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PALEOCENE AND LOWER EOCENE MAMMALS OF EUROPE

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INTRODUCTION

Continued stratigraphic and faunal study of the American Paleocene and Lower Eocene demands as much knowledge as possible of contemporaneous geologic and faunal events in western Europe. It is the purpose of the present note to facilitate study by giving a succinct review of current knowledge of the European mammalian faunas of these epochs. The subject has recently been placed on a new and incomparably more satisfactory basis by the fine French and Belgian studies of P. Teilhard de Chardin (especially 1921, 1927, see references), and the present résumé is primarily a review of his work, although it also takes into account the other literature of the subject. This is supplemented by some personal acquaintance with the French Thanetian. Some specimens of each of the genera of this fauna were studied, in which connection I wish to thank Doctors M. Boule, C. Depéret, and W. O. Dietrich; and a brief visit was made to the classic section along the Mont de Berru near Reims.[1]

FAUNAL LISTS

THANETIAN OF FRANCE. *Pleuraspidotherium-Neoplagiaulax* Zone

La Fère:

Arctocyon primævus

Merfy (Horizon of Sables moyens de Jonchery):

Plesiadapis ?tricuspidens

Rilly and Chenay:

Plesiadapis ?tricuspidens

Cernay-les-Reims:

Neoplagiaulax eocænus
Neoplagiaulax copei
Liotomus marshi
Adapisoriculus minimus
Adapisorex chevilloni
Adapisorex gaudryi
Adapisorex aff. *?dolloi*

[1]Most of the known Thanetian mammals come from the Cernaysian gravel, a local stratum, so that it is customary to speak of the Cernaysian fauna. The name is derived from the village of Cernay-les-Reims (not to be confused with Cernay-la-Ville, which is in Seine-et-Oise) at the foot of the hill (Mont de Berru) on its west side, near the productive localities.

Dissacus europæus
Dissacus gaudryi
Plesiadapis tricuspidens
Chiromyoides campanicus
Arctocyon primævus
Arctocyonides trouessarti
?Arctocyonides spp.
?Mioclænid indet.
Tricuspiodon rutimeyeri
Pleuraspidotherium aumonieri
Pleuraspidotherium remense
Orthaspidotherium edwardsi

?THANETIAN

Jonchery, sables moyens—a supposedly Thanetian horizon, but the mammals reported by Lemoine (1880) and Depéret (1907), not restudied by Teilhard, suggest confusion with Sparnacian strata:

Arctocyon primævus ("*Arctotherium cloezi*")
cf. *Hyracotherium* sp. ("*Pliolophus*")
cf. *Hemiacodon* sp.

SPARNACIAN OF FRANCE. *Hyracotherium-Coryphodon* Zone

Meudon and Vaugirard:

?Platychœrops aff. *daubrei*
Paramys sp.
Pachyæna gigantea
Palæonictis gigantea
Hyracotherium cf. *leporinum*
Hyracotherium sp.
Coryphodon oweni

Épernay Region—Archaic part of the Faune Agéienne of Lemoine:

Palæosinopa osborni
Platychœrops daubrei
Paramys lemoinei
Paramys nanus
Paramys sp.
Proviverra pomeli
Esthonyx munieri
Phenacodus teilhardi
Hyracotherium sp.

Muirancourt (Soissonais):.

Palæonictis gigantea

Sézanne:

?Hyracotherium vismæi

Pourcy:

Coryphodon eocænus
New, indet. (Depéret, 1907, p. 12).

Cernay-les-Reims (above Cernaysian gravel):

Coryphodon oweni

LANDENIAN[1] OF BELGIUM. *Hyracotherium-Coryphodon* Zone

Orsmael:

Peratherium constans
Cf. *Adapisoriculus* sp.
Adapisorex dolloi
Insectivore, indet.
Platychœrops orsmaelensis
Eochiromys landenensis
?Heterohyus sp.
Omomys belgicus
Oxyclænid, indet.
Mesonychid, indet.
Oxyænids or hyænodontids, spp. indet.
Cf. *Sinopa* sp.
Miacids, spp. indet.
Phenacodus teilhardi
Paramys lemoinei
Paramys nanus
Microhyus musculus
?Protodichobune sp.

Erquelinnes:

Plesiadapid, indet.
?Arctocyonides sp.
Hyracotherium sp.
Coryphodon eocænus
Adapisorex dolloi
Omomys belgicus
Paramys lemoinei
Cf. *Oxyæna* sp.

Leval:

Coryphodon eocænus

Vinalmont:

?Hyopsodus sp.

LONDON CLAY, ETC., OF ENGLAND. *Hyracotherium-Coryphodon* Zone

Sands below London Clay—?Woolwich Beds.

Kyson:

Peratherium colchesteri
Gen. indet. ("Insectivorous bat" of Owen).
Hyracotherium cuniculum

?Localities:

Coryphodon sp.

London Clay (All?):

Sheppey:

Hyracotherium leporinum
Argillotherium toliapicum[2]

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[1]*Sensu stricto:* the term is sometimes made to include the Thanetian, older than the restricted Landenian.

[2]Davies, 1884. A supposed creodont of uncertain affinities.

Coryphodon eocænus

Herne Bay:

Hyracotherium leporinum

Platychœrops richardsonii

Dulwich:

Coryphodon eocænus

Harwich:

Hyracotherium vulpiceps

Croydon:

Coryphodon croydonensis

CUISIAN OF FRANCE. *Propachynolophus-Lophiodon* Zone

Épernay Region—More advanced part of the Fauna Agéienne of Lemoine:

Protoadapis curvicuspidens

Protoadapis recticuspidens

Propachynolophus maldani

Propachynolophus gaudryi

Propachynolophus sp.

Chasmotherium-stehlini

Lophiodon sp.

Protodichobune oweni

Fismes:

Lophiodon larteti

RANGE OF GENERA

1—Thanetian.

2—Sparnacian and equivalents.

3—Cuisian.

4—Post-Cuisian in Europe.

	1	2	3	4
MULTITUBERCULATA				
Ptilodontidæ				
Neoplagiaulax	×			
Liotomus	×			
MARSUPIALIA				
Didelphiidæ				
Peratherium		×		×
INSECTIVORA				
Leptictidæ				
Adapisorex	×	×		
Pantolestidæ				
Palæosinopa		×		
Nyctitheriidæ				
Adapisoriculus of Orsmael		×		
PRIMATES				
Plesiadapidæ				
Plesiadapis	×			
Chiromyoides	×			
Platychœrops		×		

	1	2	3	4
Eochiromys		×		
Heterohyus		?		×
Anaptomorphidæ				
Omomys		×		
Adapidæ				
Protoadapis			×	×
TILLODONTIA				
Esthonychidæ				
Esthonyx		×		
RODENTIA				
Ischyromyidæ				
Paramys		×		
CARNIVORA				
Arctocyonidæ				
Arctocyonides	×	?		
Arctocyon	×			
Mesonychidæ				
Dissacus	×	×		
Pachyæna		×		
Oxyænidæ				
Palæonictis		×		
Proviverridæ				
Proviverra		×		×
CONDYLARTHRA				
Phenacodontidæ				
Phenacodus		×		
Meniscotheriidæ				
Pleuraspidotherium	×			
Orthaspidotherium	×			
Tricuspiodontidæ				
Tricuspiodon	×			
AMBLYPODA				
Coryphodontidæ				
Coryphodon		×		
PERISSODACTYLA				
Hyracotheriidæ				
Hyracotherium		×		
Propachynolophus			×	
Lophiodontidæ				
Chasmotherium			×	×
Lophiodon			×	×
ARTIODACTYLA				
Dichobunidæ				
Protodichobune		?	×	
INCERTÆ SEDIS				
Adapisoriculus of Cernay	×	?		
Argillotherium		×		
Microhyus		×		

EUROPEAN CORRELATION

	Mammalian Étages France	Champagne Faunas of Lemoine	Belgium	England
Lower Eocene	Cuisian	Agéian	Upper Ypresian, or Ypresian, *sens. strict.*	——?——
			Lower Ypresian	London Clay
	Sparnacian		Upper Landenian, or Landenian, *sens. strict.*	Woolwich and Reading Beds
Paleocene	Thanetian	Cernaysian	Lower Landenian	Thanet Sands
	(Montian)			
——?—— Cretaceous	(Danian)			

The Thanetian has produced mammals only in the region of Reims, in France, and chiefly from the gravel (so-called conglomerate) of Cernay. This Cernaysian gravel marks the end of Thanetian time (Depéret, 1906), but Teilhard (1921) suggests that the whole Thanetian of this region will be found to have a unified fauna. The fauna consists of multituberculates, insectivores, plesiadapids, creodonts, and archaic ungulates of peculiar character.

Mammals of Sparnacian age have been found at numerous localities in the Anglo-Franco-Belgian Basin, but not elsewhere in Europe.[1] The fauna is marked negatively by the absence of multituberculates and of the Thanetian ungulates, positively by the first appearance of rodents, perissodactyls, and artiodactyls. Tarsiids, esthonychids, oxyænids, proviverrids, coryphodonts, and phenacodonts also appear in collections for the first time, although some of them may have been present previously. Some Thanetian mammals continue with little apparent change.

Faunas definitely of Cuisian age have so far been recognized only in the Paris Basin, and adequate differentiation of the mammals of this étage must depend on future work. It seems to be chiefly distinguished

[1]Beds of this age occur over a much larger area, and may eventually yield mammals elsewhere. Depéret (1907, Proc. 7th Int. Zool. Cong., Boston, p. 769) believes that the type of his *Lophiaspis maurettei*, from Palette, near Aix in Provence, is of Lower Ypresian age, although the beds in which it occurred are referred to the Middle Eocene (Lutetian) by Vasseur.

by the replacement of *Hyracotherium* by *Propachynolophus*, and by the first appearance of true lophiodonts.

The Sparnacian doubtless includes several distinct zones, but despite the work of Depéret and others these cannot yet be clearly recognized. The London Clay has been referred to the Cuisian (see Stamp, 1921) on the basis chiefly of the invertebrates, yet its mammals are clearly very close to those of the typical Sparnacian, and older than those of the restricted Cuisian. A slightly earlier zone is seen in the Woolwich Beds, and perhaps the fauna of Orsmael in Belgium, but these cannot yet be distinguished on the basis of the known mammalian remains.

The upper limit of the Paleocene has been placed at three different levels. A common European usage is to include the whole of the lower Eocene, as here understood, to the summit of the Cuisian. Or it may be placed above the Landenian, in which case the Sparnacian is supposed not to include any lower Ypresian or Londinian equivalents and the latter are placed in the true Eocene as opposed to the Sparnacian and Thanetian Paleocene. Or, finally, it may be placed above the Thanetian and below the Sparnacian. In the light of the crucial mammalian evidence, and particularly of increased knowledge of equivalent American faunas (especially Matthew), there is little question that the latter is the more natural and practicable division, at least from the vertebrate standpoint.

The lower limit of the Paleocene will continue to be rather dubious from any point of view. The vertebrates cast no light on this problem in Europe. The American Puerco and Torrejon should be included in the Paleocene and are older than the Cernaysian. The lowest Thanetian may be a partial equivalent, or part or all of their span may be represented by the Montian, which is often included in the Paleocene, but which may be as old as the Lance. The stratigraphic problem is exceedingly complex, but would probably be cleared up by the discovery of adequate land vertebrate faunas.

AMERICAN EQUIVALENTS

Depéret, Osborn, Matthew, and Teilhard have worked out the homotaxy of American and European early Tertiary mammal-bearing horizons in a way that now seems very satisfactory and calls for little comment. The evidence is briefly presented, however, in connection with the data reviewed above.

The known Thanetian mammalian fauna compares as follows with those known from America:

Thanetian	American Allies
Neoplagiaulax, *Liotomus*	Inadequately known, but close to American genera, Torrejon to Gray Bull.
Adapisoriculus	Affinities uncertain.
Adapisorex	*Leptacodon*, Tiffany.
Plesiadapis	*Plesiadapis*, Tiffany, Clark Fork.
Chiromyoides	Close to *Plesiadapis*.
Dissacus	*Dissacus*, Torrejon to Gray Bull.
Arctocyon	About intermediate between *Clænodon*, Torrejon, and *Anacodon*, Gray Bull, Lysite.
Arctocyonides	Very close to *Thryptacodon*, Tiffany, Clark Fork, Gray Bull.
Tricuspiodon	No close relatives in America.
Pleuraspidotherium	*Meniscotherium*, Clark Fork, Largo, Lost Cabin.
Orthaspidotherium	Probably allied to above, but no close relative in America.

That the Thanetian or Cernaysian fauna is typically Paleocene has long been recognized, and it has been correlated with the Puerco or Torrejon. Teilhard suggested correlation with our uppermost Paleocene horizons, especially the Tiffany, and this has been accepted by Matthew. Further study only serves to emphasize this homotaxy. Both the positive and negative evidence clearly imply an earlier horizon than our typical Eocene Sand Coulee or Gray Bull and a later horizon than our Torrejon. The correspondence with the Tiffany and Clark Fork is seen to be rather close. The presence of meniscotheres, suggested by Teilhard to indicate possible later age, is not anomalous, as the Thanetian genera differ from ours and are somewhat more primitive than *Meniscotherium*. Furthermore, meniscotheres do occur in the Clark Fork and probably in the approximately equivalent levels of the Paskapoo, although little known.

The deposits of the two continents are of quite different facies. The Cernaysian gravel was deposited in brackish estuarine waters, while the American deposits, although varied, were all formed on flood plains, in some cases probably at a considerable altitude. In the Cernaysian, the peculiar meniscotheres and *Plesiadapis* are common, arctocyonids and insectivores fairly frequent, other mammals rare. In the Mason pocket of the Tiffany, *Plesiadapis*, multituberculates, and marsupials are common, and the rest of the fauna consists largely of small insectivores and primates which are individually rare but so varied as to constitute a large part of the fauna. Outside of this pocket, the Tiffany contains mostly *Phenacodus* and *Periptychus*, with rare creodonts. The Clark Fork contains condylarths in abundance, frequent esthonychids and creodonts,

with amblypods, meniscotheres, and primates relatively rare. The Bear Creek Fort Union represents a third very distinct American facies, with plagiomenids (elsewhere unknown in the Paleocene) very common, other insectivores and the peculiar primate *Carpolestes* frequent, and creodonts, ungulates, and other groups relatively rare.

The fauna of the Cernaysian gravel differs little more from these three American faunas than they do among themselves. On account of these very marked differences due largely or entirely to facies, one hesitates to draw inferences from negative evidence. Yet it is very striking that in our Paleocene the ungulates are almost exclusively amblypods and phenacodonts, while in the contemporaneous European fauna these groups are quite unknown and their places are taken by three genera peculiar to that continent, only one of which has a close ally (and that rare at this level) in America.

The Sparnacian and Wasatch are still more similar, as the following list shows:

Sparnacian and Equivalents	American Allies
Peratherium	*Peratherium*, Gray Bull to John Day.
Adapisorex	*Leptacodon*, Tiffany; leptictids, Cretaceous through Oligocene.
"*Adapisoriculus*"	Nyctitheriidæ, Upper Paleocene to Middle Eocene.
Palæosinopa	*Palæosinopa*, Wasatch and Wind River.
Eochiromys	*Labidolemur*, Tiffany.
Platychœrops, *Heterohyus*	[1]
Omomys	*Omomys*, Gray Bull, Lysite, Lower Bridger.
Protoadapis	*Pelycodus*, Sand Coulee to Lost Cabin.
Esthonyx	*Esthonyx*, Clark Fork to Lost Cabin.
Paramys	*Paramys*, entire Eocene.
Dissacus	*Dissacus*, Torrejon to Gray Bull.
Pachyæna	*Pachyæna*, Wasatch and Wind River (Gray Bull species).
Palæonictis	*Palæonictis*, Gray Bull.
Proviverra	*Proviverra*, Lower and Middle Eocene.
Phenacodus	*Phenacodus*, Clark Fork to Lost Cabin.
Coryphodon	*Coryphodon*, Clark Fork to Wind River.
Hyracotherium	*Eohippus*, Wasatch and Wind River.
Protodichobune	*Diacodexis*, Wasatch and Wind River.
Microhyus	Affinities unknown.

The current view that the Sparnacian and Wasatch are homotaxial is obviously correct. The faunas are almost identical. Not only essential contemporaneity, but also free intermigration or immediate deriva-

[1] These genera, or very close relatives, may occur in the Wasatch, but the evidence is not yet wholly available.

tion from a common source are indicated. The transition from the Paleocene to the Eocene is very similar in the two continents. In both, some Paleocene genera and phyla survive, but in both the transition is especially marked by the introduction of new groups from some unknown source.

It has already been suggested that the various Sparnacian faunules of Europe are not exactly contemporaneous. In general, they appear to be close to the Gray Bull, but the fauna of Orsmael retains some special affinity with the Paleocene, and may be earlier, although it is certainly post-Thanetian. The conventional Sparnacian may include some Lysite equivalents, but there is no definite evidence of this.

There are apparently no groups of mammals which appear in the European Paleocene or lower Eocene before they appear in America. Of the several cases in which the reverse seems to be true, only that of the phenacodonts is worthy of emphasis. This group (*Tetraclænodon*) was very prominent in America before the Cernaysian gravel was deposited in Europe, yet it does not appear in the latter continent until the Sparnacian. It is quite possible, however, that it will yet be found in Paleocene beds there of facies different from the Cernaysian. The case of *Coryphodon* is not analogous, for this genus was not derived from any known earlier American form, and the Clark Fork, where it first appears, may be slightly younger than the Cernaysian. In the Clark Fork, *Coryphodon* appears and *Periptychus* is absent, while in the Tiffany, nearly contemporaneous but possibly a little earlier, *Periptychus* survives, but *Coryphodon* is absent.

The Cuisian is apparently homotaxial with the Wind River, or with the later Wind River and earliest Bridger. It marks the beginning of that divergence between the mammals of America and Europe which is increasingly apparent in the middle and upper Eocene.

SOME NOTES ON NOMENCLATURE AND AFFINITIES

ADAPISORICULUS AND ADAPISOREX

Lemoine referred to his species *Adapisoriculus minimus*, four specimens from Cernay. Of these, only one is mentioned by Teilhard, a fragment of a lower jaw with a single molar, the original of Lemoine 1885, Pl. XI, Fig. 13. The original of Pl. XI, Fig. 14, is a nearly complete lower jaw with a single tooth which does not agree well with the other tooth, the lectotype. The other two specimens, Pl. XI, Figs. 15–16, are fragments of jaws without teeth. The genus thus rests on a single tooth, redescribed and accurately figured by Teilhard (1921, p. 17, Fig. 8F; Pl. I, Fig. 3). It is somewhat imperfect, the tip of the metaconid and all of the protoconid broken off.

In the Université de Lyon is a perfect lower molar collected at Cernay by Professor Depéret, who kindly permitted its study. It is larger than the type of *Adapisoriculus minimus* and has a relatively larger metaconid.

Lemoine considered *Adapisorex* and *Adapisoriculus* as closely related insectivores. In 1921, Teilhard treated them together under "les Insectivores," but suggested that "*Adapisoriculus* pourrait bien être un Didelphe." In 1927, however, he considered *Adapisoriculus* as an insectivore, on the basis of new specimens referred to the genus, derived from the Landenian at Orsmael.

Teeth of this primitive tuberculo-sectorial type occur in several orders, and the attribution of isolated specimens is exceedingly difficult. In the Orsmael specimens, two of which include the alveoli of the cheek teeth, the formula seems definitely to be P^3 M^4. This would establish this animal as an insectivore, and it is suggestive of the Nyctitheriidæ, reference to which is confirmed by an upper molar later described by Teilhard (1928).

It does not seem certain, however, that this Orsmael animal is really *Adapisoriculus minimus*. It seems to be distinctly smaller, the heel longer and lower relative to the trigonid, the hypoconid-metaconid crest more definite, the hypoconulid slightly less internal. It is just such minutiæ which separate the primitive lower molars of several distinct orders in the older Tertiary. It still seems quite possible that the original impression of Teilhard—an impression which was very strongly my own also after studying the originals—was correct, and that the true Cernaysian *Adapisoriculus*, and also the Lyons specimen, are didelphids.

Adapisorex has generally been considered as representing a distinct family, Adapisoricidæ, allied to the Tupaiidæ, but Teilhard's recent memoir (1927, pp. 10–11) indicates that it is a leptictid. Its closest American ally appears to be *Leptacodon*, with which Teilhard was unable to compare it. *Leptacodon tener* differs from *Adapisorex dolloi* chiefly as follows:

Posterior mental foramen somewhat more anterior.

Paraconid of P_4 more distinct, heel narrower and less sharply cut off from trigonid.

Lower molars relatively longer and narrower, paraconids relatively larger, heels wider relative to trigonids.

All of these characters, however, are variable in the different species referred to *Adapisorex*. The known specimens of *Adapisorex chevilloni* cannot be distinguished generically from *Leptacodon*, although there are various distinctions of specific value from *L. tener*, such as its somewhat greater size.

This modified conception of *Adapisorex* reopens the question of the supposed extinct tupaioids, a subject too complex to pursue further here.

PLATYCHŒROPS-PLESIADAPIS

Platychœrops richardsonii Charlesworth 1854 was based on a partial palate from

the London Clay of Herne Bay. The original description was published anonymously and was very brief, but it was ascribed to Charlesworth and gives a diagnosis, so that it must be recognized as valid. The same specimen was subsequently described and figured by Owen (1865), who considered the animal as a hyracothere. He made no reference to the previous name, but called it *Miolophus planiceps*. Lydekker (1887, Cat. Fossil Mammalia, British Museum, Vol. V, p. 4; and elsewhere) used the correct name, *Platychœrops*, and, recognizing that it was not an ungulate, considered it as closely allied to *Esthonyx*.

Teilhard (1921, p. 62) recognized, for the first time, the true affinities of this strange species. It is a plesiadapid certainly congeneric and possibly conspecific with "*Plesiadapis*" *daubrei* Lemoine 1879. The genus *Plesiadapis* dates only from 1877 when the genotype *P. tricuspidens* Gervais was established on material from the Thanetian at Cernay-les-Reims. Considering the two genera as synonymous, Teilhard yet adopts the later name as better known.

Lemoine recognized two subgeneric groups of *Plesiadapis:* the *Tricuspidens* group, which is Thanetian, and the *Subunicuspidens* group, which is Sparnacian ("Agéien"). As recognized by Teilhard, these are natural divisions, quite distinct and not directly ancestral and descendant, although closely related. A valid and very convenient solution of this problem is to recognize these groups as separate genera. The Thanetian genus is *Plesiadapis*, the Sparnacian *Platychœrops*.

The chief distinctions, which are clearly of generic value by present mammalogical standards, are as follows:

	Platychœrops	*Plesiadapis*
1.	I^2 with two apical cusps.[1]	Three.
2.	No paraconule on P^4.	Prominent paraconule on P^4.
3.	Molar cusps generally subcrescentic.	Molar cusps more bunoid.
4.	Molar mesostyle strong.	Weak.
5.	P_3 partly, P_4 wholly molariform.	P_3 and P_4 similar save for incipient metaconid on P_4. Not molariform.
6.	On M_{1-2} metastylid large, paraconulid present.	Metastylid small or absent, paraconulid absent.
7.	M_3 with para- and metaconulids. Heel more complex.	No para- or metaconulids. Heel simpler.

The distinction is the more interesting in that it lends emphasis to the fact, noted in different words by Teilhard, that it is *Plesiadapis* which occurs in the American upper Paleocene (*Nothodectes* Matthew) and not *Platychœrops*.

EOCHIROMYS-LABIDOLEMUR

Teilhard (1927, p. 15) expresses the wish that precise comparison might be made between *Eochiromys*, from the Landenian of Belgium, and *Labidolemur*, from the Tiffany of Colorado (and, now, upper Fort Union

[1]Except in the plesiadapid from Meudon (Teilhard 1921, p. 51), which otherwise agrees with *Platychœrops* so far as may be judged from isolated teeth.

of Montana). Thanks to his excellent figures and to the availability of the originals of *Labidolemur*, this can now be done.

The lower incisors are very similar. That of *Labidolemur* has the crown slightly more curved and the posterior part of the upper crest more denticulate. In *Eochiromys* there are two single-rooted teeth between the incisor and M_1. In *Labidolemur* there was probably only one, but the specimens are broken and two may have been present. The molars, of peculiar pattern, are similar in the two genera almost to identity. Teilhard's figures suggest somewhat better differentiation of the talonid cusps in *Eochiromys*.

In *Eochiromys* there are two mental foramina, but they may open into a common deep groove. In *Labidolemur* this groove is still deeper and the foramina are closer together, so that the effect is of a single foramen. In both, the posterior part of this combined foramen is beneath the anterior end of M_2. The two known species of *Labidolemur* are somewhat larger than *Eochiromys landenensis*.

Teilhard's suggestion of relationship between these genera is fully substantiated. Of characters of possible generic value, there is little to distinguish them beyond the probable presence of only one premolar and the less distinct talonid cusps in *Labidolemur*— both rather doubtful features. The genera are either identical or very closely related.

As suggested by Matthew and by Teilhard, it is probable that at least two quite distinct groups are included in the Plesiadapidæ as currently used, although it is difficult to separate them. One, exemplified by *Plesiadapis*, *Chiromyoides*, *Platychœrops*, and possibly by *Trogolemur* and *Uintasorex*, generally has the lower incisor less enlarged, the mental foramen farther forward, and retains two or three premolars. In this group the molars are very lemuroid in structure. In the other group, exemplified by *Labidolemur* and *Eochiromys* and perhaps including *Heterohyus*, *Phenacolemur*, and *Apatemys*, the incisor is usually larger, often with limited enamel band, the mental foramen is far back, and the premolars number one or two. The molars of this group are definitely less lemuroid and the trigonids are quadrate.

Phenacodus teilhardi, new name

It is proposed to replace *Phenacodus europæus* Teilhard 1927, *non Phenacodus europæus* Rütimeyer 1888, by the new name *Phenacodus teilhardi*. Rütimeyer's name was incorrect, as the animal was later found to be an artiodactyl and called *Meniscodon europæus*, but the homonymy nevertheless invalidates the later name according to the accepted codes of nomenclature. Teilhard recognized the homonymy, but did not consider it deterrent.

PLEURASPIDOTHERIUM AND ORTHASPIDOTHERIUM

The work of Teilhard (1921, pp. 37–47) leaves little further question as to the long disputed immediate affinities of *Pleuraspidotherium*. It seems to be a relative of the American Upper Paleocene and Lower Eocene *Meniscotherium*.

The dentition of *Pleuraspidotherium* seems, on the whole, more primitive than that of *Meniscotherium*. P_4 is molariform in both, but in *Pleuraspidotherium* it is less lophiodont and the trigonid and talonid are less separated externally. In the lower molars the trigonid and talonid are less equal in height and the ridge from metaconid to hypoconid is not so strong. As in *M. tapiacitis*, but not other species of *Meniscotherium*, the metastylid is weak or absent. In the upper molars, the external cusps are less selenodont, the mesostyle not so much produced or reflected, the pseudhypocone (apparently a displaced metaconule) less elongated internally, except on M^3, the protoconule somewhat smaller, and the secondary metaconule (a cuspule on the anterior limb of the pseudhypocone in *Meniscotherium*) very weak or absent. In *Meniscotherium* there is also a small, sharp cingular cusp anteroexternal to the protocone which is absent in the European genus. The general resemblance in the dentition is very striking, however, and no other similar pattern occurs in the Eocene.

On the humerus, the greater trochanter is smaller in *Pleuraspidotherium;* the entepicondyle is more slender and lacks the foramen,—a remarkable feature,—and the trochlea is more cylindrical, less deeply grooved and crested. The ilium is less curved, with a lower crest and less prominent rectus femoris origin. The femur is quite similar to that of *Meniscotherium*, but the lesser trochanter is more produced, less platelike, the third trochanter is more proximal and less prominent, and the patellar groove is shorter and wider.

Teilhard states on the authority of Matthew that on the astragalus of *Pleuraspidotherium* the trochlea is more deeply grooved, the internal crest stronger than in *Meniscotherium*. This is imperfectly substantiated by an astragalus in my possession, on which these differences are very slight. As in *Meniscotherium*, the trochlea is considerably shallower and the internal crest much lower than in *Phenacodus*, for example, and these features constitute a point of resemblance rather than of distinction. The arrangement of the inferior facets is typically condylarthran, very like *Phenacodus*. The typical development in *Meniscotherium* of the inferiointernal process of the body is exactly similar in *Pleuraspidotherium*. The greatest distinction lies in the presence in the latter genus

of a small astragalar foramen. In spite of this, I believe that the astragalus tends to support the suggested relationship. The Clark Fork *Meniscotherium* (?) *priscum* Granger may prove to be more nearly comparable with *Pleuraspidotherium* in structure, as it is in age, but it is very little known.

The case for *Orthaspidotherium* is by no means so clear. As Teilhard has fully shown, it is quite unlike any known American mammal. It also differs considerably from *Pleuraspidotherium* in many respects, but, no closer comparison offering, there is sufficient resemblance to warrant its tentative placing in the Meniscotheriidæ.

The broader relationships of these genera have also been much debated. The excellent American material requires thorough restudy in the light of the suggestion of Teilhard and others of relationship to the Hyracoidea. Schlosser's suggestion of relationship between *Meniscotherium* and the Perissodactyla, and between *Orthaspidotherium* and the Artiodactyla, is highly improbable.

TRICUSPIODON

The lower teeth of this genus were redescribed and carefully evaluated by Teilhard (1921, pp. 34–36), who concluded that the genus may be referred to the Periptychidæ in a distinctive subfamily. In 1920 (p. 118) Schlosser described an upper jaw, with two molars, which he made the type of a new species, *Arctocyonides lemoinei*. In a supplementary note (1921, p. 107) Teilhard suggested that this might represent the upper dentition of *Tricuspiodon*.

After studying the original of "*Arctocyonides lemoinei*," through the courtesy of Dr. Dietrich, I am inclined to believe with Teilhard that this belongs in *Tricuspiodon*. The essential characters of the genus are as follows:

P_{3-4} with triangular trigonids, paraconid and metaconid present, small one-cusped heels. Enamel smooth on all teeth. Trigonids of M_{2-3} with three cusps. Metaconid slightly larger than paraconid, protoconid larger than either. Metaconid and paraconid closely approximated. Heels simple, with small hypoconulid, posterior on M_3 but not forming a third lobe. M^2 without parastyle, hypocone moderate and directly posterior to protocone, protocone widely separated from paracone and metacone, which are external, equal, not crescentic. Relatively large proto- and metaconules. M^3 reduced, hypocone absent or vestigial, metacone much reduced, contour oval.

These characters are suggestive of the periptychids in the molarized premolars and some other details, but they clearly cut the genus off sharply from any recognized periptychid, and the upper molars, espe-

cially, are quite without the characteristic periptychid stamp. They are suggestive of the Mioclænidæ, which led Schlosser to place the genus in this family (1923), but the dentition as a whole, if correctly associated, certainly could not belong to a mioclænid. *Tricuspiodon* is probably an archaic ungulate, but it is not close to any other known genus and cannot be placed in any established family other than the Tricuspiodontidæ.

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