THE LATE OLIGOCENE RODENT FAUNAS OF CANALES (MP28) AND PARRALES (MP29) FROM THE LORANCA BASIN, PROVINCE OF CUENCA, SPAIN

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ABSTRACT

Two rodent faunas from the Upper Oligocene fluvial sediments of the Upper Detrital Unit of the Loranca Basin are described. The oldest fauna of Canales contains Issiodoromys limognensis and is correlated to MP28; the other, more modern fauna of Parrales contains I. pseudanaema and it is correlated to MP29. The cricetid genera Adelomysartion Huguene, 1969 and Allocricetodon Freudenthal, 1994 are reviewed and the latter one is considered to be a junior synonym of the former one. The faunas are compared to other Spanish late Oligocene faunas such as Vivel de Río, Hinojosa de Jarque, and Sayatón 1 and 6. The resulting succession is correlated to the most important remaining European late Oligocene localities, and the biochronological subdivision of this period is discussed.

Keywords: Rodents, biochronology, Upper Oligocene, Loranca Basin, Spain.

RESUMEN

Se describen dos asociaciones de roedores fósiles procedentes de depósitos fluviales del Oligoceno Superior localizados en la Unidad Detritica Superior de la Cuenca de Loranca. El yacimiento de Canales es el más antiguo, contiene Issiodoromys limognensis y pertenece a la MP28; el otro yacimiento, Parrales, contiene I. pseudanaema y pertenece a la MP29. Se realiza la revisión de los criptidos Adelomysartion Huguene, 1969 y Allocricetodon Freudenthal, 1994, y se propone la sinonimia de estos dos géneros. Estas faunas se comparan con otras faunas españolas del Oligoceno Superior, como Vivel de Río, Hinojosa de Jarque y Sayatón 1 y 6. La sucesión resultante se correlaciona con las localidades más importantes del Oligoceno Superior europeo, y se discute la subdivisión bioestratigráfica para el Oligoceno Superior.

Palabras clave: Roedores, bioestratigrafía, Oligoceno Superior, Cuenca de Loranca, España.

INTRODUCTION

The Loranca Basin is situated in the central eastern part of Spain (Fig. 1) and it is considered to be the vastest internal depression of the Iberian Range. The western margin of the basin is defined by the thrust belt of the Sierra de Altomira and the eastern limit is formed by the folded Serranía de Cuenca.

Three major stratigraphic units are recognized in the Tertiary stratigraphic succession of this basin; the Lower Detrital Unit, the Upper Detrital Unit, and the Terminal Unit respectively (Díaz Molina & López Martínez, 1979). The deposition of the Lower Detrital Unit was synchronous with the deformational event that formed the Sierra de Altomira and the Loranca Basin during Eocene to Late Oligocene times. The Upper Detrital Unit of the Loranca Basin is about 900 m thick and it filled the basin from the Late Oligocene to the Early Miocene. The
Figure 1. Geographic situation of the two studied Upper Oligocene localities.

Terminal Unit is of Early - Middle Miocene age.

The Canales level is situated near the village of Huete (Fig. 1) and consists of a light-grey silt with scattered small gastropod fragments and tiny gypsum crystals in a sequence of predominantly fluvial deposits of the Upper Detrital Unit. Some 6200 kg of sediment were screened, which yielded approximately 96 dental remains of rodents. These sediments are exposed in the eastern and western flanks of the N-S striking anticline of Huete. The level of Parrales is exposed at the eastern border of the Río Mayor some 2 km north of Huete and consists of a fine yellow-grey silt with small conglomeratic elements of calcareous algae at the bottom of a channel. 3725 kg were sampled which yielded 149 rodent teeth.

The teeth were measured using a Nikon monocular digital measuring microscope: measurements are given in 0.1 mm units. The nomenclature of the cheek teeth is for the Theridomyidae after Vianey-Liaud (1972), for the Gliridae after Daams (1981), for the Eomyidae after Álvarez Sierra (1987), and for the Cricetidae after Freudenthal et al. (1994). The specimens are stored at the Department of Paleontology of the Complutense University of Madrid.

SYSTEMATIC DESCRIPTION

CANALES

Family Theridomyidae Alston, 1876

Issiodoromys limognensis Schmidt-Kittler & Vianey-Liaud, 1987
Pl. I, figs. 1-3

Material and Measurements: Because of the bad state of preservation only three $M_2$ could be measured. The length, width and height of these three teeth are respectively 21.6 x 15.2 x —; 22.4 x 16.0 x 52.0; 20.0 x — x 41.2. Remaining material consists of fragments of 3D', 1P', 9M², 1M', 2D', 1P, 4M₁, 2M₁.

Discussion

Because of the scarcity and the bad preservation of the material, a good description has not been possible, although the sinus(id) contains cement. The measurements of the occlusal surface (length and width) are similar to those of I. querçyi (Schlosser) and I. limognensis. The estimated hypsodonty of our material is similar to the mean value of the hypsodonty of I. limognensis from Pech Fraysse and Viveil del Río (Hugueney et al., 1987), measured in $M_{1,2}$ with the sinclind III with island shape, and larger than the mean value of Pech Desse (Hugueney et al., 1987).

Family Cricetidae Rochebrune, 1883

Adelomyarian Hugueney, 1969

*1969 Adelomyarian Hugueney, 56.

Adelomyarian cornelli (Freudenthal, 1994)
Pl. II, figs. 4, 5

Material and measurements: 1 fragmentary $M'$ (~ x 12.1 approximately); 1 $M$ (13.6 x 12.9); 1 $M'$ (10.5 x —); 1 $M_1$ (13.7 x 11.6); 1 $M_1$.

Description

$M'$: The anterior part of the tooth is missing. The anterior arm of the hypocone joins the posterior wall of the protocone below the occlusal surface. Two short mesolophs extend into the mesosinus. The metaophole points obliquely forward and joins the anterior part of the hypocone. The posteroloph encloses the posterosinus.

$M$: The labial anteroloph encloses the anter squirrel and meets the basis of the paracone. The well-developed, lingual anteroloph descends along the lingual tooth border and ends in a cusp at the posterior basis of the protocone, thus separating the protocone from the tooth border. A long, and well-developed posterior spur of the paracone descends toward the labial tooth border where it ends just before reaching the independent mesostyl. The anterior arm of the hypocone points obliquely forward into the mesosinus, where it bifurcates. One end continues as a short mesoloph into the mesosinus, and the other end joins the labial wall of the protocone. The metaophole is more or less transverse, and joins the anterior part of the hypocone. From the top of the metacone a spur descends into the mesosinus toward the end of the paracone spur, but without reaching it. The well-developed posteroloph is connected to the metacone, thus closing the posterosinus.

$M'$: The labial anteroloph joins the basis of the paracone, thus enclosing the labial anter squirrel. The lingual anteroloph descends to the basis of the protocone. The protolophole points obliquely forward and joins the junction of the labial and lingual anteroloph. The endoloph descends from the
protocone and meets the anterior wall of the hypocone well below the occlusal surface. The anterior arm of the hypocone points obliquely forward and ends free in the mesosinus. The metacone has an anterior spur which descends into the mesosinus. The posteroloph encloses the posterosinus.

M₂: The medium-long, lingual anterolophid is connected to the anterior basis of the metaconid, thus closing the anterosinusid. The labial anterolophid descends and continues along the labial basis of the protoconid to the anterior basis of the hypoconid, thus bordering the sinusid. The metalophid points sharply forward and meets the anteroconid. The posterior arm of the protoconid extends halfway into the mesosinusid, where it bifurcates. One part ends as a short mesolophid and the other part joins the forward pointing hypoconid. The hypolophid points backwards. The posterolophid ascends to about halfway the posterior wall of the entoconid, thus closing the posterosinusid.

Discussion

Freudenthal (1994) defined Allocricetodon with his new species Allocricetodon cornelli from Mirambuenu 1 (unit MP28) as the type species, Heterocricetodon landroveri Daams et al., 1989 (MP25) and Pseudocricetodon incertus (Schlosser, 1884) (MP25-27) were also included in the genus. It appeared however that the diagnostic features to distinguish Allocricetodon from Adelomyarian are not obvious (Table 1). Both are of medium size, and the only difference in the lower molars, is the length of the posterior arm of the protoconid. However, the personal appreciation of this feature may influence in the characterization and does therefore not serve for generic distinction. If the longitudinal ridge is continuous and no mesolophid-like ridge extends as a continuation of the posterior arm into the mesosinusid, we consider the posterior arm of the protoconid to be absent. In more modern representatives of Adeomyarian the longitudinal ridge tends to be interrupted and the protoconid exhibits an oblique posterior arm ending free in the mesosinusid. So, the absence of a longitudinal ridge makes it seem that there is a well-developed posterior arm of the protoconid. The generic diagnosis of Allocricetodon is based on species from MP25-28 levels, and since Adelomyarian is from more modern levels, this difference represents a different evolutionary stage. Another distinctive feature would be the anterocone-paracone connection of M₁. In Allocricetodon it would be frequently present according to Freudenthal (1994), but our own observations showed that this feature is also present in Adelomyarian. Judging from table 15 (character 4, state 5) in Freudenthal (1994), it appears that this connection is present in 10 % (N=10) of A. incertus from Mirambuenu 4C (MP25-26) and in 39.5 % (N=38) of A. cornelli from Mirambuenu 1 (MP28).

Adelomyarian vireti Hugueney, 1969 from La Milloque (MP29, Brunet, 1979) shows this feature in 19 % (N=25) and A. alberti Daams, 1989 from Sayatón 6 also in 19 % (N=21) (Daams, 1989). Another distinctive feature would be the outline of M₁. In Allocricetodon it is trapezoidal according to Freudenthal (1994), but our own appreciation is that of subquadrate. Moreover, comparing figures of the various species of these two genera, no difference in outline whatsoever is observed. Summarizing, the only distinctive feature to distinguish Adelomyarian from Allocricetodon would be the interrupted longitudinal ridge of the lower molars. Furthermore, several characters present in the type species of Allocricetodon are even diagnostic for Adelomyarian. One of these features, not mentioned by Freudenthal, is the direction of the paracone-protolophule complex of M₁. In A. incertus it tends to be prorverse, and in A. cornelli, A. alberti and A. vireti this complex is strongly prorverse. Another feature is the protococon-entolophule connection in M₁. In A. incertus from Mirambuenu 4C and in A. cornelli from Mirambuenu 1 this connection is predominantly low (Freudenthal, 1994, table 16, character 9). This low connection or the absence of this connection is characteristic for the more modern A. vireti and A. alberti. The same feature is observed in M₁, but less conspicuous. Consequently Allocricetodon is considered to be a junior synonym of Adelomyarian.

The material from Vivel del Río assigned to Allocricetodon cornelli by Freudenthal (1994), is too poor in order to make a statistical comparison. Surprisingly Freudenthal (1994) did not even mention or compare his material to Adelomyarian. The material from Vivel, collected by Adrover, and described by Hugueney et al. (1987) as Adelomyarian sp. agrees with Adelomyarian cornelli.

Hugueney et al. (1987) noted the resemblance between A. incertus and Adelomyarian sp. from Vivel and suggest that the former be the ancestor of the latter. We propose here an evolutionary lineage of Adelomyarian incertus - cornelli - vireti which is characterized by the following trends:

1. Simplification of the dental pattern by the loss of mesoloph(id)s
2. Relative size decrease of M₁
3. Reduction of the anterocone complex in M₁
4. Development of an obliquely forward pointing paracone-protolophule complex
5. Reduction of entoloph in upper molars and ectolophid in the lower ones. Interrupted longitudinal ridges are seen in A. vireti from the Upper Oligocene of Eggingen-Erdbeerhecke and Eggingen-Mittelhart 1 (Werner, 1994). A. alberti from Sayatón-6 is considered to be an endemic off-shoot of the main Adelomyarian lineage (Fig. 2).
Heterocricotodon landroveri Daems et al., 1989 from MP25 of Pareja (Daems et al., 1989) and Mirambueno 4C+4D (Freudenthal, 1994) does not show the above mentioned dental features that are characteristic for Adelomyarion. As can be seen in Table 1 the features of Allocricetodon considered to be diagnostic by Freudenthal (1994) are also present in Heterocricotodon, with the exception of the size. We don’t think that size is a reliable feature for generic separation and consequently Allocricetodon can’t be distinguished from Heterocricotodon on the basis of the criteria given by Freudenthal (1994). This may explain why this author erroneously assigned Heterocricotodon landroveri to Allocricetodon.

Daems et al. (1989) mentioned that A. incertus from Carrascosa (MP25) may be attributed to H. landroveri in spite of some slight morphological differences. The large size difference (Fig. 3) does not allow such a statement however.

A. cornelli from Canales is of similar size and morphology as the type material of A. cornelli from Mirambueno 1 (Freudenthal, 1994). It is also of the same size as A. cornelli from Vivel del Río (Fig. 3). Table 3 in Freudenthal (1994) shows under M₃ a very small specimen from Vivel del Río assigned to Adelomyarion cornelli, which however falls outside the range of variation of the type material and all other assemblages attributed to this species. Therefore we assign it to Adelomyarion sp. This small-sized species is present in Canales too (see below).

Adelomyarion sp.
Pl. II, figs. 1-3

Material and measurements: 1 fragmentary M¹, 1 M² (10.6 x 10.9), 1 M₁ (14.3 x 9.1) and 1 M₁ (10.9 x 9.7).

Description

M¹: The enamel of the anterior and labial parts of the tooth are missing. The entoloph splits up into two arms towards the middle of the molar; the lingual arm joins the postero-lingual wall of the protocone, and the labial one is connected to the posterior wall of the paracone. The metalophule points obliquely forwards and it is connected to the anterior part of the hypocone.

M₂: The labial anteroloph nearly reaches the basis of the paracone, thus leaving the anteroincisus open. The lingual anteroloph descends and continues along the lingual border to the basis of the hypocone, thus separating the protocone from the tooth border. The protolophule points obliquely forward and meets the anterior arm of the protocone. The sinus points sharply forward. The mesecone is visible as a slight inflation of the endoloph. A mesoloph is absent. The metalophule is more or less transverse and joins the endoloph before the hypocone. The posteroloph joins the metacone halfway, thus enclosing the posteroincisus.

M₃: The small, sub-rounded anteroconid is lingually connected to the anterior spur of the metaconid, thus bordering the lingual anteroincisus. The labial spur of the anteroconid descends along the labial tooth border toward the basis of the protoconid without reaching it. The small metaconid meets the lingual extension of the protoconid. From the top of the metaconid a spur descends along the lingual border and reaches the basis of the entoconid, thus closing the mesoincisus. From the well-developed mesoconid a medium-long mesolophid extends into the mesoincisus, but without reaching the lingual border. The narrow entolophid connects the mesecone to the posterior wall of the protoconid. The posterior part of the entolophid is wider and meets the anterior wall of the hypoconid. The hypolophid is transverse and it joins the anterior part of the hypoconid. The posterolophid does not reach the basis of the entoconid, thus leaving the posteroincisus open. The sinusid is wide and transverse. A low and longitudinal ridge is present at the labial border of the sinusid.

M₄: The medium-long, lingual anterolophid is connected to the anterior basis of the metaconid, thus closing the anteroincisus. The labial anterolophid descends to the basis of the protoconid without reaching it. The metalophid points sharply forward and meets the anteroconid. The posterior arm of the protoconid points obliquely backward and curves round longitudinally to meet the transverse hypolophid. The posterolophid is connected to the top of the entoconid, thus enclosing the posteroincisus.

Discussion

The material from Canales has been assigned to the genus Adelomyarion mainly by the morphology of the entoloph of M¹ and its relatively small M₃, Adelomyarion sp. from Canales is of smaller size and it has a less complicated dental pattern than A. alberti Daems, 1989 from the Upper Oligocene (MP30) of Sayatôn 6. Its dental pattern agrees more with that of A. vireti but its teeth are of smaller size (Fig. 3). The material from Canales is smaller and less complex than Adelomyarion cornelli (Freudenthal, 1994) from Vivel del Río (Adelomyarion sp. in Hugueney et al, 1987).

Pseudocricotodon cf. adroveri Freudenthal, Hugueney & Moissenet, 1994
Pl. III, figs. 1-3

Material and measurements: 1 fragmentary M¹ (— x

Plate 1


4-5 Issiodoromys pseudanaeae (Gervais, 1848) from Parrales. 4. M² sin. (PAR 62), a-c, occlusal, posterior and lingual views. 5. M₁, dext. (PAR 65).

The horizontal bar represents 1 mm.
10.2); 4 M₂ (10.3 x —, 10.6 x 9.9, 10.3 x 9.8, — x 9.7); 1 M₃ (8.9 x —); 1 M₁ (— x 8.8); 2 M₃ (12.2 x 10.4, 12.3 x 10.2); 1 M₂ (11.9 x 9.8).

Description

M₁: The anterior part of the antercone is missing. The paracone is larger than the metacone. The anterior arm of the protocone is nearly transverse and ends free near the antero-lateral border of the paracone. The short protolophule points slightly backward and joins the endoloph just behind the protocone. The sinus points sharply forward. The long, but interrupted, mesoloph reaches the labial border. The long metalophule is transverse and it joins the hypocone. The cisternoloph is low and ends at the postero-lateral basis of the metacone.

M₂: The paracone is larger than the metacone. The protolophule is double. The labial anteroloph reaches the basis of the paracone. In one specimen a lingual anteroloph is present, which descends straight down to the crown basis. The complete, anterior protolophule points slightly forward and joins the anterior part of the protocone. The posterior protolophule sprouts from the endoloph behind the protocone and points obliquely forward toward the antero-lateral basis of the paracone, without reaching this cusp, however. A medium-long mesoloph is present. One specimen has a mesostyl. The mesosinus is wide and flat. The metalophule is transverse in one specimen, and points obliquely forward in the other two. It joins the endoloph before the hypocone. The posterolophole descends from the hypocone to the labial border, without closing the posterosinus. The sinus points sharply forward.

M₃: The anterior part of the tooth is missing. An eutomesolophole is present in the wide and transverse sinus. A short and obliquely forward pointing mesolophole is present in the wide and shallow mesosinus. The hypolophidole point slightly backward and joins the hypocone. The posterolophole continues toward the top of the entoconid, thus enclosing the posterosinus.

M₄: The metacone is larger than the entocone. The medium-long, lingual anteroloph encloses a hardly distinct anterosinusid. The labial anteroloph is very small. The metalophule is transverse and meets the anterior part of the protocone. The posterior arm of the protocone points obliquely forward and sprouts from the entolophidole. The entolophidole is inflated behind the posterior metalophule. The mesosinus is wide and flat. Mesolophidoles are absent. A slightly elevated ridge sprouts from the entolophidole into the transverse sinusid indicating the presence of an eutomesolophidole. The hypolophidole is more or less transverse and joins the anterior part of the hypocone. The posterolophidole continues toward the top of the entoconid, thus enclosing the posterosinusid.

M₅: The medium-long, lingual anterolophidole reaches the antero-lateral basis of the metacone. The labial anterolophidole descends straight down to the anterior basis of the protocone. The narrow and low anterior metalophidole joins the metacone at the anterior extension of the protoconeid. The transverse, posterior arm of the protocone is short and ends free in the wide and plain mesosinusid. A short, obliquely forward pointing mesolophidole is present. A slightly elevated ridge sprouts from the entolophidole into the backward pointing sinusid indicating the presence of an ectomesolophidole. A low and narrow, free-ending, more or less longitudinal, ridge extends from the entolophidole to the posterosinusid.

Discussion

Hitherto six Pseudocricotodon species have been described. These species and their respective type localities are the following: P. montalbanensis Thaler from the Lower Oligocene (MP23) of Montalbán; P. philippi Hugueney from the Lower Oligocene (MP23) of St.-Martin-de-Castillon; P. moguntiacus (Bahlo, 1975) from the Lower Oligocene (MP24) of Heimersheim; P. simplex Freudenthal, Hugueney & Moissinet, 1994 from the Upper Oligocene (MP25) of Mirambueno 4C; P. adroveri Freudenthal, Hugueney & Moissinet, 1994 from the Upper Oligocene (MP28) of Vivel del Río; and P. thaleri Hugueney, 1969 from the Upper Oligocene (MP30) of Coderet. P. philippi is far out the smallest species of the genus and it has a simple dental pattern (e.g. the mesolophidole is always absent in M₂ (Freudenthal et al., 1994)). Therefore we consider our material from Canales not to belong to this species. The other five species have approximately similar size ranges and are of larger size than P. philippi.

P. moguntiacus is the largest species of the genus Pseudocricotodon (Dienemann, 1987). Our material fits in the size range of P. moguntiacus from Heimersheim (Bahlo, 1975) but morphologically they are different. P. moguntiacus differs from P. cf. adroveri from Canales by its better-developed paracone and metacone in M₁ and M₂, by its anterior arm of the protoconid pointing towards the anterocone, by its protolophule connection close to the anterocone in M₁, by its ectolophidole low and by its better-developed posterior arm of the protoconid, mesolophidole and eutomesolophidole in the M₃ and M₄. P. simplex from Mirambueno 4C (Freudenthal et al., 1994) differs from P. cf. adroveri from Canales by its simpler dental pattern, which is most evident by the absence of a mesolophidole in the M₃.

P. thaleri from Coderet (Hugueney, 1969) has a more complex dental pattern than the material from Canales. The forward paracone spur is frequently present and the anterior arm of the protocone is directed towards the anterocone in M₁. P. thaleri has also well-developed

Plate II

7 Heterozeroxus sp. from Canales. D₂ dext. (CAN 118). The horizontal bar represents 1 mm.
mesophylophids and ecomesophylophids in the lower molars. Not any of these characters are present in our material.

Morphologically the poor material from Canales falls inside the range of variation of *P. adroveri* from Vivel del Río and Mirambuenu 2A. However, since some of the diagnostic characters of the latter species could not be observed in our material we prefer to assign it to *P. cf. adroveri*.

Family *Eomyidae* Dépéré & Douxami, 1902

*Eomys* cf. *zitteli* Schlosser, 1884
Plate IV, figs. 12-18

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Table 1. List of characteristic features of *Allocricetodon*, *Heterocricetodon* and *Adelomyarion*. The diagnostic characters of *Allocricetodon* were taken from Freudenthal (1994). The appreciation of features of the two other genera are according to the authors of this paper.

**Material and measurements:**

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**Description**

**D**: Fairly bunodont teeth. The well-developed anteroloph measures approximately half of the tooth width. The mesoloph is absent in two specimens, it is short in two and it reaches the labial border in one. In two specimens there is a mesostyl near the paracrista.

**P**: The short anteroloph ends labially free, and its lingual end joins the protoloph midway in 2 specimens. In one case the anteroloph is absent. The mesoloph is short in two specimens, and in the other one it reaches the labial border.

M¹²: The anteroloph is better developed in M¹ than it is in M². The mesoloph is short in two specimens, of medium length in one, long without reaching the labial border in 4, and it reaches the labial border in 8 cases.

M³: The anteroloph is very small. The mesoloph is long and reaches the labial border. There is no sinus.

**D**: The long mesoloph reaches the lingual tooth border and the well-developed hypolophid connects enotocid to hypoconid.

**P**: Bunodont. The small anterolophid is lingually isolated and it may even be reduced to a tiny cusp. The mesolophid is absent in one specimen, it is short in two, of medium length in one, and in both cases it is long and reaches the lingual tooth border. The short posterolophid ends free and does not reach the lingual tooth border.

M₁₂: Relatively bunodont. The lingual anterolophid is short to medium of length and it does not reach the lingual tooth border, with the exception of one specimen. The mesolophid is short in seven specimens, it is of medium length in four and in one specimen it is long and reaches the lingual border. The posterolophid is a well-developed ridge of medium length in 4 specimens, but in the other ones it is smaller.

M₃: The anterolophid is absent in one specimen. In the other specimens the lingual anterolophid is a short ridge which ends free lingually. The labial anterolophid is short and ends at the basis of the protoconid. The well-developed mesolophid joins the hypolophid, with the exception of one specimen. A posterolophid is absent.

**Discussion**

The assemblage of *Eomys* from Canales is morphologically and metrically homogeneous. Among the known *Eomys*-species only two have a size
comparable to the one of our material from Canales: *E. ebnatensis* Engesser, 1987 from the Upper Oligocene of the Swiss Molasse and *E. zitelli* Schlosser, 1884 from the Upper Oligocene of western Europe. Specific separation between *E. ebnatensis* and *E. zitelli* is done or the basis of slight size differences, hypsodonty and morphology of premolars and lower molars (Engesser, 1987). *E. ebnatensis* from its type locality Ebnat (Engesser, 1987) is somewhat larger than *E. zitelli* from Vivel del Río (Huguene et al., 1987). The size ranges of our assemblage overlap with the ones of both above mentioned species. As for the dental pattern of the upper cheek teeth no significant differences could be observed between *E. ebnatensis* from Ebnat, Wynau 1 and Forntant 6 (Engesser, 1990), *E. zitelli* from the Quercy (Engesser, 1990), Vivel del Río (Huguene et al., 1987) and *E. zitelli* from Canales. In the lower cheek teeth are various morphological differences are observed however. Engesser (1987) mentioned that *E. ebnatensis* has better developed mesopholids and 4th lingual synclinids than *E. zitelli*. Our material from Canales has *zw* long mesopholids such as is observed in *E. zitelli* from the Quercy and Vivel del Río, and the size of the 4th lingual synclinids falls within the range of variation of this species. Engesser (1987, 1990) explained that *E. ebnatensis* may be distinguished from the relatively bunodont *E. zitelli* by its more hypsodont teeth. Fresh or slightly worn teeth from Canales are relatively bunodont and agree more with those of *E. zitelli*. Summarizing, we think that morphologically (mesopholids, fourth lingual synclinids and bunodonty) our material is strongly related to *E. zitelli*, but since our material is not very abundant, we prefer to name it *Eomys* cf. *zitelli*.

**Family Zapodidae** Coutes, 1875

**Plesiosminthus** sp.

Plate V, fgs. 1-4

### Material and measurements

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### Description

M1: The labial anteroloph is continuous, and in one specimen only a small anteroconule is distinct in this ridge. The lingual anteroloph is weakly developed and consists of a narrow style going straight down from the anterocone to the crown basis. Labially the anterior valley is open. The entoloph is continuous. The protoloph is transverse in one specimen, and it points slightly forward in the other two. The mesoloph parts from the triangular mesocone and reaches the labial border. A mesostyl is indistinct. The metaloph is transverse. The posteroloph is labially isolated from the metacone. Lingually it is connected to the basis of the hypocone in one specimen, and it is separated from this cusp in the other two. A low cusp is present at the anterior wall of the hypocone. The sinus points sharply forward.

### Discussion

*Plesiosminthus* sp. from Canales has smaller teeth than any hitherto known species of the genus. It differs from *P. promyariun* Schaub from the Upper Oligocene (MP29) of Pech Desse by the absence of an anteroconule in the anteroloph and by the absence of an extra cusp at the labial end of the anteroloph of M1. In Pech Desse the mesostyl of M1 is distinct, whereas this cusp is absent in Canales. In M1 of Pech Desse the endoloph is interrupted or weakly developed, while this ridge is continuous in Canales.

*Plesiosminthus* sp. from Canales differs morphologically from *P. schauff* from Parrales by its continuous and well-developed anteroloph of M1, its relatively smaller mesocone in M2 by the presence of a medium.
Figure 3. Length ranges of the molars of *Adelomysarion* and *Heterocricetodon* species from the Upper Oligocene of France (DIEUP, COD-1, COD-3, MILLOQ), Germany (EHR7) and Spain (the remaining localities). Data of Coderet are from Hugueney (1969); Diecupentale from Baudelot & Olivier (1978); Sayatón-6 from Daams (1989); La Milloque from Brunet (1979); Canales from this paper; Vivel del Río from Hugueney et al. (1987) and Freudenthal (1994); Mirambueno 1, 2A, 4C, 4D from Freudenthal (1994); Carrascosa from Lacombe & Morales (1987); and Pareja from Daams et al. (1989). *H. l.* corresponds to *Heterocricetodon landroveri*.

long mesoloph in one M₂, and by the double protolophule in another M₂.

Until now three lineages of *Plesiosminthus* have been proposed. The first lineage is that of *P. promyarian - P. myarian* and it is among others characterized by the presence of the posterior arm of the protoconid in M₂, and the frequent occurrence of double protolophules in M₁⁻² (Hugueney & Vianey-Liaud, 1980). The second lineage would be that of *P. moralesi - P. schaubi* (Álvarez Sierra et al., 1996) in which the two above mentioned features are absent. The third lineage would be that of *P. winistoeferi* (Engesser, 1987) from the uppermost Oligocene of Switzerland characterized by its large size and the presence of a well-developed posterior arm of the protoconid in M₂. The latter feature is considered to be a primitive character by Hugueney & Vianey-Liaud (1980) and Engesser (1987) and it would point at a more primitive evolutionary stage than that of the much older *P. promyarian. Plesiosminthus* sp. from Canales fits morphologically in the *P. promyarian - myarian* lineage but its size is significantly smaller than that of *P. promyarian* from the more or less contemporaneous fissure fillings Pech Desse and Pech du Fraysse.

Family *Gliidae* Thomas, 1897

*Peridyromys* sp.
Pl. VI, figs. 1-8

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Plate III


The horizontal bar represents 1 mm.
Description

The upper molars have a concave occlusal surface, the valleys are wide and the ridge slopes are gentle.

M\(^2\): One specimen has a centrally situated protocone, whereas it is situated more towards the postero-lingual border in the other two. The labial extension of the anteroloph joins the anterior wall of the paracone in one specimen and it is isolated in the other two. The anterior centralloph is connected to the paracone, and it is longer than the posterior centralloph. The posterior centralloph joins the metacone. The posterocone is connected to the protocone, but is separated from the metacone by a shallow furrow. A tiny extra ridge is present between the protoloph and anterior centralloph. The posterocone meets the protocone below the occlusal surface, and labially this ridge is separated from the metacone.

M\(^3\): The anteroloph is an isolated ridge. The trigone has a symmetrical U-shape. The anterior centralloph is longer than the posterior one. Both ridges join paracone and metacone respectively. A tiny extra ridge is present between the protoloph and anterior centralloph in one specimen. The posterocone meets the protocone and labially this ridge is separated from the metacone.

M\(^4\): The anteroloph joins the protocone, thus forming a continuous endoloph. At its labial side the anteroloph is separated from the paracone. Two short centraloloophs are present. One of these continues way into the central valley to form an irregularly shaped ridge. The anterior centralloph is connected to the paracone, but the posterior one is separated from the metacone. The posterocone encloses the posterior valley.

M\(_\text{m}\): Wide valleys and ridges. The anterolophid joins the protoconid in four out of five specimens. The metalophid is connected to the metaconid in two specimens and separated from this cusp in the other three. The short to medium-long centrallophid meets the metaconid. Mesolophid and posterolophid meet each other at the enotocnid, which is a distinct cusp in one specimen. A tiny extra ridge is present in the posterior valley.

M\(_s\): The anterolophid meets the protoconid. The metalophid is separated from the metaconid. The medium-long centrallophid is somewhat shorter than in M\(_m\). The mesolophid is separated from the posterolophid at the lingual side by a deep furrow. A well-developed extra ridge is present in the posterior valley. One anterior root is present.

Discussion

Peridyromys sp. exhibits a mixture of primitive and modern features. The concave occlusal surface and centrally situated protocone of one M\(^3\) and the distinct enotocnid of one M\(_s\) remind of Glioravus, but the complete mesolophid of M\(_s\) and the generally well-developed ridges of all elements are typical of more evolved gliids. Peridyromys sp. from Canales is of the same size as Peridyromys murinus (Pomel) from the Lower Miocene of Spain but it has lower crowns and a slightly more complicated dental pattern. It is also slightly smaller than P. columbarrii Daams, 1989 from the Upper Oligocene of Sayatón 6 (Daams, 1989), it has a more simple dental pattern, but the crown height is similar. Our material from Canales agrees both metrically and morphologically perfectly with Peridyromys murinus from the Upper Oligocene of St-Victor-la-Coste (Huguener, 1968). However, we prefer to restrict P. murinus to those teeth which are relatively hypsodont and lacking extra ridges in most cases. Therefore we doubt if P. murinus from St-Victor really corresponds to P. murinus, although the crown height of this assemblage has never been studied.

Family Sciuridae Baird, 1857

Heteroxerus sp.

Pl. II, fig. 7

Material and measurements: 1 M\(_s\), 1 D\(^4\) (1,18 x 1,29).

Description and discussion

The preservation of the M\(_s\) is so bad that hardly any structure can be described. The D\(^4\) has a small hypcone in a more lingual position than the protocone. The posterocone and metalophid are connected to the protocone. There is a large metaconule. The long posterocone reaches the metacone.

The size and dental pattern of the D\(^4\) from Canales is similar to that of H. costatus (Freudenberg, 1941) from Guimersheim (Kristofit, 1992). However the assignation of our material to the latter species is hazardous since only a deciduous tooth is available.

PARRALES

Family Theridomyidae Alston, 1876

Issiodoromys pseudanaema (Gervais, 1848)

Plate I, figs. 4-5

Material and measurements: The few teeth present are broken and one specimen only (M\(_s\), 17.1 x 13.8) could be measured.

Plate IV


The horizontal bar represents 1 mm.
Discussion

The most characteristic features of this material are its high degree of hypsodonty (3 of one specimen of M₃), and the absence of roots in rather worn specimens. These two features are only present in *I. pseudanaema* and in *I. brunsatensis* Schmidt-Kittler & Vianey-Liaud, 1987. Although the fragmentary material could not be measured, with the exception of one M₃, it is apparent that the size of the teeth is larger than that of *I. brunsatensis* from Coderet (Hugueney, 1969; Schmidt-Kittler & Vianey-Liaud, 1987). Other peculiar features are the presence of enamel at the lingual side of the lower cheek teeth, and the lesser curvature of the upper cheek teeth. In the teeth from Coderet the enamel becomes rapidly lost and the upper cheek teeth are more curved.

**Family Cricetidae** Rochebrune, 1883

**Eucricetodon cf. collatus** (Schaub, 1925)

**Pl. III, figs. 4-7**

**Material and measurements:** M¹ (- x -); M² (16.0 x 14.7); M₃ (18.9 x 12.5); M₄ (16.7 x 13.5); M₅ (16.8 x 13.2).

**Description**

M¹: The simple, bean-shaped anterocone is situated somewhat lingually. The labial and lingual parts of the anterocone descend to reach the bases of paracone and protocone respectively. The anterior arm of the protocone points obliquely forward and ends free near the antero-lingual basis of the paracone. A short mesoloph is present. The remaining part of the tooth is missing.

M²: The labial anteroloph joins the basis of the paracone, thus closing the anterosinus. A lingual anteroloph is absent. A mesoloph is absent. The sinus points sharply forward. The wide posteroconulid joins the basis of the metacone, thus closing the narrow posterosinus.

M₃: The posterior arm of the protoconid runs obliquely backward to turn transversely to join the postero-labial basis of the metaconid. The entolophid joins the posterior wall of the protoconid about halfway. A mesolophid is absent. From the top of the metaconid a crest descends along the lingual border toward the entoconid but without reaching this cusp. The posteroconulid runs along the posterior border of the tooth and ascends toward the top of the entoconid, thus closing the posterosinusid. A hypoconulid is distinct in the posteroconulid.

M₄: The lingual anterolophid is medium long and encloses the narrow, lingual anterosinusid. The labial anterolophid descends to meet the basis of the protoconid. The well-developed, posterior arm of the protoconid ends free in the mesosinusid. The entolophid is oblique and joins the posterior wall of the protoconid just below the occlusal surface. The posteroconulid widens behind the hypoconulid, indicating the hypoconulid, but then becomes narrow to join the basis of the entoconid, thus bordering the posterosinusid.

M₅: The lingual anterolophid is medium long and encloses the narrow, lingual anterosinusid. The well-developed, posterior arm of the protoconid ends free in the mesosinusid. The entolophid is oblique and joins the anterior wall of the protoconid just below the occlusal surface. A relatively high ridge is present between the top of the entoconid and the posterior wall of the metaconid, thus bordering the mesosinusid.

**Discussion**

The size of the teeth of *E. cf. collatus* from Parrales falls within the size ranges of *E. collatus*, *E. longidens* Hugueney, 1969 and *E. hesperius* Engesser, 1985 although the length of our M₃ is closer to the mean value of those of *E. longidens* from Coderet than that of *E. collatus* from Kütigen. The length of M₅ of *E. cf. collatus* from Parrales exceeds the size range of *E. collatus* from Kütigen, but falls within the size range of *E. longidens* from Coderet according to the size ranges given by Hugueney (1969). In Engesser (1985) the size ranges of the Kütigen material are somewhat larger, so that our M₃ from Parrales falls more or less in the size range of *E. collatus*. The M₅ falls within the morphological variation of *E. longidens*, and our M₅ may correspond to either species. Morphologically our material fits less with *E. hesperius* from Paulhaci (Engesser, 1985) by the badly developed mesoloph(id)s. On the other hand, the differences between *E. longidens* and *E. collatus* are so small that specific separation is questionable. Our poor material does not correspond to *E. praecursor* because of its larger size and its more evolved dental pattern (absence of posterior arm of the hypoconid in M₃ and M₅).

The few teeth of *Eucricetodon* gr. *praecursor-collatus* from the Upper Oligocene (MP29) of Hinojosa de Jarque 2 (Cuenca & Canudo, 1994) should probably be assigned to *E. praecursor* since the M₅ has a well-developed posterior arm of the hypoconid.

**Adelomyarion vireti** Hugueney, 1969

**Pl. II, fig. 6**

**Description and discussion**

Only one fragmentary M¹ is present. The simple and bean-shaped anterocone joins the protocone lingually. At the anterior wall of the paracone a narrow spur descends along the labial border without reaching the anterocone. The protocone has a transverse anterior arm which joins the paracone. An oblique ridge is present between the labial wall of the protocone and the endolophid. The

---

**Plate V**


The horizontal bar represents 1 mm.
inflated endoloph meets the postero-lingual basis of the paracone. A mesoloph is absent. The estimated size of this fragment agrees with that of the various Adelomyarion vireti assemblages. The fact that the strongly forward pointing protolophule is connected to the anterior arm of the protocone would point at a more evolved stage than that of A. cornelli from Canales, and it would fall inside the range of variation of A. vireti.

Family Eomyidae Depéret & Douxami, 1902

_Eomys huerzereli_ Engesser, 1982
Pl. IV, figs. 8-11

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**Description**

P: The anteroloph is absent in one specimen, and in the other it is short and wide. A mesoloph is absent. The posteroloph is very short in one specimen, and in the other it is longer, but without reaching the labial tooth border.

M1: The anteroloph is well-developed. The mesoloph is short in three and of medium length in two specimens. One specimen has a low mesostyl. The posteroloph descends from the hypocone toward the labial border where it ends free just before reaching it.

M2: The anterolophid consists of labial and lingual part. The mesolophid is short in one specimen, of medium length in two, and long without reaching the lingual tooth border in one specimen. The posterolophid is absent in two specimens. When it is present, it is well developed.

M3: The anterolophid is narrow and consists of a lingual and a labial part. The short mesolophid joins the reduced entoconid in one specimen and it is separated from this cusp in the other. A posterolophid is absent.

**Discussion**

_E. huerzereli_ from Parrales has on the average smaller teeth than _E. gigas_ Comte & Vianey-Liaud, 1987 from the Upper Oligocene of Pech du Fraysse. Our material agrees both metrically and morphologically with _E. huerzereli_ from the Swiss Molasse (Engesser, 1982 and 1990). According to Engesser (1982) this species is characterized by four-rooted M1, short to medium-long mesoloph(id)s that never reach the tooth border, hypsodont teeth which is most distinct at the lingual part of the M2 and a well-developed anterolosinus of M3. Except that we cannot observe the number of roots in any M1, the remaining features agree well with our material from Parrales.

_E. cf. huerzereli_ from MP29 of Sayatón 1 (Álvarez Sierra et al., 1996) is of the same size as our material from Parrales, although the P from Parrales if longer. _Eomys_ aff. _huerzereli_ from Hinojosa de Jarque 2 (MP29, Cuenca & Canudo, 1994) is of similar size and dental pattern as our material and both assemblages fall inside the range of variation of _E. huerzereli_ from its type locality Rickenbach. _E. aff. huerzereli_ from MP29 of Verneuil, France (Huguenev, 1984) is of smaller size than _E. huerzereli_ from Rickenbach and the Spanish localities. It has four-rooted M, like the type material, which made Huguenev (1984) consider the Verneuil assemblage to be ancestral to the one from Rickenbach.

_Rhodanomys hgueneyae_ Engesser, 1987
Pl. IV, figs. 1-7

**Material and measurements:**

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**Description**

M2: The anteroloph and posteroloph are narrower and lower than the other ridges. In all four specimens the mesoloph is long and reaches the labial tooth border.

P: The anteroloph is a short, narrow and low ridge stuck to the anterior border of the tooth. The mesoloph is long and it is separated from the metacone by a furrow. The posteroloph is badly developed.

_M2_: The anterolophid is very short. The mesolophid is short in one specimen and absent in the other.

_M3_: The lingual anterolophid is of medium length in two and long in the other two specimens. The labial part of the anterolophid is better developed than the lingual part. The mesolophid is short in one specimen and of medium length in the other three. A posterolophid is absent.

_M4_: The anterolophid is badly developed. The mesolophid joins the entoconid. A posterolophid is absent.

**Discussion**

The evolutionary trends of the _Rhodanomys - Ritteneria_ lineage are toward smaller teeth and reduction and the loss of various ridges like anteroloph(id)s, mesoloph(id)s, posteroloph(id)s and longitudinal ridges. (Huguenev, 1969; Álvarez Sierra, 1987; Engesser, 1987, 1990 amongst others).

The material from Parrales shows primitive features like well-developed anterolophes and mesolophes in all upper molars, a continuous longitudinal ridge (except in one specimen), and a short to medium-long mesoloph in all M2. Morphologically our assemblage is similar to the two oldest representatives of _Rhodanomys: Rh. hgueneyae_ Engesser, 1987 from the Upper Oligocene of Spain and Switzerland and _Rh. transiens_ Huguenev, 1969.
from the Upper Oligocene of Spain, France, Germany and Switzerland.

According to Engesser 1987, 1990 *Rh. hugueneyae* has larger teeth than *Rh. transiens*, it has better developed anterolophs, longer mesolophs, and more frequently a posterolophid in M₃. Both species have teeth with primitive features on the one hand, and some more evolved characters on the other. The difference between the two species lies in the relative abundance of these features. For instance, the posterolophid is present in 55.5% of M₃ of *Rh. hugueneyae* from Küttigen, in 31.5% of M₃ of *Rh. aff. hugueneyae* from Brochene Fluh 53 and in *Rh. transiens* from Bergasa, Coderet and Sayatón 6 these numbers are 20%, 28.5% and 19% respectively. As *Rh. hugueneyae* evolves gradually into *Rh. transiens*, we need well-represented populations to obtain reliable determinations.

Our material has short to medium-long mesolophids and the posterolophid is absent in all lower molars. Specimens with short or medium long mesolophids are present in both species but they are more frequent in *Rh. transiens*. On the other hand, all upper molars of *Rhodonomys* from Parrales have a well-developed anteroloph, which is a primitive feature frequent in *Rh. hugueneyae*. Considering the evolutionary trends of this lineage we conclude that our assemblage is slightly older than the ones of *Rh. transiens*, especially because of the well-developed anterolophs. Unfortunately the material attributed to *Rh. hugueneyae* by Engesser (1987, 1990) is not abundant, hampering a good comparison, but the absence of posterolophids and the shorter mesolophs of M₃ in our assemblage from Parrales may indicate that our material is slightly more evolved.

The size of the teeth of our material falls within the size ranges of *Rh. transiens* from the Upper Oligocene of Coderet (Hugueney, 1969), Bergasa (Álvarez Sierra, 1987), Sayatón 6 (Daams, 1989) and Les Pierrettes (Engesser, 1990). Only the size of our P₃ appears to be slightly larger. The teeth from Parrales are slightly smaller than those of *Rh. hugueneyae* from Küttigen, Brochene Fluh 19/20 and *Rh. aff. hugueneyae* from Brochene Fluh 53 and Fintreusse 8 (see Engesser, 1990). *Rh. hugueneyae* from Parrales is of similar size as the same species from Sayatón 1 (Álvarez Sierra et al., 1996) with the exception of the larger P₃ of Parrales.

Considering the morphological and metrical features discussed above, we may conclude that the assemblage from Parrales is more evolved than the ones of *Rh. hugueneyae* from the Upper Oligocene of Switzerland, but they are slightly less evolved than the ones of *Rh. transiens* from Bergasa and Coderet. *Rh. transiens* from the Upper Oligocene of Sayatón 6 (Daams, 1989) may represent a more evolved stage.

In Parrales *Rh. hugueneyae* is associated with a large-sized eomomy (Eomys huerzeleri) like in Sayatón 1. According to Engesser (1987, 1990) *E. huerzeleri* concurs with *Rh. hugueneyae* in various localities from the swiss Upper Oligocene like Rance, La Cornalle, Brochene Fluh 4/5 and 19/20 and Basel Skt Jakob. These localities are situated between the levels of Rickenbach (MP29) and Küttigen (MP30).

Family *Zapodidae* Coes, 1875

_Plesiosminthus schaubi_ Viret, 1926

Pl. V, figs. 5-11

<table>
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<td>mean</td>
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<td>M₃ 13</td>
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<tr>
<td>M₃ 13</td>
<td>8.4</td>
<td>8.9</td>
</tr>
</tbody>
</table>

Description

M₁: The anteroloph is continuous and nearly reaches the labial border in 10 specimens and it is interrupted at about 1/3 of the tooth width from the labial border in 3 specimens. An anteroconule is distinct in the anteroloph in 5 out of 13 specimens. The interpolation of the anteroloph is behind the anteroconule, and the labial part consists of a short and elongated cusp-like ridge. The connection between the protocone and paracone is variable. In 2 specimens the protolophule is transverse and it joins the protocone directly. In 9 specimens the protolophule points obliquely backward and meets the entoloph just behind the protocone. In one specimen the entoloph is interrupted so that the sinus forms a continuous valley with the valley between the anteroloph and paracone. In another specimen the entoloph breaks more toward the back so that the sinus forms a continuous valley with the anterior mesosinus. The sinus points strongly forward. The mesoloph parts from the well-developed, triangular mesocone and reaches the labial border in 12 specimens, where it ends in a mesostyl in 8. In 2 specimens the mesoloph is of medium length and it does not reach the mesostyl. The metalophule may be slightly curved, and it meets the hypocone transversely. The posteroloph is low and it does not join the metacone. Lingually this ridge may be either isolated from the hypocone (in 5 specimens) or it may join the basis of this cusp (in 9 cases). In one specimen the sinus does not have an additional ridge but in the other 13 there is a ridge of variable aspect. It may be a cusp at the lingual border (in 5 specimens); it may be a longitudinal ridge (in 6); or a more or less transverse ridge (in 2). In one specimen this longitudinal ridge continues into a cingulum bordering the antero-lingual part of the molar.

M₃: A distinct anteroconule is present in the anteroloph in 11 out of 16 specimens. Labially the anteroloph does not join the paracone. The protolophule points slightly backward or it is transverse and it joins the anteroloph just after parting from the protocone. The entoloph is interrupted in 7 out of 18 specimens so that the sinus and the anterior mesosinus form a continuous valley. The mesoloph parts from the triangular mesocone and reaches the labial border in all specimens. The mesostyl is less distinct than in *M₁* or not distinct at all. The sinus points strongly forward. The metalophule is transverse or it points slightly forward, and it joins the entoloph just before the hypocone. The posteroloph sprouts from the top of the hypocone and it may or may not
be connected to the basis of the metacone. On the anterolingual wall of the hypocone a low cusp is present in 9 specimens. In 2 specimens this cusp is longitudinally elongated and directed toward the top of the hypocone. In 2 specimens a cingulum ridge runs from the anteroconule along the lingual border to the basis of the hypocone, thus separating the protocone from the lingual border. In 2 specimens there is a transverse ridge in the sinus and in 3 other specimens the sinus is void of cusps or ridges.

M\textsuperscript{3}: The sinus is closed in one, and open in the other specimen. The mesoloph is long in both specimens.

M\textsuperscript{2}: The anteroconid is an isolated, round or transversely somewhat elongated cusp in 14 specimens; it is connected to the protoconid in one, and it joins the metaconid in 2 specimens. The furrow separating the anteroconid from the protoconid is deeper than the one between anteroconid and metaconid. The protoconid and metaconid meet each other transversely or the meeting point of these two cusps lies somewhat more backward. From the well-developed triangular mesoconid a long and low mesoloph extends to the lingual border where it ends in a small, but distinct mesostylid. In one specimen only the mesoloph is interrupted before reaching the mesostylid. The entolophid connects the mesoconid with the protoconid in 13 specimens, and in 4 specimens the entolophid is interrupted or absent at this place. In one specimen a low longitudinal connection is present between the mesolophid and the protoconid-metaconid junction. The posterior part of the entolophid is generally well developed and it is connected to the meeting point of hypo- and entoconid in 12 specimens; it joins the entoconid in 2; it meets the hypoconid in 2 and it is absent in one case. The transverse hypolophid is connected to the entolophid before the hypoconid in 12 specimens; in 3 specimens the hypolophid joins the anterior part of the hypoconid, and in 2 specimens the hypolophid points backward and meets the hypoconid in the middle. The posterolophid widens behind the hypoconid to form an elongated hypoconulid in 13 out of 17 specimens. The posterolophid reaches the lingual border where it curves round to mount the entoconid, thus closing the posterior valley. In one specimen the posterolophid is interrupted between hypoconid and hypoconulid. In 8 out of 17 specimens a weak to moderately developed ridge goes down from the hypoconulid toward the postero-labial basis of the hypoconid.

M\textsuperscript{3}: Both the lingual and labial anterolophid are well developed, and they part from the anterolophid. In one specimen the anterolophid is an isolated ridge because of the absence of the anterolophid. The lingual anterolophid ends at the basis of the metaconid. The labial part ends at the basis of the protoconid in 10 specimens and in 6 it continues as a cingulum ridge ending at the basis of the hypoconid. The metalophid meets the anteroconulid just before the protoconid in 13 cases, and in 2 specimens the metalophid and protoconid meet each other transversely. The oblique entolophid runs between protoconid and entoconid-hypoconid meeting point. The mesolophid is long and ends at the lingual border in a slightly distinct or indistinct mesostylid in 14 specimens. In one case the mesolophid is of medium length and a mesostylid is absent, and in another specimen the mesolophid is of medium length but a mesostylid is present. The hypoconulid meets the entolophid before the hypoconid. The posterolophid is constricted just behind the hypoconid, but then widens to form a hypoconulid in 9 specimens. In the other 5 the hypoconulid is not or hardly distinct. The posterolophid joins the basis of the entoconid, thus closing the posterior valley.

M\textsuperscript{3}: The lingual anterolophid is relatively short, but the labial one reaches the basis of the protoconid. The short anterolophid joins the protoconid-metaconid connection. A short, oblique mesolophid is present.

Discussion

P. schaubi from Parrales is of the same size as the same species from Codrett (Hugueney, 1969). Only the M\textsuperscript{3} from Parrales is slightly larger. The morphology of the upper molars from Parrales agrees perfectly with that of the upper molars from Codrett. Some slight differences are observed in the lower molars. In Parrales the anterolophid of M\textsuperscript{3} is generally isolated, whereas in Codrett this cusp joins the metaconid in most cases. Another difference is that in Parrales the mesoconid is connected to the protoconid in nearly all specimens, whereas in Codrett this connection does not exist in the major part of the specimens. We do not know if these differences are due to geographical provinciality, or to (slight) evolutionary differences.

Family Gliridae Thomas, 1897

Peridyromys murinus (Pomel, 1853)

Pl. VI, fig. 9

Material and measurements: 1 M\textsuperscript{3} (8.6 x 10.6).

Description and discussion

Relatively hypsodont. The protoloph meets the metaloph somewhat inside the tooth. The posteroloph joins the protocone, but it is isolated from the paracone.

---

**Plate VI**


9 Peridyromys murinus (Pomel, 1853) from Parrales. P\textsuperscript{3} sin. (PAR 201).


The horizontal bar represents 1 mm.
A well-developed anterior centroloph is present. This specimen falls within the morphological and metrical range of variation of *P. marinus* from the Lower Miocene of Spain.

*Armantomys cf. bijmai* (Lacombe & Martínez-Salanova, 1988)

Plate VI, figs. 10-13

**Material and measurements:** 1M\(^1\) (10.4 x 12.2), 1 fragmentary M\(_1\), 1M\(_1\) (10.5 x 10.2), 1M\(_1\) (9.5 x 9.1).

**Description**

M\(_1\): Relatively hypsodont. The protoloph meets the metaloph at the high protocone. The posteroloph is connected halfway to the posterior wall of the protocone. Labially a furrow separates this ridge from the paracone. A well-developed anterior centroloph is present.

M\(_1\): Both specimens are worn. The anteroloph is separated from the protoconid. The centroloph is short. Postero- and mesolophid meet at the entoconid.

M\(_1\): The ridges are high. The anteroloph is separated from the protoconid. The centroloph is very short. The metaloph does not join the metaconid. The meso- and posterolophid meet at the entoconid. The posterolophid meets the mesolophid labially at the posterior wall of the mesoconid.

**Discussion**

Morphologically the few teeth from Parrales agree with those of *A. bijmai* from the Lower Miocene of Santa Cilia (MN1) and Quel 1 (MN2a), Daams (1990), but the size of our material is slightly smaller.

Gliroidae indet.

Pl. VI, figs. 14,15

**Material and measurements:** 1M\(^1\) (7.8 x 10.7), 1M\(_1\) (9.5 x ——).

**Description**

M\(^1\): A continuous endoloph is present. The anteroloph joins the paracone. Proto- and metaloph meet the endoloph separately. An isolated posterior centroloph of medium length is present. The posteroloph joins the metaconid.

M\(_1\): The anteroloph is separated from the protoconid. The metaloph meets the base of the metaconid. The centroloph is of medium length. Meso- and posterolophid meet at the entoconid. An extra ridge is present in the posterior valley.

### BIOSTRATIGRAPHY

The faunal lists of Canales and Parrales are as follows:

**CANALES**

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<th>Genus</th>
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<td>Plesiosminthus sp.</td>
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<td>6.5  %</td>
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<td>Heteroxerus sp.</td>
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<td>14.5 %</td>
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<tr>
<td>Adelomyarion sp.</td>
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<td>3.9  %</td>
</tr>
<tr>
<td>Adelomyarion cornelli</td>
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<td>3.9  %</td>
</tr>
<tr>
<td>Pseudocricetodon cf. adroveri</td>
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<tr>
<td>Total Number of M1-2</td>
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**PARRALES**

<table>
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<tr>
<th>Genus</th>
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<tr>
<td>Issiodoromys pseudanaeuma</td>
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</tr>
<tr>
<td>Plesiosminthus schaubi</td>
<td>67</td>
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<td>Eomys huergeleri</td>
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<td>Armantomys cf. bijmai</td>
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<td>Eucricetodon cf. collatus</td>
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The most useful species for correlation of the Canales fauna is *Issiodoromys limognensis* which is exclusive for MP28 with Pech du Frayse as reference locality. Another Spanish fauna from MP28 is that of Vivel del Rio from the Teruel Basin (Hugueneu et al., 1987) which contains nineteen rodent species (Fig. 4). Characteristic species shared by Canales and Vivel del Rio are *Issiodoromys limognensis*, *Eomys zitteli*, *Adelomyarion cornelli*, *Adelomyarion sp.*, and *Pseudocricetodon adroveri*. Canales is much poorer and has only nine rodent species. Part of this poverty is due to the small size of our sample but *Eucricetodon dubius*, *Eomys major* and *Microdromys praemaurus*, which are frequent in Vivel, are clearly missing in Canales. Another difference between the two faunas is the presence in Canales of the very small-sized *Plesiosminthus* sp. contrasting with the larger sized *Plesiosminthus promyarian* from Vivel (see Fig. 4 in Álvarez Sierra et al., 1996). Some features may point at a younger age for the Canales fauna such as the absence of *Eucricetodon dubius*. In Late Oligocene faunas of MP27-28 from western Europe this species is very common and it is substituted by *Eucricetodon praecursor* at the turn of MP28/29. But the faunal difference may also be due to the different paleoenvironmental setting of the localities; the Vivel fauna is found in a lacustrine sequence, whereas the Canales level forms part of an extensive fluvial system (Daams et al., 1996), the so-called Tórtola fan (Díaz Molina & Tortosa, 1996). Other Spanish rodent faunas attributed to MP28 are the ones from Mirambuenu 1 and 2A from the same area as Vivel del Rio (Freudenthal, 1994; Freudenthal et al., 1994). Unfortunately only the Cricetidae have been studied (op cit.) and consequently complete faunal lists are not available. But the presence of *Adelomyarion cornelli* and *Eucricetodon dubius* in Mirambuenu 1 and 2A and that of *Pseudocricetodon adroveri* in Mirambuenu 2A confirms this correlation.

Agustí et al. (1985) and (1987) described a succession
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<tr>
<td>28</td>
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<td></td>
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<tr>
<td>28</td>
<td>VIV</td>
<td>2696</td>
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</table>

**Figure 4.** Distribution chart of late Oligocene rodents from Central Spain. VIV = Vivel del Río; CAN = Canales; HIN = Hinojosa de Jarque 2; SAY-1 = Sayatón 1; PAR = Parrales; SAY-6 = Sayatón 6.

of Late Oligocene/Early Miocene micromammalian faunas from the eastern Ebro Basin. Faunas such as Fraga 4 and Les Canotes were correlates to MP27 because of the presence of *Iissiodoromys querzi*, the next ones in age such as Fraga 7 and 11 were assigned to MP30 mainly because of the presence of *Rhodanomys transiens*, and the more modern ones such as Torrente de Cinca 68 and Ballobar 21 to MN1 because these faunas contain *Rhodanomys schlosseri*. Hence, MP28 and MP29 would not be represented. In a later stratigraphic study combined with magnetostratigraphy (Agustí et al., 1994) a different correlation was proposed and the MP27 faunas (Schmidt-Kittler, 1987) were assigned to MP28/29. However, the referred faunas are void of any taxa characteristic of MP28/29, but several of these do have *Iissiodoromys querzi*, which is exclusive for MP27. Since the biochronological subdivision of the Late Oligocene is mainly based on the evolution of Theriodomyidae, we think that the correlation such as proposed by Agustí et al. (1987) is the correct one. As our two faunas are from MP28 and 29 respectively, we will not compare our data to the Ebro succession.

The fauna of Parrales is correlated to MP29 because of the presence of *Iissiodoromys pseudanae* and *Eomys huerzeleri* (Fig. 5). It shares with Sayatón 1 from the Madrid Basin (Alvarez Sierra et al., 1996) *Adeomyomys monti*, *Eomys huerzeleri* and *Rh. hueneneyae* (Fig. 4). However, Parrales is considered to represent a more modern fauna than Sayatón 1 since *Rh. hueneneyae* is more evolved, and since it contains *Plesiosminthius schaubi* which is considered to be the descendant of *P. moralesi* from Sayatón 1. Our Parrales fauna is somewhat younger than that of Hinojosa de Jarque 2 from a smaller intramontane Basin in Teruel (Cuenca & Canudo, 1994) because it has *E. cf. collatus* and *Plesiosminthius schaubi* whereas in Hinojosa the respectively earlier representatives *E. praecursor* and *P. moralesi* are present (Fig. 4).

After comparing the Parrales fauna to other European ones, it appeared that there are two faunal groups in MP29 (Fig. 5); one older one without *Rhodanomys* and one younger one with *Rhodanomys hueneneyae*. Both groups contain *Eomys huerzeleri*. *Eomys* is absent beyond MP29. This successional bipartition on the basis of *Eomyidae* is recognizable in western and central Europe. In the Freshwater Molasse of Switzerland and Savoy, Engesser (1990) recognized faunas with *Eomys huerzeleri* and without *Rhodanomys* which he correlated to the Rickenbach Zone. Other, more modern faunas such as La Cornalle, Rances, Brochene Fluh 4/5, Basel-St. Jakob with *E. huerzeleri* and *Rhodanomys* were assigned to either Rickenbach (+) or to Küttingen (-) such as Brochene Fluh 19/20. The Hinojosa fauna from Spain contains *Eomys huerzeleri* but it lacks *Rhodanomys* and may consequently be correlated to the older faunal group of MP29. Sayatón 1 and Parrales have both *E. huerzeleri* and *Rhodanomys* and belong to the more modern faunal group. Our Parrales fauna also contains *Eucrietodon cf. collatus* which confirms its correlation to the more modern faunal group.
**Figure 5.** Distribution chart of selected rodent taxa from fluvo-lacustrine faunas from the Upper Oligocene of Western and Central Europe. Data are from the following sources: For the Swiss localities Fornant 7 and 6, Boudry L. F., Findreus 18, Rickenbach, La Cornalle, Rances, Brochene-Fluh 19/20, Küttigen (Burbank et al., 1992; Engesser, 1987, 1990; Engesser & Mayo, 1987; Engesser et al., 1984; Mejón et al., 1985; Hugueney et Kissling, 1972). For the Spanish locality Bergasa (Álvarez Sierra et al., 1987); and for the French fauna Cournon-les-Soumérours (Brunet et al., 1981). The other localities are referred to in the text.

Aguilar et al. (1997) correlated the faunas of Canales and Parrales erroneously to MP 29 and MP 30 respectively, following an earlier correlation of Álvarez Sierra et al. (1994). The reasons of these errors are not clear.

**ACKNOWLEDGEMENTS**

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