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MIOCENE MONKEY FROM MELCHINGEN

*ABSTRACT: Reports of Vallesian cercopithecoid primates in Europe are scarce and poorly supported, but Turolian and subsequent records are common and well established. In contrast, hominoid primates are relatively common in Vallesian deposits, but are rare in Turolian and later deposits. This observation has given rise to several hypotheses concerning competitive exclusion, adaptations and palaeoclimatic changes. During a revision of European Miocene suids carried out since 2010, the author has found several mis-identified hominoids in various collections. Recently, a cercopithecoid fossil (*Mesopithecus* sp. cf. *pentelicus*) was recognised in the historical collections from Melchingen, Swabian Alb, Germany, a site well known for the hominoids that it yielded. The Melchingen fauna, previously correlated to MN 9, is in fact comprised of a mixture of Vallesian and Turolian elements which are preserved differently (brown teeth for Vallesian specimens, pale cream to white teeth for Turolian ones). The Melchingen monkey tooth has pale cream-coloured enamel, from which we infer a Turolian age for it, although there must remain some doubt about its age. At 48°21' latitude north, this is one of the most northerly known late Miocene cercopithecoids. The aim of this paper is to describe and interpret this fossil and to discuss its importance for understanding the evolution of European Late Miocene primate faunas.*

KEY WORDS: Cercopithecidae - Late Miocene - Melchingen - Swabian Alb - Germany

INTRODUCTION

Cercopithecoid primates are well known from European Turolian, Pliocene and Pleistocene deposits (Köhler *et al.* 1999, Eronen, Rook 2004). In contrast, their Vallesian fossil record is poor, with material reported to be present at only four localities (*Table 1*) about the veracity of which there is justifiably a great deal of doubt.

Melchingen is a karst deposit in the Swabian Alb (*Figure 1*) (48°21'18"N; 9°08'46"E). The bohrerz (bean

ore - pisolithic iron oxide nodules) infilling the Swabian fissures was mined by hand during the 1800's and many fossils were collected and found their way into museums in Tübingen, Stuttgart and elsewhere in Germany. Fossils from Melchingen have featured in many publications, some as far back as the 1830's (Jäger 1835, 1839, 1850, Quenstedt 1853, Branco 1898, Schlosser 1901, 1902, Koken 1905, Remane 1921a, 1921b, Klähn 1924, Haupt 1935, Simons, Pilbeam 1965, Szalay, Delson 1979, Andrews *et al.* 1996, Begun 2002). Estimates of the age of the Melchingen deposits have

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been conservative, with most recent authors correlating the deposits to MN 9 (Mein 1999, Ginsburg 1999, Huguency 1999, Pickford 2012). However, recent re-assessment of the suids from the deposits indicate that the Melchingen deposits accumulated at various times (Table 2), including MN 9 (basal Vallesian) and the Turolian (MN 11 – MN 12), while some of the deposits in the nearby fissures at Salmendingen (which yielded remains of *Hippopotamus*) accumulated during the Latest Turolian equivalent in age to the Ventian (MN 13) (Figure 2) of the Mediterranean zone.

BACKGROUND TO THE DISCOVERY OF THE MELCHINGEN MONKEY

During revision of European Late Miocene suids, the author had occasion to examine fossils in many collections, and has found mis-identified primate material in some of them (Pickford 2010, 2012, 2013a). While studying the old collections of suids from the Swabian Alb (Figure 2, Table 2) housed at the Geological and Palaeontological Institute of the University of Tübingen (GPIT), a tooth from

Melchingen, labelled in the handwriting of M. Schlosser as a carnivore lower incisor, was recognised to be an upper lateral incisor of a cercopithecoid (Figure 3).

Melchingen is well known for the hominoid primates that it yielded in the mid- to late 1800's (Quenstedt 1853, Branco 1898, Schlosser 1901, 1902, Koken 1905, Koenigswald 1956a, Pickford 2012) but this is the first time that cercopithecoids have been reported from the Swabian Alb. The only Miocene monkeys previously reported from Germany are from Eppelsheim (Haupt 1935, Koenigswald 1956b) and Wissberg Gau-Weinheim in the Rhine Graben (Delson 1973). The Eppelsheim canine, attributed to cf. *Semnopithecus eppelsheimensis* by Eronen and Rook (2004) could be from a pliopithecoid (Andrews *et al.* 1996). As for the lower molar described by Koenigswald (1956b) which was attributed to *Rhenopithecus eppelsheimensis* (Haupt 1935) it may prove to be a deciduous tooth of a hominoid (Pickford 2012). The P4/ from Wissberg (Delson 1973) is of uncertain status and age (Andrews *et al.* 1996). Therefore the presence of a monkey tooth at Melchingen is important, as it confirms the existence of the family in Germany during the Late Miocene.

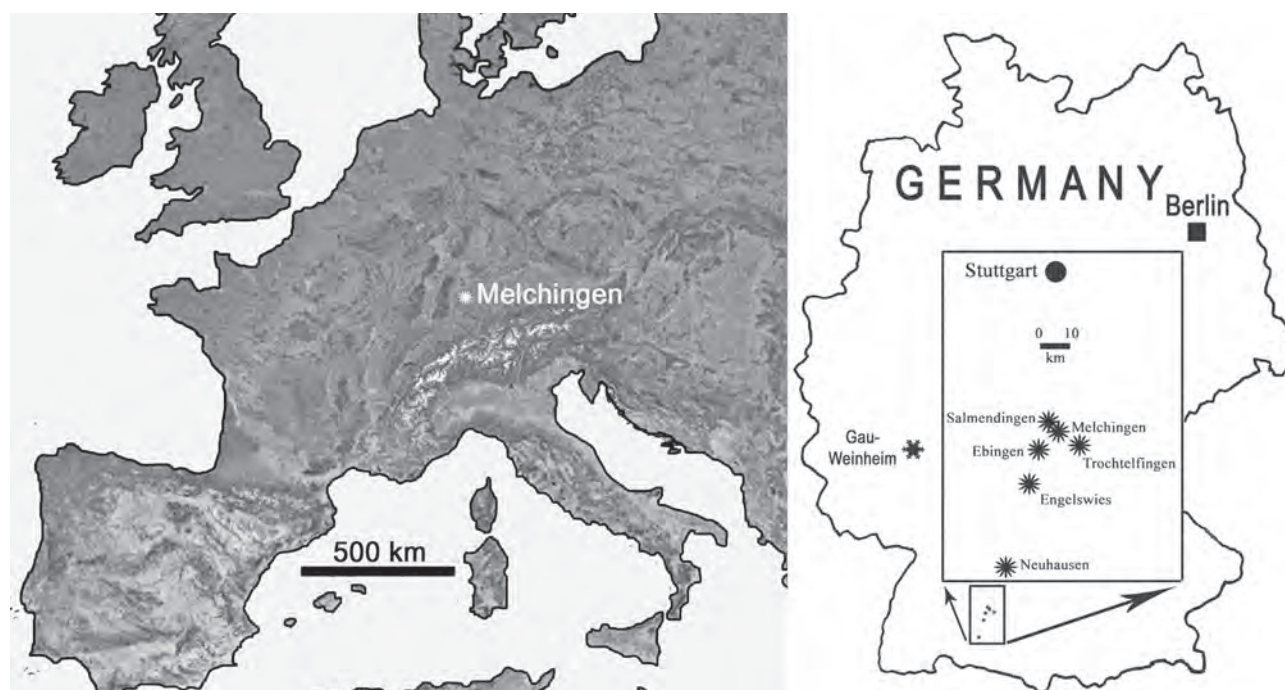


FIGURE 1. Location of Melchingen, in the Swabian Alb, Germany, north of the Alps (white patches).

TABLE 1. List of fossil cercopithecoid occurrences in Europe – data from Eronen, Rook 2004 and Andrews *et al.* 1996. Note the relative paucity of Vallesian occurrences (MN 9, MN 10) all of which are of doubtful status compared with the rich, well documented Turolian and subsequent levels (MN 11 *et seq.*).

MN 9 (All records are doubtful)

Eppelsheim, Germany: cf. *Semnopithecus eppelsheimensis*
 (a pliopithecoid according to Andrews *et al.* 1996; see also McKenna, Bell 1997: 344, genus *Presbytis*)
 Wissberg, Germany: ??? *Mesopithecus* sp. (Delson 1973)
 Gorna Susica, Bulgaria: ??? *Mesopithecus pentelicus*

MN 10 (The only record is doubtful)

Grossulovo, Ukraine: ??? *Mesopithecus pentelicus*

MN 11 (Many confirmed records)

Grebeniki, Ukraine: *Mesopithecus pentelicus*
 Maragheh (Middle beds), Iran: *Mesopithecus pentelicus*
 Mollon, France: *Mesopithecus* indet. (*Mesopithecus* sp.?)
 Ravin des Zouaves 5, Greece: *Mesopithecus pentelicus*
 Vathylakkos 2, Greece: *Mesopithecus* cf. *pentelicus*
 Vathylakkos 3, Greece: *Mesopithecus* indet. (*Mesopithecus* sp.?)

MN 12 (Many confirmed records)

Chomateres, Greece: *Mesopithecus pentelicus*
 Kalimanci 2, Bulgaria : *Mesopithecus pentelicus*
 Kromidovo 2, Bulgaria : *Mesopithecus pentelicus*
 Molayan, Afghanistan: *Mesopithecus pentelicus*
 Pikermi, Greece: *Mesopithecus pentelicus*

MN 13 (Many confirmed records)

Baccinello V3, Italy: *Mesopithecus* sp.
 Baltavar, Hungary: *Mesopithecus pentelicus*
 Brisighella, Italy: *Mesopithecus* cf. *pentelicus*
 Casablanca M, Spain: *Macaca* cf. *sylvana* (*Macaca* n. sp.?)
 Casino, Italy: *Mesopithecus pentelicus*
 Dytiko 1, Greece: *Mesopithecus* cf. *monspessulanus*
 Dytiko 1, Greece: *Mesopithecus* cf. *pentelicus*
 Dytiko 2, Greece: *Mesopithecus* cf. *monspessulanus*
 Dytiko 2, Greece: *Mesopithecus* cf. *pentelicus*
 Dytiko 3, Greece: *Mesopithecus* cf. *pentelicus*
 Gravitelli, Italy: *Mesopithecus* sp.
 Hatvan, Hungary: *Mesopithecus pentelicus*
 Maramena, Greece: *Mesopithecus pentelicus*
 Polgardi, Hungary: *Mesopithecus* cf. *pentelicus*

MN 14 (Many confirmed records)

Megalo Emvolon, Greece: *Dolichopithecus ruscinensis*
 Montpellier, France: *Dolichopithecus ruscinensis*

Montpellier, France: *Macaca sylvana*
 Montpellier, France: *Mesopithecus monspessulanus*
 Osztramos 1, Hungary: *Macaca* indet. (*Macaca* sp.?)
 Pestlorinc, Hungary: *Dolichopithecus ruscinensis*

MN 15 (Many confirmed records)

Csarnota 2, Hungary: *Macaca* cf. *sylvana*
 Layna, Spain: *Dolichopithecus ruscinensis*
 Malushteni, Romania: *Mesopithecus monspessulanus*
 Malushteni, Romania: *Paradolichopithecus* cf. *arvernensis*
 Orrios 7, Spain: *Macaca* indet. (*Macaca* sp.?)
 Perpignan, France: *Dolichopithecus ruscinensis*
 Perpignan, France: *Mesopithecus monspessulanus*
 Wölfersheim, Germany: *Dolichopithecus ruscinensis*
 Wölfersheim, Germany: *Mesopithecus monspessulanus*
 Ivanovce, Slovakia: Colobinae gen. et spec. indet. (see Fejfar, Heinrich 1985)

MN 16 (Many confirmed records)

Balaruc, France: *Macaca* sp.
 Beremend 4, Hungary: *Macaca* sp.
 Cova Bonica, Spain: *Paradolichopithecus* sp.
 Cova Bonica, Spain: *Macaca* cf. *sylvana*
 Gundersheim 1, Germany: *Macaca* cf. *sylvana*
 Hajnáčka, Slovakia: *Mesopithecus monspessulanus*
 Moreda, Spain: *Paradolichopithecus* sp.
 Triversa (Fornace RDB), Italy: *Macaca* cf. *sylvana*
 Triversa (Fornace RDB), Italy: *Mesopithecus monspessulanus*
 Viallette, France: *Paradolichopithecus* cf. *arvernensis*

MN 17 (Many confirmed records)

Capo Figari, Italy: *Macaca majori*
 Kuruksaj, Tadjikistan: *Paradolichopithecus sushkini*
 La Puebla de Valverde, Spain: *Macaca* cf. *sylvana*
 La Puebla de Valverde, Spain: *Paradolichopithecus* cf. *arvernensis*
 Mugello, Italy: *Macaca florentina*
 Orosei, Italy: *Macaca majori*
 Saint Vallier, France: *Macaca* cf. *sylvana*
 Senèze, France: *Macaca* cf. *sylvana*
 Senèze, France: *Paradolichopithecus arvernensis*
 Tegelen, Netherlands: *Macaca florentina*
 Vatera, Greece: *Paradolichopithecus arvernensis*
 Nová Vieska, Slovakia: *Paradolichopithecus* sp. (Vlačíky *et al.* 2009).

Material and Methods

The fossil described here is part of the old collections from Melchingen, Swabian Alb, housed in the Geologische und Palaeontologische Institut, Universität Tübingen (GPIT MA 2340). The specimen was measured with sliding calipers to the nearest 0.1 mm. Stereo images were captured with a Sony Cybershot Digital Camera, and treated with photoshop to remove unwanted background, and to enhance the contrast. The scale was added to the image after treatment because it has been noticed that scales included at the time of image acquisition are often incorrect due to a combination of parallax and digital effects.

Age of Melchingen

Melchingen is generally correlated to MN 9 (Hugueney 1999, Mein 1986, 1999). Some of the fossil suids from the site (*Parachleuastochoerus huenermanni*, *Propotamochoerus palaeochoerus*) (Hünemann 1968, personal observations) comfort this correlation (Table 2), whereas the presence of *Hippopotamodon major* suggests a later correlation, because elsewhere in Europe its range spans MN 10 (Vallesian) to MN 12 (Turolian) or somewhat younger (Latest Turolian equivalent to the

base of MN 13: Ventian). The possibility of a mixed fauna in this karst deposit is not impossible. Inspection of the preservation characteristics of the fossils reveals the presence of reworked specimens (broken teeth with rolled and polished surfaces) alongside fresher, relatively undamaged material. The fossils from the site come in two different colours, brown ones, which are Early Vallesian, and white ones, which are Late Vallesian, Turolian and Ventian. It should be noted that the nearby site of Salmendingen, which possibly represents the same karst system as Melchingen, also yielded some Turolian-Ventian faunal elements. A hippopotamid lower canine preserved in the Tübingen collections (GPIT MA 2234) has similar whitish enamel as the *Hippopotamodon* teeth from Melchingen and Salmendingen and suggests an age equivalent to the Ventian (Morales *et al.* 2013) for some of the deposits (i.e. Late Turolian in previous literature). The earliest known representatives of this family outside Africa are of Ventian age (Spain: Crusafont *et al.* 1964; Italy: Seguenza 1907) from which it is concluded that Salmendingen yields specimens of this age as well as Vallesian fossils. The same could apply to Melchingen. Thus all that can be said about the age of the Melchingen monkey is that it could be late

TABLE 2. Measurements of suid fossils from Melchingen, Swabian Alb, Germany and correlations to the MN Zonation. (All measurements were made by the author, except for that of GPIT MA 1178-36, which was published by Hünemann (1968)). The left M3/ of *Hippopotamodon major* was reported by Hünemann (1968) to be from the nearby site of Salmendingen, but the label with the fossil indicates that it is from Melchingen (lt – left, rt – right, x – meristic position not known).

Catalogue N°	Tooth	Length	Breadth	Taxon	Correlation
GPIT MA 2350	I1/ rt	24.0	10.5	<i>Hippopotamodon major</i>	MN 10-MN 13
GPIT MA 1178-1	m/3	--	18.0	<i>Hippopotamodon major</i>	MN 10-MN 13
GPIT MA 6-6-18	M3/ lt	--	26.8	<i>Hippopotamodon major</i>	MN 10-MN 13
GPIT MA 1319	p/4 lt	20.2	15.0	<i>Hippopotamodon major</i>	MN 10-MN 13
GPIT MA 1178-25	p/3 rt	21.0	13.4	<i>Hippopotamodon major</i>	MN 10-MN 13
GPIT MA 4983	M3/ lt	--	14.4	Indeterminate small suid	None
GPIT MA 1178-36	M1/	18.3	16.7	<i>Propotamochoerus palaeochoerus</i>	MN 9
GPIT MA 1320	M2/ rt	--	19.0	<i>Propotamochoerus palaeochoerus</i>	MN 9
GPIT MA 4981	p/4 rt	14.0	8.6	<i>Parachleuastochoerus huenermanni</i>	MN 9
GPIT MA 4985	Mx/ lt	--	15.1	<i>Parachleuastochoerus huenermanni</i>	MN 9

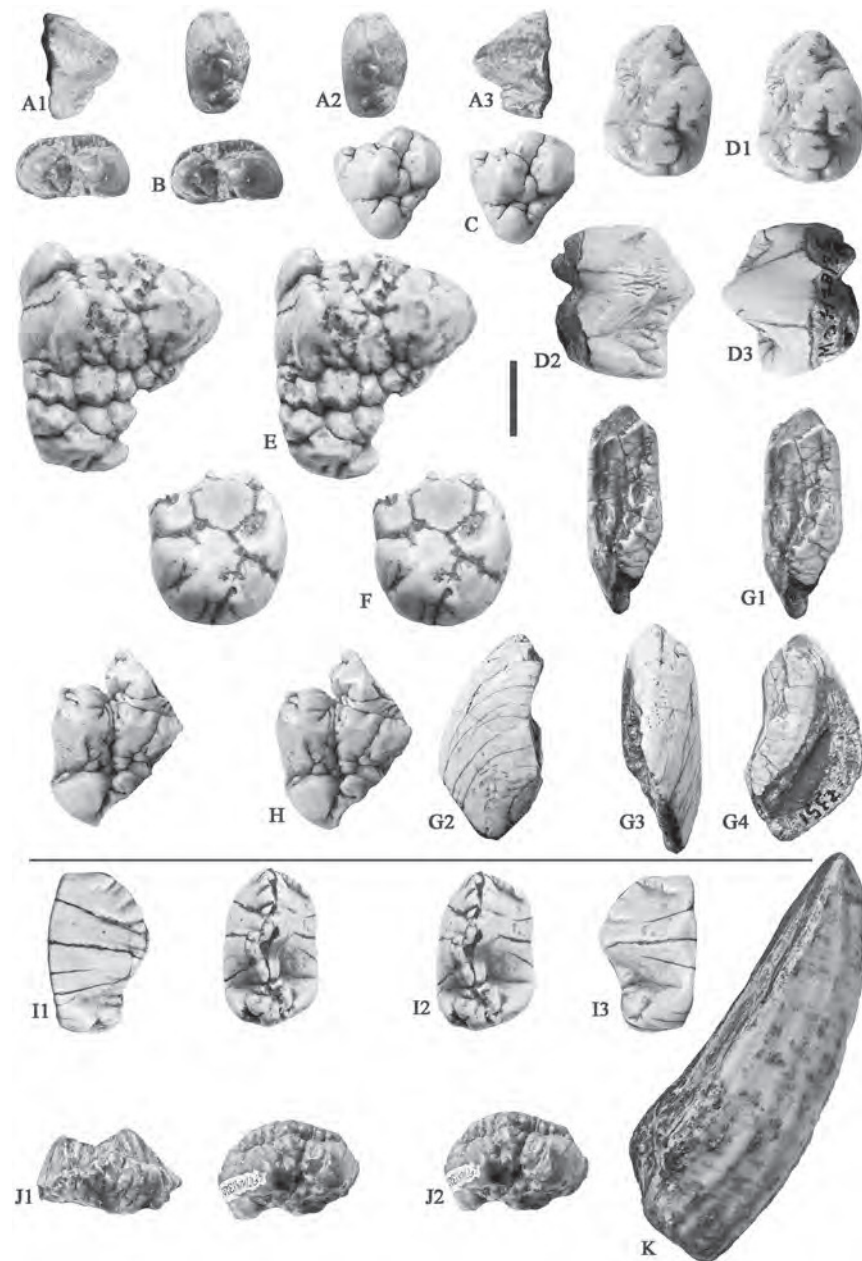


FIGURE 2. Suidae from Melchingen (above the line) and Salmendingen (below the line), Swabian Alb, Germany. There are two kinds of preservation at both sites. Specimens with brown enamel correspond to Early Vallesian taxa (*Parachleuastochoerus huenermanni* and *Propotamochoerus palaeochoerus*) while specimens with white enamel correspond to later assemblages, probably Turolian (*Hippopotamodon major* and one indeterminate small suid). A) GPIT MA 4981, *Pa. huenermanni*, right p/4, lingual, stereo occlusal and buccal views, B) GPIT MA 4985, *Pa. huenermanni*, upper molar anterior loph, stereo occlusal view, C) GPIT MA 4983, indeterminate species, left M3/ fragment, stereo occlusal view, D) GPIT MA 1319, *H. major*, left p/4, stereo occlusal, buccal and lingual views, E) GPIT MA 6-6-18, *H. major*, left M3/ fragment, stereo occlusal view, F) GPIT MA 1178-1, *H. major*, m/3 talonid, stereo occlusal view, G) GPIT MA 2350, *H. major*, right I1/, stereo lingual, mesial, labial and lingual views, H) GPIT MA 4984, *H. major*, molar fragment, stereo occlusal view, I) GPIT MA 1178-25, *H. major*, right p/3, lingual, stereo occlusal and buccal views, J) GPIT MA 1320, *Pr. palaeochoerus*, right M2/ anterior loph, mesial and stereo occlusal views, K) GPIT MA 2234, *Hippopotamus* sp. lower canine, buccal view. (Scale: 10 mm).



FIGURE 3. GPIT 2340, left I2/ of *Mesopithecus* sp. cf. *pentelicus*. A) mesial, B) stereo lingual, C) distal, D) labial views, E) original label accompanying the specimen in the handwriting of M. Schlosser (scale: 10 mm).

Vallesian, Turolian or Ventian, probably Turolian on the basis of its preservation characteristics.

Systematic Palaeontology: Order Primates Linnaeus 1758, Family Cercopithecidae Gray, (1821), Subfamily Colobinae Blyth (1875), Genus *Mesopithecus* Wagner

(1839), Species *Mesopithecus* sp. cf. *pentelicus* Wagner (1839).

Description

The isolated cercopithecoid upper lateral incisor from Melchingen (Figure 3, Table 3) is in medium wear, having lost the apical part of the crown due to use. The enamel is whitish. In labial and lingual views, the crown is longest apically and narrows gently towards the cervix. In mesial and distal views, the crown broadens from apex towards the root, and is broadest just above cervix. It has a concave lingual surface separated by a low ridge from a small distal basin. The lingual concavity shows a slight central ridge, which fades out basally. The labial surface is bulbous. On the mesial and distal sides the cervix curves apically to about the same height. The root tapers gently from cervix to apex in labial and lingual views. In mesial and distal views the root shows a shallow longitudinal valley.

TABLE 3. Measurements (in mm) of GPIT 2340, cercopithecoid tooth from Melchingen.

GPIT MA 2340	Left I2/
Mesio-distal length	4.0
Labio-lingual breadth	5.3
Root height buccal side	8.4
Root height lingual side	8.4

This tooth is similar to upper lateral incisors of *Mesopithecus pentelicus*. Comparison with material from Pikermi, in which the lateral incisors are in situ, reveals close correspondence, not only in morphology, but also in dimensions. Despite the medium stage of wear which makes direct comparison of dimensions delicate, the available sample from Pikermi has teeth that are at a similar stage of wear as the Melchingen specimen, and it is clear that the latter tooth would not look out of place in a *Mesopithecus* skull from Pikermi.

From this it is concluded that the Melchingen primate incisor is likely to belong to the genus *Mesopithecus*.

European Late Miocene Palaeoanthropological Record

There are very few European localities that have yielded hominoids in association with monkeys (Szalay, Delson 1979), which makes Melchingen rather unusual. Pickford (2012) recorded three hominoid taxa at the site, *Neopithecus brancoi*, *Dryopithecus fontani* and *Hispanopithecus laietanus* (Table 4). The question arises: were the Melchingen hominoids and the monkey contemporaneous. The answer is probably not, because Melchingen shows two distinct patterns of preservation of fossils, teeth with brown enamel belong to Early Vallesian taxa such as *Parachleuastochoerus crusafonti* (MN 9) and *Propotamochoerus palaeochoerus* (MN 9) whereas teeth with white enamel belong to Turolian and/or Ventian taxa such as *Hippopotamodon major* (MN 10 - MN 13). A similar situation occurs at Salmendingen, with brown teeth belonging to *Propotamochoerus palaeochoerus* and white teeth belonging to *Hippopotamodon major*. In addition there is a true hippo, *Hippopotamus sensu lato* (probably Ventian) at Salmendingen, represented by a lower canine with white enamel. The conclusion is that both

these sites yielded mixed faunas, an older Early Vallesian fraction, and a younger Turolian-Ventian one. The Melchingen monkey incisor has white enamel, like teeth of the Turolian suoids, is unrolled, and is probably of this age. Thus the Melchingen hominoid and monkey fossils were probably not fossilised at the same time.

Palaeoclimatic considerations

The palaeohumidity maps of Eronen and Rook (2004) proposed changes in the climatic regimes of Europe during the Vallesian and Turolian. The Swabian Alb falls within the very humid zone during MN 9, but became slightly drier during MN 10 and much drier during MN 11.

The site of Melchingen could thus document aspects of this climatic change, preserving elements of a fauna (with hominoids) adapted to humid conditions (teeth preserved brown implying mobile ferrous ions circulating in ground waters) during MN 9, giving way to one adapted to somewhat drier conditions during MN 10 and even more arid conditions during the Turolian (teeth preserved white, implying relative immobility of ferrous ions in the ground waters) of which cercopithecids were an important element.

Finally, the evidence for the presence of Vallesian monkeys in Europe is still very slender, with doubts being expressed either about the taxonomic appurtenance or about the ages of the specimens reported to be from this time span. By the Turolian, in contrast, monkeys comprised a prominent element of the faunas in many mid-latitude parts of Europe, and on the basis of the Melchingen monkey specimen, this distribution included the southern parts of Germany as far north as 48°21' latitude. The Eppelsheim "monkey" canine described by Haupt (1935) belongs to a non-

TABLE 4. Hominoid specimens from Melchingen, listed by Pickford 2012.

Catalogue N°	Specimen	Mesio-distal length	Bucco-lingual breadth	Taxon
GPIT MA 2125	m/2 right (or m/1)	9.9	9.1	<i>Neopithecus brancoi</i>
GPIT MA 2127	M1/ right (or M2/)	10.2	11.2	<i>Neopithecus brancoi</i>
GPIT MA 2123	m/3 right	13.0	11.0	<i>Dryopithecus fontani</i>
GPIT MA 2126	M2/ left	10.8	11.2	<i>Dryopithecus fontani</i>
GPIT MA 2128	m/1 right	9.6	7.6e	<i>Hispanopithecus laietanus</i>

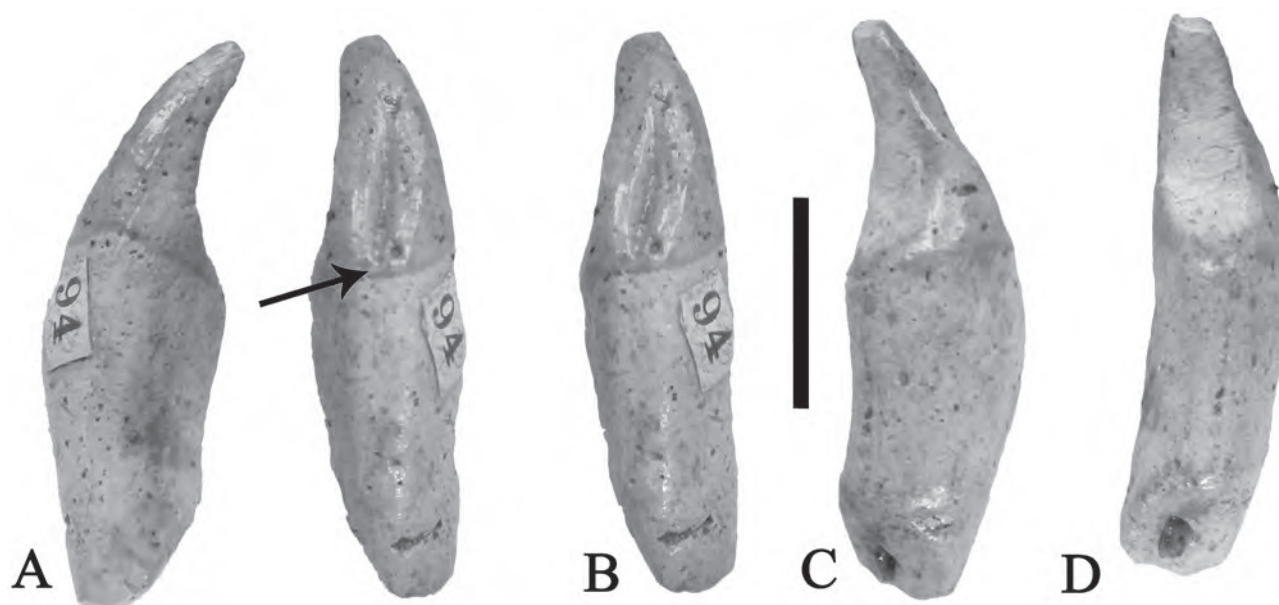


FIGURE 4. GPIFB 94, cast of an upper right male canine of a non-cercopithecoid primate from Eppelsheim, Germany. A, buccal; B, stereo mesial; C, lingual; D, distal views. Arrow points to the base of the mesial groove (scale : 10 mm).

cercopithecoid primate, as was suspected by Andrews *et al.* (1996). A cast of an upper right male canine kept in the Geo-Palaeontology Institute, Freiberg im Bresigau, reveals that the crown has a prominent mesial groove which stops short of the cervix, unlike cercopithecoid canines in which the mesial groove extends onto the root. Thus this record of the presence of Vallesian monkeys in Europe can be deleted.

Discussion and Conclusions

GPIT MA 2340 from Melchingen, Swabian Alb, Germany, is a cercopithecoid upper left lateral incisor, close in morphology and dimensions to corresponding teeth of *Mesopithecus pentelicus*, a colobine which is widespread in Turolian deposits of Europe (Eronen, Rook 2004) but not previously securely recorded from Vallesian deposits. The specimens from Gorna Susica, Bulgaria (MN 9) and Grossulovo, Ukraine (MN 10) are doubtfully attributed to the species. The only other Vallesian monkeys reported from Europe comprise three isolated teeth, a canine from Eppelsheim and a damaged lower molar and a premolar from Wissberg, Gau-Weinheim. The former is the type specimen of *Semnopithecus eppelsheimensis* Haupt (1935). Andrews *et al.* (1996) listed the latter canine as Pliopithecidae indet (see comment in Tab. 1) There is doubt about the attribution of the lower molar from the Rhine Graben

described by Koenigswald (1956b). It could be a deciduous tooth of a hominoid (Pickford 2012). The other supposed monkey from Germany is a P4/ from Wissberg (Delson 1973) correlated to MN 9, but possibly younger (Andrews *et al.* 1996).

The Melchingen monkey fossil confirms the presence of this family Cercopithecidae in Germany, hitherto poorly supported by the supposedly Vallesian Eppelsheim and Wissberg specimens from the Rhine Graben. For many years the Dinotheriensande deposits were correlated to MN 9, but it is now known that the fauna from the sands span a considerable period of time (Pickford, Pourabrishami 2013, Pickford 2013b) which means that Haupt's (1935) specimen of *Semnopithecus eppelsheimensis* could be younger or older than previously thought, as could the upper premolar from Wissberg identified by Delson (1973).

Melchingen is one of the few European sites to have yielded both hominoids and cercopithecoids. However, the possibility that the fauna from Melchingen may be a mixture of elements from MN 9 or MN 10 and later, as indicated by the suid fauna, does not necessarily imply that these two families co-existed at the site. It is likely that all the hominoids are from MN 9 a warm and humid palaeoclimatic phase in Western Europe (Eronen, Rook 2004) whereas the cercopithecoid tooth may be from MN 10 or from the Turolian (MN 11–12, or even Ventian, MN

13) which corresponds to a drier, cooler palaeoclimatic phase in Western Europe. The monkey tooth has white enamel like the teeth of the suid *Hippopotamodon major* from Melchingen and the *Hippopotamus* canine from the nearby site of Salmendingen.

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