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Eomyops hebeiseni n. sp., a new large Eomyidae (Rodentia, Mammalia) of the Upper Freshwater Molasse of Switzerland

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Key words: New species, Eomyidae, Rodentia, Mammalia, Middle Miocene

ZUSAMMENFASSUNG

Beschrieben wird eine neue, extrem grosse Art von *Eomyops* aus der Oberen Süsswassermolasse (Mittelmiozän, MN 5/MN 6) der Schweiz. *Eomyops hebeiseni* n. sp. der Fundstelle Chatzloch zeichnet sich gegenüber den drei bisher bekannten Arten *Eomyops catalaunicus* (HARTENBERGER 1966), *Eomyops bodvanus* (JÁNOSSY 1972) und *Eomyops oppligeri* (ENGESSER 1990) im wesentlichen durch deutlich grössere Dimensionen aus. Morphologisch steht die neue Art *Eomyops catalaunicus* am nächsten.

ABSTRACT

In this paper a new, extremely large species of *Eomyops* is described. *Eomyops hebeiseni* n. sp. of the locality Chatzloch (Upper Freshwater Molasse of Switzerland, Middle Miocene, MN 5/MN 6) is distinctly larger than the three hitherto known species *Eomyops catalaunicus* (HARTENBERGER 1966), *Eomyops bodvanus* (JÁNOSSY 1972) and *Eomyops oppligeri* (ENGESSER 1990). Morphologically, *Eomyops hebeiseni* n. sp. is closest to *Eomyops catalaunicus*.

Introduction/Historical review

In 1966 Hartenberger described a new European small bunodont eomyid with a lingual anteroloph on the M^1 and M^2 from the Young Miocene locality Can Llobateres (Spain, MN 9) which he then named *Eomys catalaunicus*.

Later, in 1968 Hugueney & Mein described similar teeth from the French localities La Grive and Lissieu (MN 7 + 8 and MN 13) which they incorporated in the North American genus *Leptodontomys* SHOTWELL 1956. They also described another new bunodont eomyid from the fissure filling Vieux Collonges (MN 4 and MN 5, Dép. Rhône, France) as *Eomys? rhodanicus*. This eomyid was also characterized by the possession of a lingual anteroloph on the M^1 and M^2.

In his discussion of the relationships of the North American and European eomyids Fahlbusch 1973 followed the argumentation of Hugueney & Mein and agreed on the morphological affinities between the North American and European forms of *Leptodontomys*.

In 1974 Fejfar described new findings of *Leptodontomys* from the localities Franzensbad (MN 5), Neudorf Spalte 1 and Strakonice (both MN 6). Fejfar (1974: 106) also postulated an immigration from east for *Leptodontomys*, together with the immigration wave of *Megacricetodon*, *Democricetodon* and *Eumyarion*.

In 1979 Engesser denied the unity of the North American genus *Leptodontomys* with the above mentioned European forms and created for the latter ones the genus *Eomyops*. Since then, various discussions have evolved concerning the generic membership of these small Old World bunodont eomyids.

In 1990 Engesser created in his monograph on eomyids a new genus for the other European bunodont eomyid (*Eomys? rhodanicus*). Because of the morphological differences to the oligocene genus *Eomys* he named the new genus *Pentabuneomys* with the hitherto only known species *P. rhodanicus*.

Recent investigations by Qiu (1994) proved that Chinese *Leptodontomys*-forms are morphologically intermediate between European *(Eomyops)* and North American *(Leptodontomys)* forms. Therefore, Qiu concluded that it is unlikely that the differences between the European and American forms are large enough to justify two different genera.

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Family Eomyidae DEPÉRET & DOUXAMI 1902
Genus *Eomyops* ENGESSER 1979
Eomyops hebeiseni n. sp.
Fig. 1

Diagnosis

Largest known species of the genus *Eomyops* ENGESSER 1979 with bunodont cheek teeth and an antique *Eomys*-like tooth pattern. It is characterized by the possession of a lingual anteroloph on the M^1 and M^2. In contrast to *Pentabuneomys*, the upper cheek teeth are with mesoloph and the lower with mesolophid.

Derivatio nominis. – Honouring Mr. Markus Hebeisen, preparator at the Paleontological Institute and Museum of Zurich, Switzerland, for his prospecting of micromammal sites in the Upper Marine and Upper Freshwater Molasse of the Napf alluvial fan, Switzerland. He also discovered the type-locality Chatzloch.

Holotype. – left $M^{1/2}$, Caz 2. Natural History Museum of Basle. Fig. 1.

Dimensions. – 1.20 x 1.39 mm

Type locality. – Chatzloch, Canton of Berne, Switzerland. National grid reference 631'300/203'400/1100 m. Locality-No. 1168–7 in the Register of the Tertiary Mammal-bearing localities of Switzerland at NMB.

Type formation. – Napfschichten, see Kaufmann (1872), Matter (1964), Salis (1967), Habicht (1987).

Stratum type. – 10 to 25 cm dark grey to green-greyish marls with small coal layers. Freshwater molluscs abundant (Helicidae, *Clausilia, Testacella*).

Referred material of the type locality. – 31 isolated teeth, 8 fragments.

Age. – Middle Miocene, intermediate in age between the Frohberg and Rümikon levels in the Biozonation of the Basis of the Upper Freshwater Molasse of Switzerland (Tab. 3, see Kälin 1997, Kempf et al. 1997). In the European MN-Unit system, it corresponds either to the youngest MN 5 or the eldest MN 6

Stratigraphic range. – *Eomyops hebeiseni* is known only from the youngest MN 5 to the eldest MN 6.

Other localities with *Eomyops hebeiseni.* – Dürrenäsch-Höhenrain (youngest MN 5 with *Megacricetodon lappi*), Uzwil-Nutzenbuech (youngest MN 5 or eldest MN 6).

Differential diagnosis

Eomyops hebeiseni differs from *Eomyops catalaunicus* (HARTENBERGER 1966) in its:

- considerably larger dimensions
- sometimes missing lingual part of the anteroloph on the $M^{1/2}$
- weaker developed 4th syncline on $M_{1/2}$
- sometimes weaker developed anterolophid on $M_{1/2}$

Eomyops hebeiseni differs from *Eomyops bodvanus* (JÁNOSSY 1972) in its:

- considerably larger dimensions
- longer mesolophs on the $M^{1/2}$
- shorter mesolophids on the $M_{1/2}$
- sometimes missing lingual part of the anteroloph on the $M^{1/2}$
- weaker anterolophid on $M_{1/2}$
- non-right-angled junction of posterolophid and hypoconid on the $M_{1/2}$
- commonly backwards directed mesolophids on the $M_{1/2}$
- weaker developed labial part of the anterolophid on the $M_{1/2}$
- weaker developed 4th syncline on $M_{1/2}$

Eomyops hebeiseni differs from *Eomyops oppligeri* ENGESSER 1990 in its:

- considerably larger dimensions
- weaker developed or even missing lingual part of the anteroloph on the $M^{1/2}$
- lack of a bifurcation of the mesoloph(id)s in upper and lower $M^{1/2}$
- commonly backwards directed mesolophids on the $M_{1/2}$
- non-right-angled junction of posterolophid and hypoconid on the $M_{1/2}$
- deeper and narrower exterior syncline on the $M^{1/2}$

Description of the type. – The nearly unworn left $M^{1/2}$ is slightly wider than it is long. It shows a lingual part of the anteroloph that is less developed than the labial part. The longitudinal crest joins the protoconus nearly transversely. In consequence, the lingual syncline is asymmetric and directed slightly forwards. The mesoloph is directed forwards and is short. The exterior syncline is deep and narrow.

Description of the dentition

The P^4 is moderately smaller than $M^{1/2}$ and is wider than it is long. The lingual part is shorter than the labial part. The mesoloph is short and directed slightly forwards. The longitudinal crest is situated more lingually.

$M^{1/2}$ show a nearly quadratic shape or are wider than they are long. Four $M^{1/2}$ show a strong lingual part of the anteroloph, which is weakly developed in three $M^{1/2}$ and completely missing in one $M^{1/2}$ (Fig. 1). On the $M^{1/2}$ with a lingual part of the anteroloph, the lingual part is always less developed than the labial part. The longitudinal crest joins the protoconus nearly transversely. In consequence, the 2nd syncline is longer than the 3rd syncline and the lingual syncline is asymmetric and directed slightly forwards. The mesoloph is short or moderately long and directed forwards. The exterior syncline is narrow.

The M^3 is distinctly smaller than $M^{1/2}$ and shows a strong proto- and paraconus. An anteroloph is present in all four specimens. The mesoloph is moderately long.

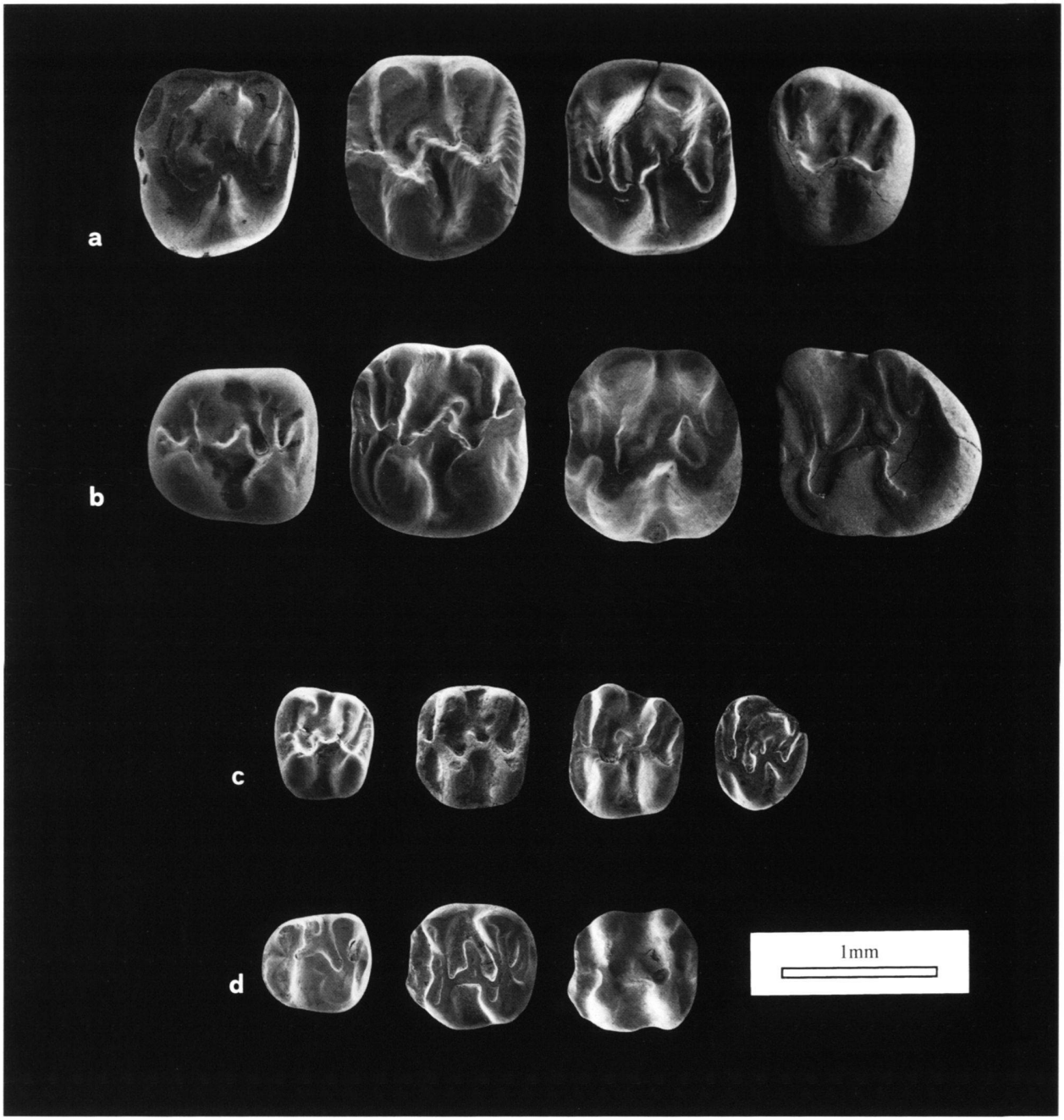
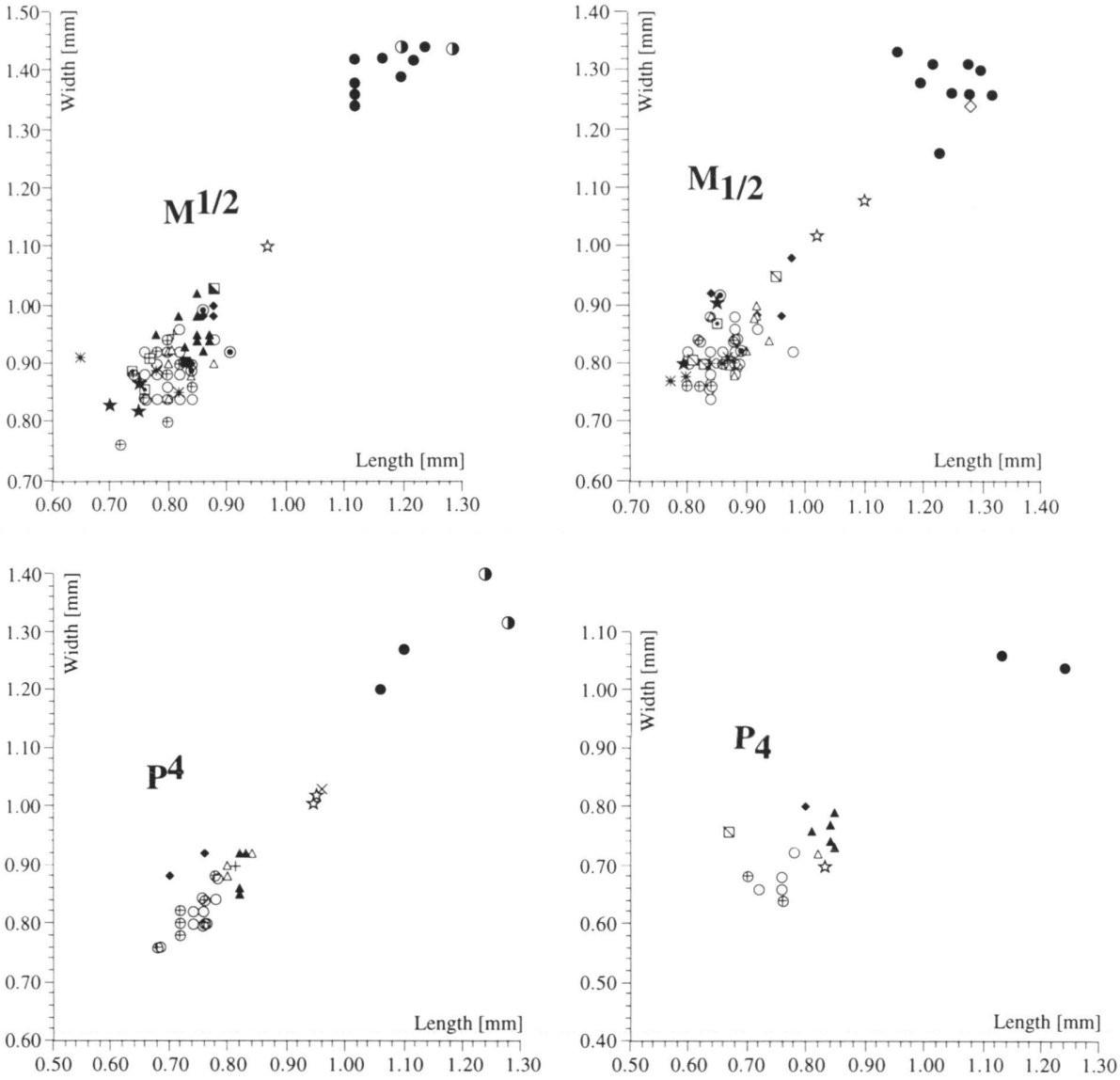


Fig. 1. *Eomyops hebeiseni* n. sp. in comparison to a normal-sized representative of the genus *Eomyops*.
a: *Eomyops hebeiseni* n. sp. from Chatzloch. P^4-M^3. P^4 dext. (invers), Caz 1, $M^{1/2}$ sin. (Holotyp), Caz 2, $M^{1/2}$ dext. (invers), Caz 3, M^3 dext. (invers), Caz 4.
b: *Eomyops hebeiseni* n. sp. from Chatzloch. P_4-M_2. P_4 sin., Caz 5, $M_{1/2}$ sin., Caz 6, $M_{1/2}$ dext. (invers), Caz 7, M_3 dext. (invers), Caz 8.
c: *Eomyops* aff. *oppligeri* from Nebelbergweg. P^4-M^3. P^4 sin., Nbw 41, M^1 dext. (invers), Nbw 42, M^2 dext. (invers), Nbw 43, M^3 sin., Nbw 44.
d: *Eomyops* aff. *oppligeri* from Nebelbergweg. P_4-M_3. P_4 sin., Nbw 48, M_1 dext. (invers), Nbw 49, M_2 dext. (invers), Nbw 50.
all figures 25x



× *Eomyops* sp.	Schernfeld, MN 17	○ *Eomyops oppligeri*	Anwil, MN 8
◩ *Eomyops* sp.	Ivanovce, MN 15	▨ *Eomyops oppligeri*	La Grive, MN 7
✳ *Eomyops bodvanus*	Osztramos 1, MN 14	⊡ ? *Eomyops oppligeri*	Arroyo del Val, MN 6
+ *Eomyops* aff. *catalaunicus*	Lissieu, MN 13	⊞ ? *Eomyops oppligeri*	Manchones, MN 6
◆ *Eomyops catalaunicus*	Can Llobateres, MN 9	□ ? *Eomyops oppligeri*	Neudorf, MN 6
▲ *Eomyops catalaunicus*	Hammerschmiede, MN 9	◑ *Eomyops hebeiseni*	Uzwil-Nutzenbuech, MN 5/MN 6
☆ *Eomyops* sp.	Marktl, MN 9	◇ *Eomyops hebeiseni*	Dürrenäsch-Höhenrain, MN 5
⊕ *Eomyops* aff. *oppligeri*	Nebelbergweg, MN 9	● *Eomyops hebeiseni*	Chatzloch, MN 5/MN 6
△ *Eomyops* aff. *catalaunicus*	Nebelbergweg, MN 9	■ *Eomyops* sp.	Franzensbad, MN 5
★ *Eomyops oppligeri*	Giggenhausen, MN 8	◉ *Eomyops* sp.	Massendorf, MN 5

Fig. 2. Scatter diagramme of the molars and premolars (P4, M1/2) of *Eomyops catalaunicus* (HARTENBERGER 1966), *Eomyops bodvanus* (JÁNOSSY 1972), *Eomyops oppligeri* ENGESSER 1990, and *Eomyops hebeiseni* n. sp. from different localities. Values after citations in Table 2 and Kälin (1993).

Tab. 1. Key features for the morphological characterization of the four hitherto described species of *Eomyops*.

	Eomyops catalaunicus (HARTENBERGER 1966)	*Eomyops bodvanus* (JÁNOSSY 1972)	*Eomyops oppligeri* ENGESSER 1990	*Eomyops hebeiseni*
lingual Anteroloph	present	present	present, pronounced	present
Mesoloph	moderately long always single	short always single	moderately long or short sometimes split	moderately long always single
direction of Mesoloph	forwards	forwards	forwards	forwards
exterior Syncline	deep and narrow	deep and narrow	wide	deep and narrow
Mesolophid	moderately long	long	moderately long	moderately long
direction of Mesolophid	backwards or transversal	transversal	backwards or transversal	backwards
Anterolophid	present, strong	present, strong	present	present
junction of Posterolophid	acute-angled	right-angled	right-angled	acute-angled
4th Syncline	strong	strong	weak	weak

The P_4 is longer than it is wide. One of the two specimens shows a small residue of an anterolophid. The mesolophid is short in one specimen and missing in the other one. The posterolophid is short, but strong and joins the hypoconid directly.

The $M_{1/2}$ are longer than they are wide. They show a strong and well developed anterolophid. In six of nine specimens the anterolophid is connected with the metalophid. The mesolophid is usually short, though rarely moderately long. The mesolophid is directed backwards in five of nine specimens and transversal in four specimens. The posterolophid does not join the hypolophid at a right angle.

The M_3 are relatively large and slightly elongated. The anteroloph is lingually and labially well developed, the 4th syncline is strongly reduced. The mesolophid is moderately long and directed transversal (3) or backwards (1).

An important diagnostic feature of *Eomyops* is the crenulated lower incisor. Unfortunately, among the few lower incisors of the locality Chatzloch there is not one with a crenulation which could be attributed to *Eomyops* as described in Figure 8 in Engesser (1979).

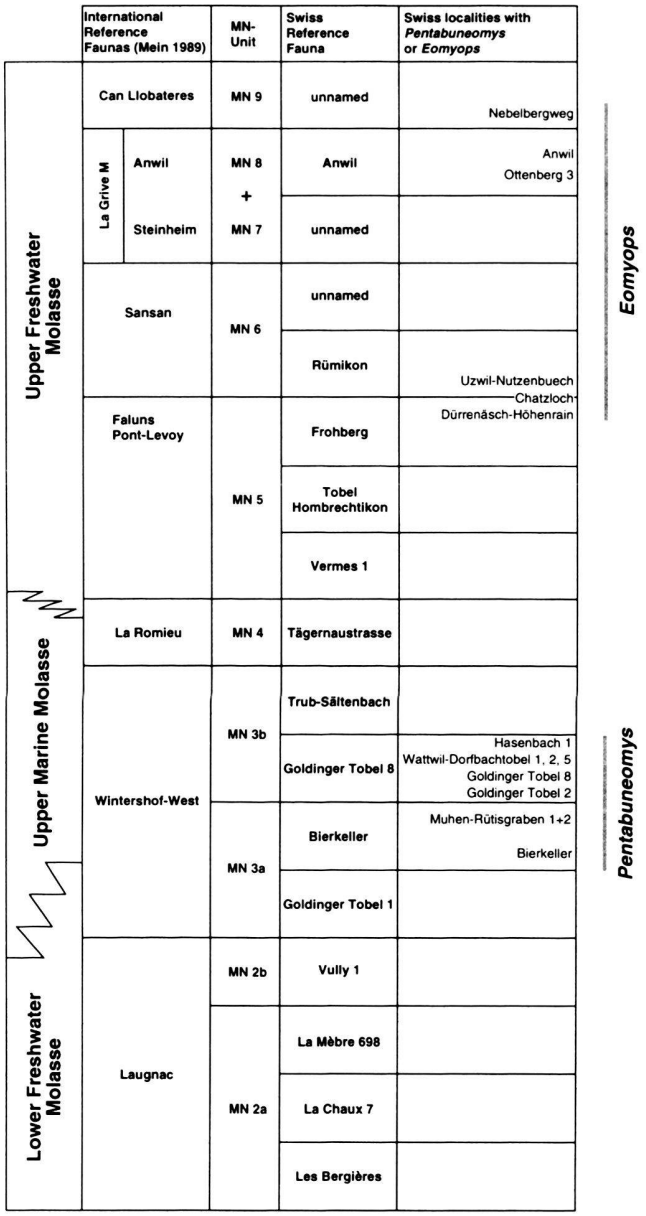
Discussion

The present discovery of a new large species of *Eomyops* of MN 5/MN 6 age does not lessen the above-mentioned quandary. Morphologically, *Eomyops hebeiseni* n. sp. is closest to *Eomyops catalaunicus* (Tab. 1). But *Eomyops catalaunicus* is much smaller and very typical for localities of younger Miocene age (Can Llobateres, Montredon, Nebelbergweg, Petersbuch 14; see Tab. 2). All other contemporaneous findings of MN 5-age (Massendorf, Franzensbad) are considerably smaller and morphologically closer to *Eomyops oppligeri*. Neither can *Eomyops hebeiseni* be incorporated into the genus *Pentabuneomys*. Indeed, there is a size increase within the evolutionary lineage of *Pentabuneomys rhodanicus* (hitherto unpublished material of the Swiss Molasse and also Engesser

Tab. 2. List of sites yielding *Eomyops* in Western and Central Europe (excluding Swiss localities).

Locality	Age	Literature	
Schernfeld	MN 17	Dehm 1962	*Eomyops* sp.
		Fahlbusch 1973	
Ivanovce	MN 15	Fejfar 1989	*Eomyops* sp.
Podlesice	MN 14	Fahlbusch 1978	*Eomyops* cf. *catalaunicus*
		Kowalski 1989	
Osztramos 1	MN 14	Jánossy 1972	*Eomyops bodvanus*
			type locality
Osztramos 9	MN 14	Jánossy 1975	*Eomyops* cf. *bodvanus*
Osztramos 10	?	Jánossy & Kordos 1977	*Eomyops* cf. *bodvanus*
Lissieu	MN 13	Hugueney & Mein 1968	*Eomyops* aff. *catalaunicus*
Ambérieu 3	MN 11	Mein 1984	*Eomyops* sp.
Dorn-Dürkheim	MN 11	Franzen 1981	*Eomyops* sp.
Suchomasty	MN 10	Fejfar 1989	*Eomyops* cf. *catalaunicus*
Ambérieu 1+2	MN 10	Farjanel & Mein 1984	*Eomyops catalaunicus*
Kohfidisch	MN 10	Bachmayer & Wilson 1980	*Eomyops* sp.
Richardhof	MN 10	Daxner-Höck 1996	*Eomyops* sp.
Montredon	MN 10	Aguilar 1982	*Eomyops catalaunicus*
Soblay	MN 10	Guérin & Mein 1971	*Eomyops catalaunicus*
Can Llobateres	MN 9	Hartenberger 1966	*Eomyops catalaunicus*
			type locality
Jujurieux	MN 9	Mein 1985	*Eomyops* sp.
Rudabanya	MN 9	Rabeder 1985	*Eomyops catalaunicus*
Götzendorf	MN 9	Rögl et al. 1993	*Eomyopscatalaunicus*
Stixneusiedl	MN 9	Rögl et al. 1993	*Eomyops* sp.
Priay II	MN 9	Welcomme et al. 1991	*Eomyops catalaunicus*
Hammerschmiede	MN 9	Fahlbusch 1975	*Eomyops* sp.
Marktl	MN 9	Fahlbusch 1973	*Eomyops* sp.
Petersbuch 14	MN 9	Bolliger & Rummel 1994	*Eomyops catalaunicus*
Petersbuch 10	MN 8/MN 9	Bolliger & Rummel 1994	*Eomyops* cf. *oppligeri*
Giggenhausen	MN 8	Fahlbusch 1973	*Eomyops oppligeri*
		Fahlbusch 1975	
Felsötárkány	MN 7/8	Kretzoi 1982	*Eomyops* sp.
La Grive	MN 7/8	Hugueney & Mein 1968	*Eomyops oppligeri*
Las Planas 5K	MN 6	Daams & Freudenthal 1988	*Eomyops* sp.
Manchones	MN 6	Bruijn 1967	? *Eomyops oppligeri*
		Fahlbusch 1973	
Arroyo del Val	MN 6	Fahlbusch 1973	? *Eomyops oppligeri*
		Fahlbusch 1975	
Neudorf	MN 6	Fejfar 1974	? *Eomyops oppligeri*
Massendorf	MN 5	Schötz 1979	*Eomyops* sp.
Strakonice	MN 5	Fejfar 1974	*Eomyops* sp.
Franzensbad	MN 5	Fejfar 1974	*Eomyops* sp.

Tab. 3. Distribution of findings of *Eomyops* and *Pentabuneomys* in the Swiss Molasse Basin.



1990: 118) but the genus *Pentabuneomys* is characterized by the possession of a mesoconus, respectively a mesoconid on M1/2 and has hitherto never been found in localities younger than MN 4[1]. Further, in the Swiss Molasse basin *Pentabuneomys* is frequent in the assemblage zones of Bierkeller and Goldinger Tobel 8 (Tab. 3, younger MN 3a and older MN 3b, Kälin 1997) and has not been recorded in younger layers.

[1] Except *Pentabuneomys rhodanicus* of Vieux Collonges which is however a fissure filling of both MN 4 and MN 5 age.

Hünermann (1981) described an isolated P_4 from the locality Rodenberg (probably MN 5) as *Pentabuneomys rhodanicus*, but the homogeneity of this locality is uncertain until a possible confirmatory reworking is carried out.

So the phylogenetic relationship of *Eomyops hebeiseni* to the three other known species of *Eomyops* is not clear. For the moment, *Eomyops hebeiseni* has to be regarded as an isolated form of *Eomyops* with hitherto unknown ancestor and descendant.

There is thus no further advance on the question of whether or not *Eomyops* and *Leptodontomys* are independant genera as originally suggested by Engesser (1979). Until this problem is resolved, we use the nomen *Eomyops* for middle and late Miocene European eomyids with an *Eomys*-like tooth pattern as proposed by Fahlbusch & Bolliger (1996).

Generally *Eomyops* seems to be a rare eomyid. There are only a few faunas that have yielded rare teeth of *Eomyops*. Teeth of *Eomyops* have been recorded from the following localities of the Swiss Molasse:

Vue-des-Alpes	MN 15	Bolliger et al. 1993 *Eomyops* cf. *bodvanus*
Nebelbergweg	MN 9	Kälin 1993 *Eomyops* aff. *catalaunicus* + *Eomyops* aff. *oppligeri*
Anwil	MN 8	Engesser 1972 *Eomyops oppligeri*, type locality
Ottenberg 3	MN 8	Bolliger 1996 *Eomyops oppligeri*
Uzwil-Nutzenbuech	MN 5/MN 6	*Eomyops hebeiseni* n. sp.
Chatzloch	MN 5/MN 6	this paper *Eomyops hebeiseni* n. sp., type locality
Dürrenäsch-Höhenrain		MN 5 *Eomyops hebeiseni* n. sp.

Localities outside the Swiss Molasse are listed in Table 2.

In the Chatzloch fauna, *Eomyops hebeiseni* n. sp. is an abundant element (9%). The faunal list of Chatzloch is:

	n =	% =
Amphiperatherium sp.	1	0.3
Galerix sp.	4	1
Dinosorex cf. *zapfei*	7	2
Soricidae indet.	3	0.9
Plesiodimylus sp.	11	3
Lanthanotherium sp.	6	2
Chiroptera indet.	2	0.5
Megacricetodon cf. *minor*	23	6.5
Democricetodon aff. *gracilis*	33	9.4
Eumyarion sp.	83	23.6
Lartetomys sp.	3	0.9
Anomalomys aff. *gaudryi*	5	1.4

Tab. 4. Measurements of *Eomyops hebeiseni* n. sp. in mm.
M1sL = Length of an upper first molar, M2iB = Width of a lower second molar.
P = premolar, D = milk-tooth

	D4sL	D4sB	P4sL	P4sB	M1/2sL	M1/2sB	M3sL	M3sB	D4iL	D4iB	P4iL	P4iB	M1/2iL	M1/2iB	M3iL	M3iB
1	1.04	1.26	1.10	1.27	1.20	1.39	1.00	1.23	1.18	0.84	1.13	1.06	1.28	1.31	1.28	1.24
2			1.06	1.20	1.17	1.42	1.00	1.23			1.24	1.04	1.25	1.26	1.20	1.28
3					1.12	1.38	0.88	1.10					1.22	1.31	1.20	1.26
4					1.22	1.42	0.96	1.18					1.16	1.33	1.08	1.14
5					1.12	1.34							1.23	1.16		
6					1.24	1.44							1.30	1.30		
7					1.12	1.42							1.32	1.26		
8					1.12	1.36							1.28	1.26		
9													1.20	1.28		
Ø	1.04	1.26	1.08	1.24	1.16	1.40	0.96	1.19	1.18	0.84	1.19	1.05	1.25	1.27	1.19	1.23

Eomyops hebeiseni n. sp.	31	8.8
Keramidomys carpathicus	65	18.5
Spermophilinus aff. *bredai*	7	2
Miopetaurista sp.	5	1.4
Palaeosciurus sp.	7	2
Blackia miocaenica	1	0.3
Paraglirulus werenfelsi	30	8.5
Miodyromys aegercii	5	1.4
Microdyromys koenigswaldi	9	2.6
Amphilagus sp.	3	0.9
Prolagus oeningensis	4	1.1
Suidae indet.	1	0.3
Cervidae indet.	1	0.3
Carnivora indet.	1	0.3
	$\Sigma = 351$	

The age of the Chatzloch fauna can be easily calibrated. In the Swiss Molasse biozonation, it is intermediate in age between the Frohberg and Rümikon levels (Tab. 3, Kälin 1997). This calibration also correlates well with the litho- and magnetostratigraphy (Kempf et al. 1997). In the European MN-Unit system, it corresponds either to the youngest MN 5 or the eldest MN 6. In addition to this, the evolutionary level of selected taxa shows more similarities with the reference locality of MN 5 (Faluns Pont Levoy – Thenay) than with Sansan, the reference locality of MN 6.

Furthermore, there are strong similarities with the Slovakian Devínska Nová Ves (Neudorf) locality (Schaub & Zapfe 1953).

One of the two other localities containing *Eomyops hebeiseni* n. sp. (Dürrenäsch-Höhenrain) yielded very large specimens of *Megacricetodon lappi* and certainly belongs to the youngest MN 5, whereas the other locality (Uzwil-Nutzenbuech) is, in its composition, almost identical with the Chatzloch locality although slightly younger. Additionally, the locality Uzwil-Nutzenbuech is probably situated slightly above the "Blockhorizont" of the Upper Freshwater Molasse of Eastern Switzerland, a marker bed which is correlated with the Ries impact of Southern Germany (Hofmann 1978). The age of the Ries event is dated at 15.1 Ma (Staudacher et al. 1982) or 14.6 ± 0.6 Ma (Gentner & Wagner 1969).

It can therefore be concluded that *Eomyops hebeiseni* n. sp. seems to be restricted to a very short time interval around the MN 5/MN 6 – "boundary".

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