipposideros</i>	(Bechstein, 1800)	Lesser horseshoe bat	Kleinhufeisennase						
Vespertilionidae	<i>Rhinolophus ferrumequinum</i>	(Schreber, 1774)	Greater horseshoe bat	Großhufeisennase						
	<i>Myotis daubentoni</i>	(Kuhl, 1819)	Daubenton's bat	Wasserfledermaus						
	<i>Myotis dasycneme</i>	(Boie, 1825)	Pond bat	Teichfledermaus						
	<i>Myotis brandti</i>	(Eversman, 1845)	Brandt's bat	Große Bartfledermaus						
	<i>Myotis mystacinus</i>	(Kuhl, 1819)	Whiskered bat	Kleine Bartfledermaus						
	<i>Myotis emarginatus</i>	(Geoffroy, 1806)	Geoffroy's bat	Wimperfledermaus						
	<i>Myotis nattereri</i>	(Kuhl, 1818)	Natterer's bat	Fransenfledermaus						
	<i>Myotis bechsteini</i>	(Kuhl, 1818)	Bechstein's bat	Bechsteinfledermaus						
	<i>Myotis myotis</i>	(Borkhausen, 1797)	Greater mouse-eared bat	Mausohr, Riesenfledermaus						
	<i>Myotis blythi</i> <i>Myotis oxygnathus</i> (Monticelli, 1885)	(Tomes, 1857)	Lesser mouse-eared bat	Kleinmausohr	not occurring in D					
	<i>Nyctalus noctula</i>	(Schreber, 1774)	Noctule	Abendsegler						
	<i>Nyctalus leisleri</i>	(Kuhl, 1818)	Leisler's bat	Kleinabendsegler						
	<i>Nyctalus lasiopterus</i> <i>Nyctalus maximus</i> (Fatio, 1869)	(Schreber, 1780)	Greater noctule	Großabendsegler	not occurring in D					
	<i>Eptesicus serotinus</i>	(Schreber, 1774)	Serotine	Breitflügelgedermaus						
	<i>Eptesicus nilssonii</i>	(Keyserling & Blasius, 1839)	Northern bat	Nordfledermaus						
	<i>Vespertilio murinus</i> <i>Vespertilio discolor</i> (Kuhl)	Linnaeus, 1758	Parti-coloured bat	Zweifarbgedermaus						
	<i>Pipistrellus pipistrellus</i>	(Schreber, 1774)	Common pipistrelle	Zwergfledermaus						
<i>Pipistrellus nathusii</i>	(Keyserling & Blasius, 1839)	Nathusius' pipistrelle	Rauhhaufgedermaus							
<i>Pipistrellus savii</i>	(Bonaparte, 1837)	Savi's pipistrelle	Alpenfledermaus							
<i>Plecotus auritus</i>	(Kuhl, 1819)	Kuhl's pipistrelle	Braunes Langohr							
<i>Plecotus austriacus</i>	(Fischer, 1829)	Grey long-eared bat	Graues Langohr							
<i>Barbastella barbastellus</i>	(Schreber, 1774)	Barbastelle	Mopsfledermaus							
<i>Miniopterus schreibersi</i>	(Kuhl, 1819)	Schreiber's bat	Langflügelgedermaus							
Rodentia										
Sciuridae	<i>Sciurus vulgaris</i>	Linnaeus, 1758	Red squirrel	Eichhörnchen						
	<i>Pteromys volans</i>	(Linnaeus, 1758)	Flying squirrel	Gleithörnchen	not occurring in D					
Citellus	<i>Citellus citellus</i>	Linnaeus, 1766	European souslik	Europäisches Ziesel, Schlichtziesel						
	<i>Citellus suslicus</i>	Linnaeus, 1766	Spotted souslik	Perlziesel	not occurring in D.					
	<i>Spermophilus citellus</i> Linnaeus, 1766 <i>Spermophilus suslicus</i> (Güldenstaedt, 1770)									
Tamaia	<i>Tamias sibiricus</i>	(Laxmann, 1769)	Siberian chipmunk	Burunduk	introduced					
	<i>Marmota marmota</i>	(Linnaeus, 1758)	Alpine marmot	Alpenmurmeltier						
Castoridae	<i>Castor fiber</i>	Linnaeus, 1758	European beaver	europäischer Biber						
Zapodidae	<i>Sicista betulina</i>	(Pallas, 1779)	Northern birch mouse	Birkenmaus						
	<i>Sicista subtilis</i>	(Pallas, 1773)	Southern birch mouse	Stuppenbirkenmaus, Streifenmaus	not occurring in D					
Cricetidae	<i>Cricetus cricetus</i>	(Linnaeus, 1758)	Common hamster	Feldhamster						
Arvicolidae	<i>Lemmus lemmus</i>	(Linnaeus, 1758)	Norway lemming	Berglemming	not occurring in D					
	<i>Myopus schisticolor</i>	(Lilljeborg, 1844)	Wood lemming	Waldlemming	not occurring in D					
	<i>Clethrionomys glareolus</i>	(Schreber, 1780)	Bank vole	Rötelmaus, Waldwühlmaus						
	<i>Clethrionomys rutilus</i>	(Pallas, 1779)	Northern red-backed mole	Polarrötelmaus	not occurring in D					
	<i>Clethrionomys rufocarpus</i>	(Sundevall, 1846)	Grey-sided vole	Graurötelmaus	not occurring in D					
	<i>Microtus agrestis</i>	(Linnaeus, 1761)	Field vole	Erdmaus						
	<i>Microtus arvalis</i>	(Pallas, 1779)	Common vole	Feldmaus						
	<i>Microtus epiroticus</i> <i>Microtus subarvalis</i> Meyer, Orlov & Skholl, 1972	Ondrias, 1966	Sibling vole	Epirus-Feldmaus	not occurring in D					
	<i>Microtus oeconomus</i>	(Pallas, 1776)	Root vole	Nordische Wühlmaus						
	<i>Microtus nivalis</i>	(Martins, 1842)	Snow vole	Schneemaus						
	<i>Microtus guentheri</i>	(Danford & Alston, 1880)	Günther's vole	Mittelmeer-Feldmaus						
	<i>Pitymys subterraneus</i>	de Sélys Longchamps, 1836	Common pine vole	Kurzohrmaus, Kleinäugige Wühlmaus						
	<i>Pitymys bavaricus</i>	König, 1962	Bavarian pine vole	Bayrische Kurzohrmaus						
<i>Arvicola terrestris</i>	(Linnaeus, 1758)	Northern water vole	Ostschermaus							
<i>Ondatra zibethicus</i>	(Linnaeus, 1766)	Muskkrat	Bisamratte	introduced						
Muridae	<i>Rattus norvegicus</i>	(Berkenhout, 1769)	Common rat	Wanderratte						
	<i>Rattus rattus</i>	(Linnaeus, 1758)	Ship rat, black rat	Hausratte						
<i>Apodemus sylvaticus</i>	(Linnaeus, 1758)	Wood mouse	Waldmaus							
<i>Apodemus flavicollis</i>	(Meichior, 1834)	Yellow-necked mouse	Gelbhalbmaus							
<i>Apodemus microps</i>	(Kratochvíl & Rosický, 1952)	Pygmy field mouse	Zwergwaldmaus							
<i>Apodemus mystacinus</i>	Danford & Alston, 1877	Rock mouse, Broad-toothed field mouse	Felsenmaus							
<i>Apodemus agrarius</i>	(Pallas, 1771)	Striped field mouse	Brandmaus							
<i>Micromys minutus</i>	(Pallas, 1771)	Harvest mouse	Zwergmaus							
<i>Mus musculus</i>	Linnaeus, 1758	House mouse	Hausmaus							
<i>Mus spretus</i>	Lataste, 1883	Algerian mouse	Heckenhausmaus							
<i>Mus spicilegus</i> <i>Mus hortulanus</i> Nordmann, 1840	Péteny, 1882	Steppe mouse	Ährenmaus							
Gliridae	<i>Eliomys quercinus</i>	(Linnaeus, 1766)	Garden dormouse	Gartenschläfer						
	<i>Dryomys nitedula</i>	(Pallas, 1779)	Forest dormouse	Baumenschläfer						
	<i>Glis glis</i>	(Linnaeus, 1766)	Fat dormouse	Siebenschläfer						
<i>Muscardinus avellanarius</i>	(Linnaeus, 1758)	Hazel dormouse	Haselmaus							
Capromyidae	<i>Myocastor coypus</i>	(Molina, 1782)	Coypu	Sumpfbiber, Nutria	introduced					

order / family	name (syn.)	description	common name (engl.)	common name (dt.)	notes	present climatic retreats				
						Scandinavia + Baltic area	European part of Russia	Alps	Southeast Europe	Southwest Europe
Lagomorpha										
Leporidae	<i>Oryctolagus cuniculus</i>	(Linnaeus, 1758)	Rabbit	europäisches Wildkaninchen						
	<i>Lepus capensis</i>	Linnaeus, 1758	Brown hare	europäischer Feldhase						
	<i>Lepus europaeus</i> Pallas 1778									
	<i>Lepus timidus</i>	Linnaeus, 1758	Mountain hare	Schneehase						
Carnivora										
Mustelidae	<i>Mustela erminea</i>	Linnaeus, 1758	Stoat	Hermelin						
	<i>Mustela nivalis</i>	Linnaeus, 1766	Weasel	Mauswiesel						
	<i>Mustela lutreola</i>	Linnaeus, 1761	European mink	europäischer Nerz	extinct since the 20th century					
	<i>Mustela putorius</i>	Linnaeus, 1758	Western polecat	Ilits						
	<i>Musteola putorius</i>	Linnaeus, 1758	Domestic ferret	Frettchen	domestic					
	<i>Martes martes</i>	(Linnaeus, 1758)	Pine marten	Baummartener						
	<i>Martes foina</i>	(Erxleben, 1777)	Beech marten	Steinmartener						
	<i>Gulo gulo</i>	(Linnaeus, 1758)	Wolverine, glutton	Vielfraß						
	<i>Lutra lutra</i>	(Linnaeus, 1758)	Otter	Fischotter						
	<i>Meles meles</i>	(Linnaeus, 1758)	Badger	Dachs						
Procyonidae	<i>Procyon lotor</i>	(Linnaeus, 1758)	Raccoon	Waschbär						
Ursidae	<i>Ursus arctos</i>	Linnaeus, 1758	Brown bear	Braunbär	extinct and reintroduced					
Canidae	<i>Canis lupus</i>	Linnaeus, 1758	Wolf	Wolf						
	<i>Vulpes vulpes</i>	(Linnaeus, 1758)	Red fox	Rotfuchs						
	<i>Nyctereutes procyonoides</i>	(Gray, 1834)	Raccoon-dog	Marderhund	introduced in Russia and subsequently immigrating					
Felidae	<i>Felis lynx</i>	Linnaeus, 1758	Lynx	Luchs						
	<i>Felis silvestris</i>	Schreber, 1777	Wild cat	Wildkatze						
	<i>Felis silvestris f. catus</i>	Linnaeus, 1758	Domestic cat	Hauskatze	domestic					
Perissodactyla										
Equidae	<i>Equus przewalskii</i>	Linnaeus, 1758	Domestic horse	Pferd	domestic					
	<i>Equus africanus</i>	Linnaeus, 1758	Domestic donkey	Hausesel	domestic					
Artiodactyla										
Suidae	<i>Sus scrofa</i>	Linnaeus, 1758	Wild boar	Wildschwein						
Cervidae	<i>Cervus elaphus</i>	Linnaeus, 1758	Red deer	Rothirsch						
	<i>Cervus nippon</i>	Temminck, 1838	Sika deer	Sikahirsch	introduced					
	<i>Cervus dama</i>	Linnaeus, 1758	Fallow deer	Damhirsch						
	<i>Alces alces</i>	(Linnaeus, 1758)	Elk	Elch	not permanent					
	<i>Rangifer tarandus</i>	(Linnaeus, 1758)	Reindeer	Ren	not occurring in D					
	<i>Capreolus capreolus</i>	(Linnaeus, 1758)	Roe deer	Reh						
Bovidae	<i>Bison bonasus</i>	(Linnaeus, 1758)	Bison	Wisent	extinct					
	<i>Bos primigenius</i>	Linnaeus, 1758	Domestic cattle	Hausrind	domestic					
	<i>Ovibos moschatus</i>	(Zimmermann, 1780)	Musk ox	Moschusochse	extinct and reintroduced					
	<i>Ovis ammon</i>	(Pallas, 1811)	Mouflon	Mufflon						
	<i>Ovis ammon f. aries</i>	Linnaeus, 1758	Domestic sheep	Schaf	domestic					
	<i>Capra ibex</i>	Linnaeus, 1758	Ibex	Alpensteinbock						
	<i>Capra aegagrus</i>	Linnaeus, 1758	Goat	Hausziege	domestic					
	<i>Rupicapra rupicapra</i>	(Linnaeus, 1758)	Chamoix	Gemse						

Sources Corbet, G. & Ovenden, D. (1980): The mammals of Britain and Europe. Collins Sons & Co., London
 Schaefer, M. (1984): Brohmer's Fauna von Deutschland. Quelle & Meyer, Heidelberg.
Systematics: Starck, D. (1995): Kaestner's Lehrbuch der Speziellen Zoologie. Vol. II-Vertebrates, Part 5: Mammals. 2 Vols. Fischer, Stuttgart, Jena.