Bollettino della Società Paleontologica Italiana	40 (2), 2001	ISSN 0375-7633	209-215	—	Modena, Giugno 2001

Pleistocene Mammals from the Netherlands

Thijs VAN KOLFSCHOTEN
Faculty of Archaeology
Leiden University

KEY WORDS – Mammalian faunas, Fauna evolution, Pleistocene, The Netherlands.

ABSTRACT – The revival of the research of the Dutch Pleistocene mammalian record led to the discovery of new localities and new finds. Several new species, listed in this paper, could be added to the Dutch record. Re-investigation of the stratigraphical setting of part of the record resulted in new insights in the stratigraphical position of the old finds and the correlation between the mammalian biozonation and the Dutch Standard subdivision of the Pleistocene became more accurate. The transition of the Early Villafranchian to the Late Villafranchian took place during the early Tiglian. The beginning of the Biharian is correlated with the late Tiglian/early Eburonian and the Biharian ended before Interglacial IV of the Cromerian Complex.

RIASSUNTO – [Mammiferi pleistocenici dei Paesi Bassi] – *Le recenti ricerche sui mammiferi pleistocenici dei Paesi Bassi hanno portato alla scoperta di nuovi siti ed al recupero di nuovo materiale. Come esposto in questo articolo, molte nuove specie sono da aggiungere al record fossile olandese. La revisione dell'assetto stratigrafico di alcuni siti ha portato a idee nuove circa la posizione stratigrafica di ritrovamenti storici e la correlazione tra le biozonazioni a mammiferi; il risultato è quello di conoscere con più accuratezza la suddivisione del Pleistocene olandese. La transizione tra Villafranchiano inferiore e superiore è iniziata durante il Tigliano inferiore. L'inizio del Bihariano è correlato con la transizione tra Tigliano e Eburoniano; il Biharian termina prima dell'integlaciale IV del complesso Cromeriano.*

INTRODUCTION

The increase of interest of Palaeolithic archaeologists and of quaternary geologists in environmental and stratigraphical questions led, about two decades ago, to a revival of the research of the Dutch Pleistocene[1] mammalian record. This revival and the following increase of research activities led to the discovery of new localities and also to the discovery of several new species. A number of these species are new for the Netherlands, others are also new in a strict sense. Re-investigation of the stratigraphical setting of for instance the area around the Tegelen locality resulted also in new insights in the stratigraphical position of old finds.

The latest compilation of Villanyian and Biharian mammal faunas from the Netherlands, presenting old data as well as the preliminary results of the 'new' research activities, dates back to 1986 (Van Kolfschoten & Van der Meulen, 1986): an overview that has been preceded by earlier extensive, summarising issues written by Rutten (1909) and Van de Vlerk & Florschütz (1950). This paper presents a summary of the latest state of our knowledge of the Quaternary mammalian record of the Netherlands and the assumed stratigraphical position of the main faunas and/or finds.

[1] The Plio-Pleistocene boundary in the Dutch stratigraphical scheme still is at the transition of the Reuverian to the Praetiglian at about 2.4 Ma. This boundary, although incorrect according to the accepted definition, is also used in this paper.

THE PROVENANCE OF THE DUTCH PLEISTOCENE FOSSIL VERTEBRATES

Most of the Dutch Quaternary fossils in the depots of museums, institutes and not to forget, in the large number of private collections of amateur palaeontologists are either from the bottom of the North Sea, the Schelde Estuarine or from dredged sediments. Commercial dredging of sand and gravel, mainly of Holocene en Pleistocene age, takes place at several localities in particular along the main rivers in the Netherlands. Fossils from these deposits can be collected at places where the sediments have been dumped for example on the Maasvlakte, an artificial area west/southwest of Rotterdam on the North Sea coast. The fossil assemblages from these localities as well as from the North Sea are, however, mixed; Holocene, Late Pleistocene and even Early Pleistocene fossil remains might be found together. Using the differences in the degree of mineralisation of the bones, the palaeo-ecological indications and the stratigraphical information of the concerning species it is often possible to divide these mixed assemblages into different groups which are presumed to represent original fauna-associations. Conclusions about the stratigraphical age of these fauna-associations are based on our knowledge of the geological setting of the area where the sediments have been dredged and on our common knowledge of the stratigraphical range of the species represented in the associations. The information about the age of these assemblages might be less accurate than one

would prefer, but despite this deficiency the faunas give, because of the occasionally huge amount of remains, valuable information, for instance about the geographical range of a species. Investigation of these collections led in the past decade to the discovery of species, which are 'new' in the Dutch record.

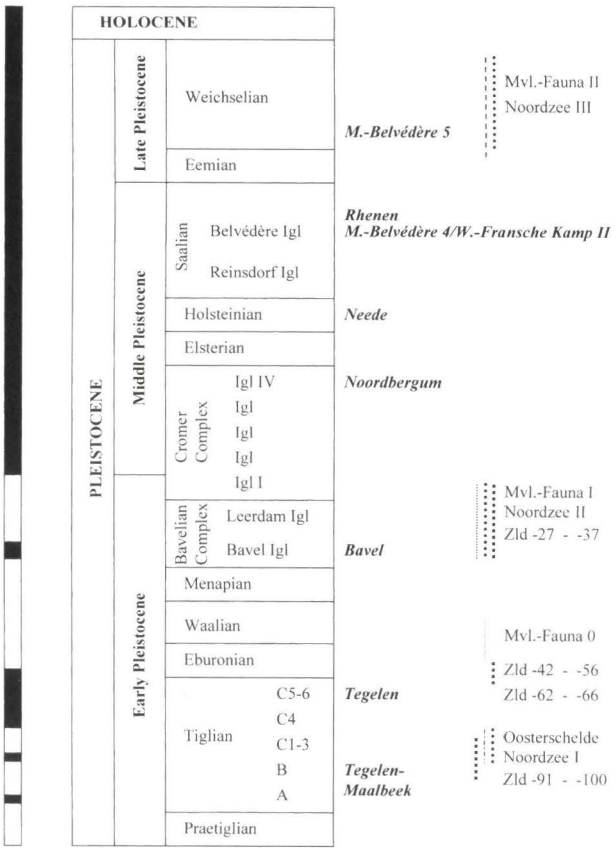
Not all the vertebrate fossil assemblages from the Netherlands are stratigraphically mixed. Most of the assemblages from the clay-, sand- and gravel pits in ice-pushed ridges in the central part of the country (e.g. Neede, Wageningen-Fransche Kamp, Rhenen), from loess- and gravel quarries in the southern part of the Netherlands (e.g. Maastricht-Belvédère) and from the clay pits in the southern part of the country (Bavel, Dorst) as well as along the Dutch-German border (Tegelen, Maalbeek) are 'clean'. The lithostratigraphical origin of the fauna is often clear; its age is a point of debate in some cases.

A third category of Pleistocene vertebrate fossils is formed by the remains from boreholes. Many boreholes yielded vertebrate remains; most of them only few. An exception are the Zuurland boreholes made by the amateur geologist Mr. L. W. Hordijk; boreholes which yielded, during the past decade, thousands of vertebrate remains. Investigation of the, mainly Early Pleistocene, remains resulted in new discoveries.

CHANGED INSIGHTS AND NEW DISCOVERIES

TEGELEN-MAALBEEK

The results of the new research activities in the area near Tegelen were presented and discussed at the 1996 SEQS-EuroMam symposium "The Dawn of the Quaternary" and were published two years later (Van Kolfschoten & Gibbard, 1998). Most remarkable was the new insight in the stratigraphical position of the finds from the clay pit Tegelen-Maalbeek. The claypit Maalbeek is well known amongst palaeontologists because of the discovery of the remains of a tapir and a mastodont. The upper and lower (pre)molars of the tapir *Tapirus arvernensis*, described and figured by Kortenbout van der Sluijs (1960), were found in 1930 in the southern part of the former pit at Maalbeek. The upper molar of the mastodont *Anancus arvernensis* was found in situ in 1960 in the pit Van Cleef, about 300 m due north of the locality where the tapir remains were discovered (Kortenbout van der Sluijs, 1960; Zagwijn, 1963). The mastodont molar and the tapir remains are, according to Kortenbout van der Sluijs (1960), from the same lithostratigraphical unit. Just as the other species recorded from the pit Van Cleef: *Mimomys* sp., *Dicerorhinus etruscus*, *Eucladoceros tegulensis*, *Cervus rhenanus* and *Leptobos* cf. *elatus*. Kortenbout van der Sluijs (1960) states that the occurrence of *Anancus arvernensis* and *Tapirus arvernensis*, which have never been found in the Tegelen pits, might



Text-fig. 1 - Stratigraphical position of the most important Pleistocene mammalian faunas from the Netherlands related to the Dutch chronostratigraphic subdivision of the Pleistocene. Bold and in italic the faunas of which the stratigraphical position is rather well known; the age of the other faunas is less well known, the range of the possible age is indicated.
(Zuurland .....; Noordzee .....;
Maasvlakte .....; Oosterschelde _._._._._).

point to a slightly different geological age; "... the Maalbeek clay is probably somewhat older than the Tegelen clay and may belong to the lower part of the Tiglian or even to the Praetiglian". The pollen spectrum obtained from a piece of clay adhering to the mastodont molar and the supposed geological setting of the area indicated, however, an early Eburonian age (Zagwijn, 1963). The age did not correspond with the established ideas about the stratigraphical range of both *Anancus arvernensis* and *Tapirus arvernensis* and the discrepancy lead to discussions about the contemporanity and the relevance of the 'Tegelen' fauna (Azzaroli *et al.*, 1988).

New exposures, additional palynological research and a reappraisal of the primary data result in alternative ideas about the stratigraphical age of the fauna from Maalbeek. The clay with the mastodont molar is now referred to as the Tiglian-B pollenzone. The tapir remains might be slightly older and are correlat-

	Zuurland -91 to -100 m.	Oosterschelde	Tegelen	Zuurland -62 to -66 m.	Maasvlakte Fauna 0	Zuurland -50 to -56 m.	Zuurland -42 to -46 m.	Zuurland -27 to -37 m.	Maasvlakte Fauna I	Neede	Maastricht-Belvédère 4	Wageningen-Franssche Kamp II	Rhenen (smaller mammal fauna)	Maastricht-Belvédère 5	Maasvlakte Fauna II
Erinaeus europaeus				sp.											
Erinaceus cf. *davidi*											+				
Sorex minutus	+		+	+		+	+				+				
Sorex araneus	sp.									cf.	+	+			
Sorex (D.) praearaneus			+	+	?	+	+		sp.						
Sorex (D.) savini								cf.							
Neomys fodiens											+		sp.		
Petenyia hungarica			+	+	?				+						
Crocidura sp.											+	+			
Beremendia fissidens			+	+			+								
Desmana thermalis	+		+	+	?		+		+						
Desmana moschata								+					+		
Galemys kormosi	+	+	+	+	?	+	+		sp.						
Talpa europaea			sp.				sp.				+		+	+	
Talpa minor				+											
Lepus europaeus															
Hypolagus sp.			+												
Ochotona pusilla															
Castor fiber			+												
Trogontherium cuvieri			+						+	+					
Eliomys quercinus											+	+			
Muscardinus avellanarius			cf.												
Sciurus vulgaris			cf.												
Spermophilus undulatus														cf.	cf.
Sicista subtilus															
Cricetus cricetus															
Cricetulus migratorius														+	
Dicrostonys torquatus														+	
Lemmus lemmus															
Clethrionomys kretzoi			+												
Clethrionomys glareolus										cf.	+	+	+		
Ungaromys dehmi			+												
Arvicola terrestris															
Arvicola terrestris cantiana										+					
Arvicola terrestris ssp. A											+	+			
Arvicola terrestris ssp. B													+	+	
Mimomys pliocaenicus		cf.	+												
Mimomys reidi			+		+										
Mimomys tigliensis		cf.	+		+										
Mimomys pitymyoides			+												
Mimomys savini									+						
Mimomys sp. (small species)									+						
Terricola subterraneus											cf.				
Microtus gregalis														+	
Microtus oeconomus											+			+	
Microtus arvalis															
Microtus agrestis											+	+			
M. arvalis and/or *M. agrestis*											+	+			
Apodemus sylvaticus			cf.							sp.	+	+			
Apodemus maastrichtiensis											+	+			
Micromys minutus			sp.												
Hystrix etrusca			cf.												

Tab. 1 - List of smaller mammals of the main Pleistocene faunas from the Netherlands.

	Oosterschelde	Noordzee I	Tegelen	Maasvlakte Fauna 0	Noordzee II	Maasvlakte Fauna I	Neede	Maastricht-Belvédère 4	Maastricht-Belvédère 5	Maasvlakte Fauna II	Noordzee III
Maccaca florentina			+								
Canis lupus											+
Ursus etruscus			+								
Ursus aff. *deningeri*						+					
Ursus spelaeus											+
Ursus arctos											+
Ursus sp.								+			
Enhydrictis ardea			+								
Martes martes											
Mustela palerminea			+								
Mustela nivalis								+			
Aonyx antiqua						+					
Crocuta crocuta spelaea										+	+
Hyaena perrieri	cf.		+								
Panthera leo spelaea										+	+
Panthera gombaszoegensis			+								
Lynx lynx						+					
Homotherium sp.	+										
Mammuthus primigenius									+	+	+
Mammuthus (A.) meridionalis	+	+	+		+	+					
Mammuthus trogontherii					+						
Palaeoloxodon antiquus										+	
Anancus arvernensis	+	+									
Equus bressanus					+						
Equus sp.	+					+	+	+	+	+	+
Equus hydruntinus											+
Dicerorhinos etruscus	cf.		+		+	+					
Stephanorhinus kirchbergensis							+				
Stephanorhinus hemitoechus								+			
Coelondonta antiquitatis									+	+	+
Sus strozzii	+		+								
Sus scrofa						+					
Hippopotamus major					+	+					
Eucladoceros tegulensis			+								
Eucladoceros ctenoides	+										
Eucladoceros sp.				+							
cf. *Megaloceros verticornis*						+					
Megaloceros sp.						+					
Megaloceros giganteus								+		+	+
Dama dama						+				+	
Cervus elaphus						+	+	+	+	+	
Cervus rhenanus	+		+								
Cervus sp.				+							
Alces cf. *gallicus*				+							
Alces latifrons					+	+					
Alces alces										+	
Rangifer tarandus									+	+	+
Capreolus capreolus								+			
Soergelia minor						+					
Leptobos elatus	sp.		cf.								
Bos taurus											
Bos primigenius										+	
Bison priscus										+	+
Bison menneri					cf.						
B. primigenius/B. priscus								+	+		
Praeovibos priscus					cf.	cf.					
Ovibos moschatus										+	+

Tab. 2 - List of larger mammals of the main Pleistocene faunas from the Netherlands.

ed to the Tiglian-A pollenzone. The new results indicate that the mammal fauna mentioned above is not younger but older than the fauna from the Tegelen pits. This model fits much better with the biostratigraphical data from localities in for example France and Italy. The presence of *Tapirus arvernensis* in particular indicates that the fauna should be correlated with the Early Villafranchian whereas the Tegelen larger mammal fauna corresponds better to the Late Villafranchian faunas (cf. Azzaroli, 1970).

Tegelen

A substantial part of the classical Tegelen fauna has been revised during the past two decades. Willemsen (1988) re-investigated the Mustelid remains and indicated the presence of *Mustela palerminea* and *Enhydrictis ardea*. The presence of *Pannonictis pliocaenica* in the Tegelen fauna, mentioned by Schreuder (1935) appeared to be based on a misidentification (Willemsen, 1988). Spaan (1992) studied the deer remains from the old Tegelen collection and concluded that only two species are represented; the large deer *Eucladoceros tegulensis* and the smaller one *Cervus rhenanus.* Biometrical studies showed, furthermore, that *Cervus philisi* and *Cervus perolensis* hardly differ from *Cervus rhenanus* and should be regarded as junior synonyms of the latter.

The rich smaller mammal assemblage from the Tegelen-Egypte clay pit, collected in 1970, has been investigated in detail by Reumer (1984) (the Soricidae), Rümke (1985) (the Desmaninae) and Tesakov (1998) (the voles). Alexey Tesakov (Moscow) studied the Tegelen voles in great detail and indicated the presence of six different voles: *Mimomys pliocaenicus, M. reidi, M. tigliensis, M. pitymyoides, Clethrionomys kretzoi* and *Ungaromys dehmi*. Tesakov concluded that the medium-sized hypsodont *Mimomys*, previously assigned to *Mimomys blanci* by Van Kolfschoten & Van der Meulen (1986), should be referred to as a new species *Mimomys tigliensis* (Tesakov, 1998). Based on the absence of *Microtus (Allophaiomys) deucalion* Tesakov (1998) assumes that the Tegelen fauna pre-dates the Olduvai Event. This conclusion is, however, still a subject for debate.

Zuurland

The amateur geologist Mr. L.W. Hordijk, who started his first deep borehole (Zuurland-1 with a final depth of 95.02 m) in 1980, continued his project and is now (October 2000) drilling his 7th borehole in the Zuurland polder, just south of the city of Brielle. Several fossiliferous horizons, alternated with sterile levels, have been found; the fossiliferous horizons yielded, in the past decades, thousands of vertebrate remains. Particular rich in mammalian remains are the levels –27 to 37 m, -42 to –46 m, -50 to –56 m, -62 to –66 m and -91 to –100 m. The first, preliminary review of the mammalian record from the boreholes Zuurland-1 and Zuurland-2 was published in 1988 (Van Kolfschoten, 1998). More thorough investigation of the vertebrate remains from the first two boreholes and of 'new' material from the following boreholes Zuurland-3 to Zuurland-7 led to a number of changes and additions:

- The larger *Mimomys* molars from the level –91 to –100 m are now assigned to *Mimomys praepliocaenicus*.
- Medium-sized voles from the levels – 62 to –66 m and from –91 m to –100m referred to as *Mimomys blanci* are, since the study of Tesakov (1998), referred to *Mimomys tigliensis*.
- A *Mimomys* species with a medium-sized hypsodont m1 characterised by a very prominent *Mimomys*-ridge, which continues to the base of the crown has been described as a new species *Mimomys hordijki* by Van Kolfschoten & Tesakov (1998). Molars of this new species came from level –62 to –66 m.
- The *Microtus (Allophaiomys)* molars from the levels –42 to –46 m and –50 to – 56 m show a negative enamel differentiation, low A/L and high B/W values and are therefore referred to as *Microtus (Allophaiomys) deucalion* (Van Kolfschoten, 1998).
- The list of Insectivores could also be extended; *Erinaceus* sp., *Sorex minutus, Beremendia fissidens* and *Petenyia hungarica* could be added.

Maasvlakte

Continuation of the investigation of the mammalian remains from the Maasvlakte led first of all to a further subdivision of the mixed faunal assemblage. Four different faunas instead of three (see Vervoort-Kerkhoff & Van Kolfschoten, 1988) have been determined. The discovery of *Mimomys reidi, Mimomys tigliensis* and *Alces* cf. *gallicus* indicated the presence of an additional group of species (Maasvlakte Fauna 0), a small fauna with an Early Pleistocene age. New in the species list of Fauna I are cf. *Megaloceros verticornis, Dama dama, Soergelia minor* and *Praeovibos* cf. *priscus* (Vervoort-Kerkhoff & Van Kolfschoten, 1999; Lister & Van Kolfschoten, in prep.). Especially the discovery of *Soergelia minor* is remarkable since this species is almost unknown in the Pleistocene fossil record in Europe.

Neede, Maastricht-Belvédère, Wageningen-Fransche Kamp, Rhenen

Faunas with a late Middle to early Holocene age have not been listed in the 1986 review and are therefore mentioned in this paper, although part of the faunal remains from these localities is not 'new'. The faunas from Neede, Maastricht-Belvédère, Wageningen-Fransche Kamp and Rhenen (Van Kolfschoten, 1981, 1985, 1991, 1993) show the faunal evolution

during the late Middle Pleistocene (the period postdating the Elsterian glaciation). During that particular period species such as *Talpa minor* and *Trogontherium cuvieri* became extinct. The molars of the Water Vole *Arvicola terrestris* show a rapid evolution during the late Middle Pleistocene; the most advanced populations, however, became locally extinct during the glacial phase at the end of the Saalian Stage. Less advanced populations that survived in southern or southeastern areas in Europe dispersed into Northwestern Europe during the following warm phase: the Eemian (Van Kolfschoten, 1990a).

More discoveries

Apart from the discoveries mentioned above there are a number of remarkable, new finds worth mentioning in this review. A revision of the large amount of (mainly Early or early Middle Pleistocene) vertebrate remains from old boreholes also led to the discovery of new data. The Asperen borehole has yielded a molar of *Mimomys stranzendorfensis* in deposits that are dated as Tiglian TC4 (Van Kolfschoten *in* Gibbard *et al.*, 1991). From about the same period or slightly older dates the oldest record of a lemming referred to as the genus *Lemmus*, found in a borehole at Eindhoven (Van Kolfschoten, 1988). Of stratigraphical importance is the discovery of molars assigned to the genus *Arvicola* in a borehole near Noordbergum located in the northern part of the Netherlands. The remains came from interglacial deposits that pre-date the Elsterian glaciation and are referred to Interglacial IV of the Cromerian Complex (Van Kolfschoten, 1990b).

Clay deposits from a pit near Bavel yielded a molar of *Microtus (Allophaiomys) pliocaenicus.* The deposits date to the Bavelian Interglacial, the earliest interglacial of the Bavalian Stage. The molar predates the Bavelian fauna, characterised by the co-occurrence of *Mimomys savini* and *Microtus arvalis*, with a late Bavalian s.l. age just as the larger mammal remains from Dorst with *Mammuthus (Archidiskodon) meridionalis* and cf. *Eucladoceros sedgwicki* (Van Kolfschoten, 1990a).

Another remarkable find with about the same age as the finds from Bavel and Dorst or maybe slightly younger is a fragment of a mandible of *Gulo schlosseri* from Nieuwegein, a village south of Utrecht where a former sand and gravel pit is located (Van Kolfschoten, in prep.). The dredged sediments contained a mixed vertebrate fauna; most of the fossils have a Late Pleistocene or Holocene age. The occurrence of *Trogontherium cuvieri*, *Mammuthus (Archidiskodon) meridionalis* and *Stephanorhinus* cf. *etruscus* indicate the presence of early Middle or even Early Pleistocene assemblage including *Gulo schlosseri*.

The rhinoceros-remains from Westerhoven, a locality in the southern part of the Netherlands, south of Eindhoven, were studied by M. Fortelius, P. Mazza and B. Sala. The investigators concluded that the "small-sized rhinoceros from Westerhoven has characters which are similar to those from Pietrafitta and Pirro" and they belong to the "group of small-sized forms with *Stephanorhinus etruscus – St. hundsheimensis* affinities" (Fortelius *et al.*, 1993). The fossil remains date from the early Cromerian; they are from the type-locality of Interglacial II of the Dutch Cromerian Complex.

One of the most recent discoveries is a fragment of a horncore assigned to *Bubalus murrensis.* The horncore is found in sediments dredged at Netterden, a small village in the valley of the River Rhine not far from the Dutch–German border. The find with, most probably, an Eemian age, is so far the most western record in Europe (Van Dam *et al.*, 1997).

Summarising conclusions

The Pleistocene fossil record from the Netherlands has been extended drastically during the past two decades. Not only has our knowledge of the Pleistocene fauna been enlarged due to the increase of the number of species but also the correlation between the mammalian biozonation and the Dutch Standard Subdivision of the Pleistocene has become more accurate due to the new discoveries. For example, it is obvious now that the transition of the Early Villafranchian to the Late Villafranchian takes place during the Early Tiglian. The chronostratigraphical position of the Biharian (a biozone characterised by the dominance of *Microtus* and the absence of *Arvicola*) is also clearer nowadays although there are still problems to be solved. The oldest *Microtus (Allophaiomys)* remains, indicating the base of the Biharian, come from the Zuurland boreholes from deposits with a depth between –50 and – 56 m. The remains are correlated with the Eburonian although the age of the deposits has not yet been satisfactorily determined and is still a subject for debate. The latest *Microtus (Allophaiomys)* record marking the end of the Early Biharian dates from the Bavel Interglacial, the earliest warm phase of the Bavelian Complex. The occurrence of molars of the genus *Arvicola* in a borehole near Noordbergum in interglacial deposits with a pre-Elsterian age (Van Kolfschoten, 1990b) indicates that the Late Biharian ends before Interglacial IV of the Cromerian Complex.

Not only is our knowledge of the Dutch Pleistocene mammalian record increasing but also that of the Pleistocene climatic history. The marine isotope record showed a much more complex history that hardly matches with the climatic history as reflected in the Dutch Standard Subdivision of the Pleistocene. Future research will lead to a re-evaluation of the Dutch Standard and hence to a re-evaluation of the stratigraphical position of the faunas and finds mentioned above. This will result in an even

more accurate correlation between the mammalian biozonation and the chronostratigraphical subdivision of the Pleistocene.

ACKNOWLEDGEMENTS

The author would like to thank Mr. L. W. Hordijk (Brielle) and Mrs. A. Kerkhoff-van Grondelle for their permission to study their important fossil mammalian collections from respectively the Zuurland boreholes and from the Maasvlakte. Olga Yates improved the English text.

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(manuscript received November 7, 2000
accepted February 2, 2001)

Thijs VAN KOLFSCHOTEN

Faculty of Archaeology, Leiden University
P.O. Box 9515, 2300 RA Leiden, The Netherlands