

A preliminary note on the cervids from Bilzingsleben

Jan van der Made, Madrid

With 8 Figures and 4 Plates

Abstract

Three cervids are found in the Middle Pleistocene of Bilzingsleben, in order of abundance *Cervus elaphus*, *Dama dama clactoniana* and *Capreolus* cf. *suessenbornensis*.

A comparison of samples of different ages in Germany and Spain suggests that the evolution of the three lineages did not follow a similar pattern, but evolution of the same lineage in Spain and Germany may have been synchronous. Size changes do not seem to be primarily caused by climate or geography.

Introduction

Since the early eighteenth century fossils from the locality of Bilzingsleben are mentioned in the literature and since the early nineteenth century also human remains (U. MANIA, 1997). The locality became well known and annual excavations since 1969 by D. Mania yielded a huge collection of fossil animals and plants and artifacts. A series of volumes on the locality, «Bilzingsleben I-IV, published in the Veröffentlichungen des Landesmuseums für Vorgeschichte in Halle and volume V, published by the Friedrich-Schiller-Universität Jena, as well as various other publications (MANIA, 1990; VLCEK, 1978, 1986) describe aspects of palaeoanthropology, palaeontology, archaeology, geology etc. However, there is still no palaeontological study on the Cervidae, which are the most abundant large mammals from Bilzingsleben.

A small part of the cervid collection has been studied. It is one of the final aims to assign as much material as possible to the different species, which has to serve as a basis for other studies, such as, for instance, taphonomy. It is another aim to know which species the fossils represent, and which place they occupy in their respective evolutive lineages and to compare them to other samples of other parts of Europe in order to study possible geographical variation. This paper gives some preliminary results.

Collections

The fossils from Bilzingsleben were compared with fossils from other localities and with remains of recent deer. When reference to material is made either the bibliography or the institute where I studied the material is cited. Abbreviations of the institutes are as following.

EBD	Estación Biológica de la Doñana, Sevilla.
FBFSUJB	Forschungsstelle Bilzingsleben, Friedrich-Schiller-Universität Jena, Bilzingsleben.
IQW	Institut für Quartärpaläontologie, Weimar.
LAUT	Laboratori de Arqueologia de la Universitat Rovira i Virgili, Tarragona.
MB	Museo de Burgos.
MCP	Musée Crozatier, Le Puy-en-Velay.
MNCN	Museo Nacional de Ciencias Naturales, Madrid
UCM	Universidad Complutense, Madrid.

Systematics

Family Cervidae Gray, 1821

Subfamily Odocoilinae

Capreolus aff. *suessenbornensis* Kahlke, 1956

Plate 1, figures 2-5; Plate 2, figure 4; Plate 4, figure 2.

Brief description and comparison

A very small number of bones and teeth of cervid morphology can be easily separated from the other deer material from Bilzingsleben; it is much smaller (triangles in Figures 1 and 2) and the teeth have a different morphology. The lower molars have the fossids open towards postero-lingual (Pl. 1, figs. 2c, 4a; Pl. 4, fig. 2a). This morphology is common in the Odocoilinae, whereas the Cervinae, have the fossids closed (Pl. 4, fig. 4). The Odocoilinae include the European Pleistocene and recent genera *Alces* (of gigantic size), *Rangifer* (of intermediate size) and *Capreolus* (of small size). The small size of the remains from Bilzingsleben indicates they belong to *Capreolus*.

Discussion

Two species of *Capreolus* are currently recognized in Europe, the small living species *C. capreolus* and the larger fossil species *C. suessenbornensis*. The large species *C. pyrgarus* lives in Asia north of the Himalayas and there is a large species from the Pliocene from the same area, *C. constantini*. (VISLOBOKOVA et al., 1995). Large European *Capreolus* is described from Untermassfeld, Voigtstedt, Süssenborn and other localities (KAHLKE, 1965, 1969, 1997) and a smaller *Capreolus* that was assigned to *C. capreolus* was described from Taubach (KAHLKE, 1976). Figures 3 and 4 give the sizes of M₁ and astragalus and metatarsals of these *Capreolus*. It appears that size decreased more or less gradually. Taubach has small astragali, but still has large teeth, which are clearly larger than those of the recent sample. The astragalus from Bilzingsleben is intermediate in size between those from Taubach and Süssenborn and the teeth are fully comparable in size to those from Süssenborn. The *Capreolus* fossils from Bilzingsleben are assigned to *C. aff. suessenbornensis*

Subfamily Cervinae Gray, 1821

Dama dama clactoniana (Falconer, 1868)

Plate 1, figure 1; Plate 2, figures 1-3; Plate 3, figure 1; Plate 4, figure 3.

Description and comparison

Among the large number of antlers, there are few antlers with the morphology of *Dama*: bifurcation brow tine-main beam low, angle between brow tine and main beam great, no bez tine, smooth surface, rose with more regular pearling etc. (Pl. 3, fig. 1) There are no distal fragments of antlers that show palmation.

Figure 1 gives bivariate plots of some of the lower cervid cheek teeth from Bilzingsleben. For the third molars (M_3), the width of the first and second lobe (DTa and DTp respectively) are plotted, since these values are less variable than occlusal length (which is affected by wear) and basal length (which is more difficult to measure in a consistent way than the width). For the premolars ($P_{2,4}$) the occlusal length (DAP) and the maximal width (DT) is plotted. The different graphs show each a large cluster of large specimens (dots) and some smaller specimens (crosses) and the graph for the M_3 shows also the *Capreolus* specimens (triangles), which are much smaller. Save for the remains of the latter genus the teeth have a cervine morphology. The size distribution of the bones (Figure 2) gives a similar result: there are two size groups with a similar morphology (in addition to the very small *Capreolus*). The separation in size seems to be better in the bones than in the teeth.

For two reasons the smaller bones and teeth are believed to belong to *Dama*: *Cervus*, which is the other deer, is found often in the same locality as *Dama* and is always the larger species, and the proportion of large versus small bones and teeth is similar to the proportion of antlers assigned to *Cervus* and *Dama* respectively.

Not enough material from *Dama* has been measured to know the extend of variation of this form in Bilzingsleben. A larger set of measurements may reveal that both forms overlap in size and that some specimens cannot be determined on the basis of size alone. (Specimens which now cluster with *Cervus*, may turn out to be in the overlap zone.) Comparisons with other samples are of limited help; both genera experienced great changes in size in time.

Discussion

There are different views on the evolution of *Dama*. Some consider that *Dama clactoniana* is a different species that was sympatric and coeval with *Dama dama* (for instance Di Stefano, 1995). Others believe that *Dama dama clactoniana* is a subspecies that evolved into the living subspecies *Dama dama dama* (LEONARDI & PETRONIO, 1986; LISTER, 1986). The clacton deer is up to 20 % larger than the living fallow deer and does not have a well developed palmation of the distal part of the antler (LEONARDI & PETRONIO, 1976).

As with the transition of the clacton deer to the fallow deer, there are also problems with the earliest *Dama*. *Dama*-like deer were already present in Europe during the late Pliocene. Azzaroli placed them first in the genus *Dama*, but later thought they were not related and created the genus *Pseudodama* for these species (AZZAROLI, 1953, 1992).

The *Dama*-like deer show gradual changes through time towards the antler morphology of the living fallow deer: the antlers became more inclined backwards, flared out more, the angle

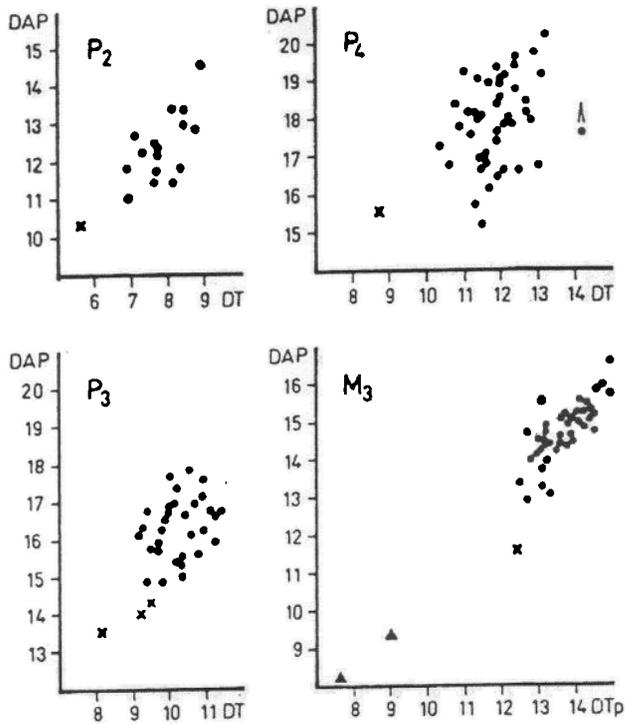


Figure 1

*Bivariate plots of the lower cheek teeth from Bilzingsleben. For the premolars, maximum length (DAP) versus maximum width (DT). For the third molar, width of the first lobe (DTu) versus width of the second lobe (DTp). Triangles = *Capreolus*, crosses = *Dama*, dots = *Cervus*. An arrow indicates that in a particular case the maximum value could not be measured. Measurements in mm.*

between the brow tine and beam became greater, the bifurcation of the brow tine and beam moved towards the burr (Figure 6) and at a late stage in evolution, palmation started to develop. There were fluctuations in size (Figure 5): the early Middle Pleistocene *Dama* became larger and from some 200 ka ago they became small again. These morphological and metrical changes seem to have been gradual; my data do not indicate ruptures and do not suggest more than one species at a time, nor do they suggest that one species is suddenly replaced by another species. With these data, a single lineage model seems best. I place the small late Early and early Middle Pleistocene forms in *Dama dama vallonensis*, the large middle Middle Pleistocene forms in *Dama dama clactoniana* and the small late Middle Pleistocene till recent forms in *Dama dama dama* (VAN DER MADE, in prep. a & b). The basal antler morphology and the large size of the deer from Bilzingsleben is consistent with an assignation to *Dama dama clactoniana*. It seems that the population is smaller than the maximum size attained by the subspecies. This might be an artifact.

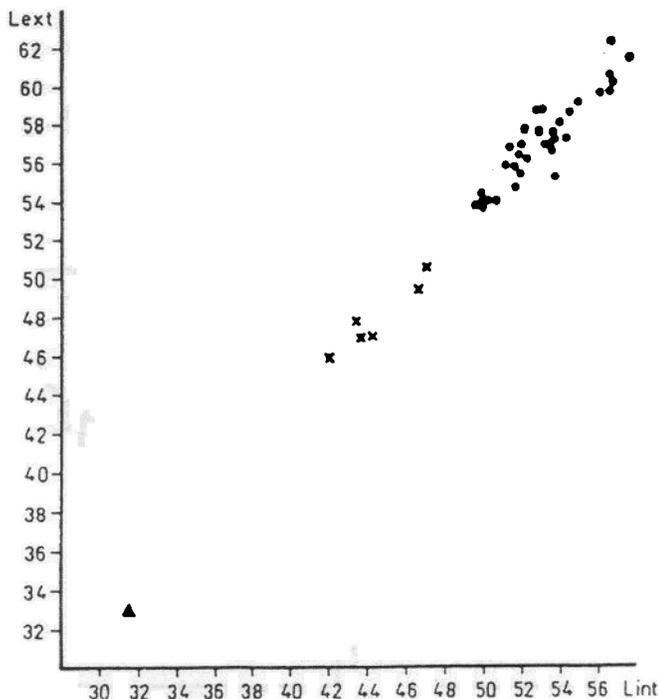


Figure 2
 Bivariate plot of the astragalus of the cervids from Bilzingsleben. External length (Lext) versus internal length (Lint). Triangles = *Capreolus*, crosses = *Dama*, dots = *Cervus*. Measurements in mm.

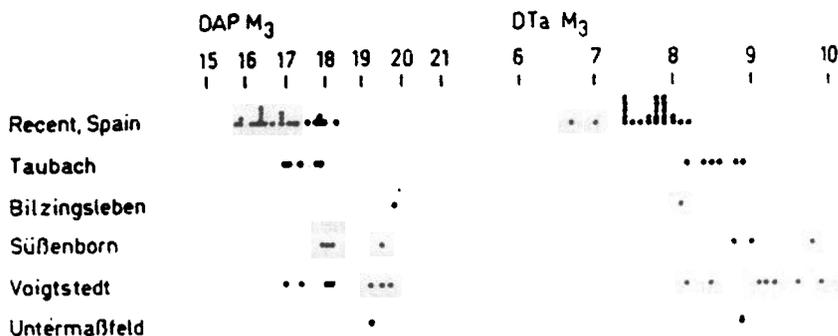


Figure 3
 Variation in the length (DAP) and width of the first lobe (DTa) in third lower molar of *Capreolus*. The localities are arranged in approximate order from old to young: Untermaßfeld (IQW), Voigtstedt (IQW), Süßenborn (IQW), Bilzingsleben, Taubach (IQW), Spain (MNCN). Females are under represented in the sample from Spain, resulting in a bias towards larger sizes. Measurements in mm.

Though, Figure 2 suggests that the postcranial skeleton of the two species can be separated better than the cheek teeth, the assignation on the basis of size is not quite satisfactory. When the number of remains studied increases, the separation in two size groups may appear less clear. A number of studies mention morphological differences between *Dama dama* and *Cervus elaphus* (which is the larger species). The most thorough study is by Lister (1996), who compared bones and teeth of *Cervus elaphus* from about 200 ka till recent and *Dama dama* from the last interglacial to recent. Both species differ in many morphological characters, but in no case in this study, all *Cervus* had the typical «*Cervus* morphology» and all *Dama* the typical «*Dama* morphology». There were always some specimens with the «wrong» morphology. This probably reflects the fact that the two species diverged a relatively short time ago; though in any case more than 1 million years ago. Fossils of the two genera of some 350,000 years ago are likely to present even less and less clear morphological differences, than the recent species and a fully reliable assignation of the remains from Bilzingsleben to species may prove to be beyond the possibilities.

Cervus elaphus Linnaeus, 1758

Plate 3, figure 2; Plate 4, figures 1 & 4.

Brief description and comparison

Most of the cervid material from Bilzingsleben belongs to a deer of intermediate to large size, with antlers that frequently present a bez tine (Pl. 4, fig. 1) and with teeth with a typical cervine morphology: the fossids of the lower molars are posterolingually closed (Pl. 4, fig. 4), whereas the odocoiline morphology is with open fossids (Pl. 1, figs. 2 & 4; Pl. 4, fig. 2). Besides there are important differences in premolar morphology. These characters are typical of *Cervus*.

The distal part of the antler is represented by a great number of specimens, including many specimens with a «coronate» morphology. The earliest true *Cervus* in Europe had antlers with all tines in one plane. The later *Cervus* had «coronate» antlers, the distal tines are not in the same plane, but have different directions. Some palaeontologists place the earlier forms in a different species, *Cervus acroronatus* (for instance, KAHLKE, 1965), but others consider it to be a subspecies of *Cervus elaphus* (for instance LISTER, 1990). Kahlke (1960, 1995) recognized still another species «*Cervus elaphoides*» (= «*Cervus reichenau*»), but Lister (1990) was of the opinion the remains belong to *Cervus elaphus*. The remains under discussion are small and seem to be acoronate.

Discussion

The morphology of antlers and teeth indicates the material should be attributed to *Cervus elaphus*. Coronate *Cervus elaphus* is cited from deposits younger than 350000 years (FAURE & GUÉRIN, 1992). Bilzingsleben should be one of the oldest localities with coronate *Cervus*. Acoronate antlers still occur in recent populations. It is likely that coronate antlers gradually became more abundant in the populations, and the age given for the appearance of coronate antlers, would be considered to be a rough indication.

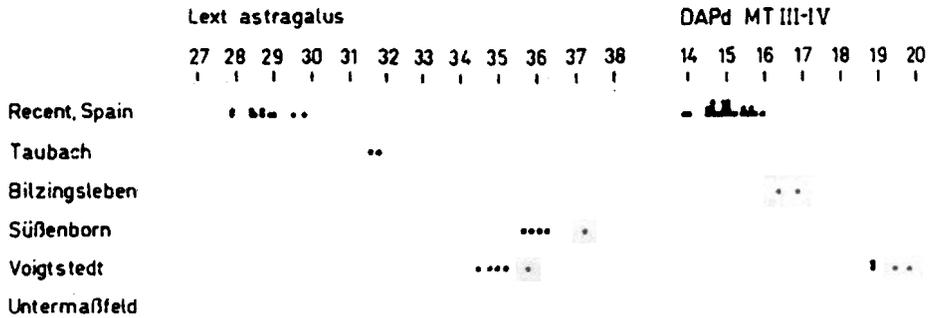


Figure 4

Variation in the length of the astragalus (*Lext*) and anteroposterior diameter of the distal roller of the metatarsals (*DAPd*) of *Capreolus*. The values for the MT III tend to be larger than those for the MT IV. Since frequently it is not known for the fossils whether the specimen is a fragment of a third or fourth metatarsal, both values are plotted. The localities are arranged in approximate order from old to young: Untermaßfeld (IQW), Voigtstedt (IQW), Süßenborn (IQW), Bilzingsleben, Taubach (IQW), Spain (MNCN). Females are under represented in the sample from Spain, resulting in a bias towards larger sizes. For the larger value for Bilzingsleben, the remaining morphology does not allow to know whether it is a remain of a metacarpal or a metatarsal, but since metacarpals tend to have smaller values than metatarsals, it is assumed the specimen is a metatarsal. Measurements in mm.

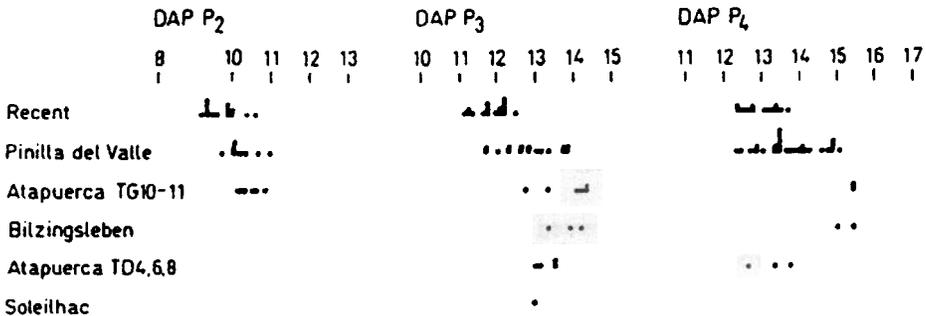


Figure 5

Variation in length (*DAP*) of the lower premolars of *Dama* through time. The localities are in approximate order from old to young: Soleilhac (MCP), Atapuerca TD4-8 (MB, MNCN, LAUT), Bilzingsleben (FBFSUJB), Atapuerca TG10-11 (MB), Pinilla del Valle (UCM), Recent Spain (EBD, MNCN).

Nearly all cheek teeth are isolated, which presents an additional problem for the lower first and second molars (M_1 and M_2), which have a very similar morphology and differ very little in size. It is likely that the M_2 had a relatively higher crown, but nearly all specimens are worn. It is also possible that the M_2 has relatively thicker enamel (VAN DER MADE, 1996). But the theme has not been studied for deer and moreover, enamel thickness is very small in deer and difficult to measure, so that measurements with a vernier calliper will result in artificially high variation of the measurements.



Figure 6

The height of the bifurcation of the brow tine and main beam above the burr, measured at the external side (Hext) as a percentage of the basal length of the antler, measured just above the burr (DAPb): $100H_{ext}/DAP_b$, in *Dama*. The localities are in approximate order from old to young: Soleilhac (MCP), Atapuerca TD4-8 (MB, MNCN, LAUT), Bilzingsleben (FBFSUJB), Atapuerca TG10-11 (MB), Pinilla del Valle (UCM), Recent Spain (EBD, MNCN).

Figure 7 shows the measurements of the $M_{1/2}$ from Bilzingsleben and of some recent *Cervus* from Spain and *Dama* from Spain and Austria. From the figure it appears that M_1 have relatively wider second lobes than the M_2 , but there is no clear separation. It is also clear that *Dama* and *Cervus* have a considerable overlap, though this need not have been the case during the Pleistocene. This method will not lead to a reliable assignation of the material. In a similar case, multivariate analysis using the (small) set of standard measurements did not yield results. Of most isolated $M_{1/2}$ from Bilzingsleben it will not be possible to say which species or which element they represent, though most specimens are likely to belong to *Cervus* and the molars that are usually more frequent in collections are the M_2 .

Figure 8 shows the occlusal length (DAP) of the third and fourth lower premolar in a series of samples of *Cervus*. The samples are in approximate stratigraphical order. Cueva de la Paloma, Cueto de la Mina and Cueva Morin have various levels (BERNALDO DE QUIROS GUIDOTTI, 1982), which are taken together here.

Recent *Cervus* are small, although the figure might give an exaggerated impression, since males are underrepresented. The small size of the recent *Cervus* was widely known already (WALVIUS, 1961). GRANDAL D'ANGLADE & LÓPEZ GONZÁLEZ (1997) reported on a locality with large and small *Cervus* (without giving the measurements); the small specimens being dated >38 ka and the large ones either between 37 and 38 ka or >38 ka. They cited a number of studies that attribute small sizes to warm conditions and large sizes to cold conditions or that suppose the coexistence of large and small forms.

The large specimens from Neumark Nord and Taubach suggest that interglacial conditions do not necessarily lead to small size in *Cervus*. Recent *Cervus* seems to be smaller than in any of the Pleistocene samples. There are several Late or late Middle Pleistocene samples and nearly all have *Cervus* of extremely large size. This suggests that large size was typical of that whole time span, both in Spain and in Germany. The slightly older Middle Pleistocene samples are small both in Germany and in Spain.

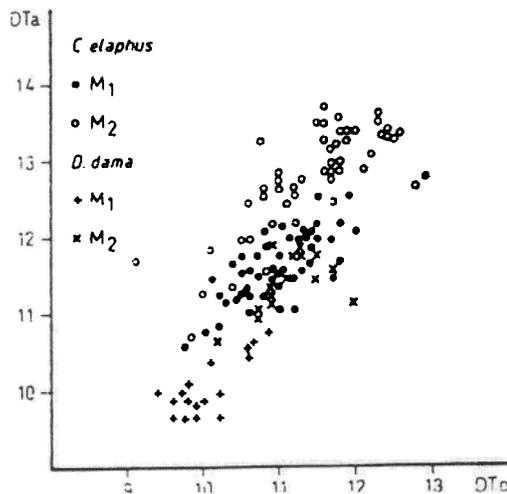
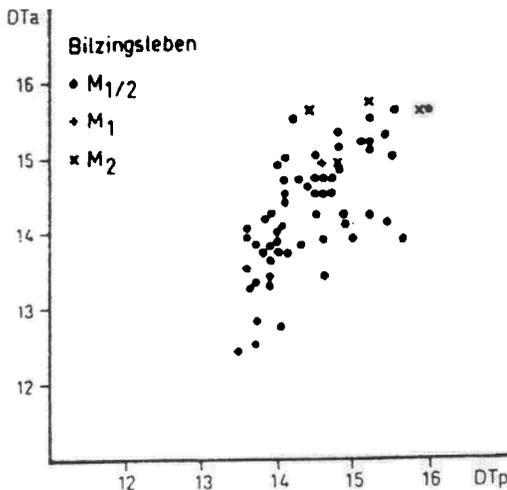


Figure 7

Bivariate plots of the first and second lower molars of the larger deer from Bilzingsleben (FBFSUJB). Width of the first lobe (DTa) versus width of the second lobe (DTp).

The upper figure gives the teeth from Bilzingsleben; dots = isolated teeth, either M_1 or M_2 , cross = M_1 in tooth row, oblique cross = M_2 in tooth row.

The lower figure gives the teeth of recent *Cervus elaphus* (MNCN) and *Dama dama* from Spain (EBD, MNCN). All teeth in tooth rows and thus all positions known. Dots = M_1 of *Cervus elaphus*, circles = M_2 of *Cervus elaphus*, crosses = M_1 of *Dama dama*, oblique crosses = M_2 of *Dama dama*. Measurements in mm.

Conclusions

There are three cervids in Bilzingsleben: *Capreolus* aff. *suessenbornensis*, *Dama dama clactoniana* and *Cervus elaphus*. The last species is the most abundant, the others are relatively rare. It is of importance for other studies that as much material as possible is assigned to species and that all anatomical parts can be determined. However, this will not be possible with a high level of confidence for all specimens.

There are changes in size in the different lineages of cervids. Though limited in number, the samples studied suggest that changes within each lineage occurred more or less at the same moment in Spain and Germany: *C. elaphus* in Bilzingsleben and Atapuerca TG10-11 has about the same size, whereas later red deer in Spain and Germany have larger maximum sizes and recent deer is small again in Spain, as well as in northern Europe. The samples studied

suggest also, that size changes in the different lineages did not follow a similar pattern. In *Capreolus* there seems to be a mere decrease in size, whereas *Cervus* and *Dama* fluctuated in size during the same period. *Dama* (smaller in Neumark Nord than in Atapuerca TG10-11) may have reached a maximum size at another moment than *Cervus* (very large in Neumark Nord, larger than in TG10-11). The number of samples studied should be increased, in order to see whether the apparent patterns are real patterns. If these patterns are real, they suggest that body size in cervids is not primarily controlled by climate (large red deer in Neumark Nord in interglacial environment), nor by geographical distribution (populations with large and others with small body size both in Germany and Spain). The apparent synchronous changes in body size suggest that no important isolation existed between Spanish and centro European populations.

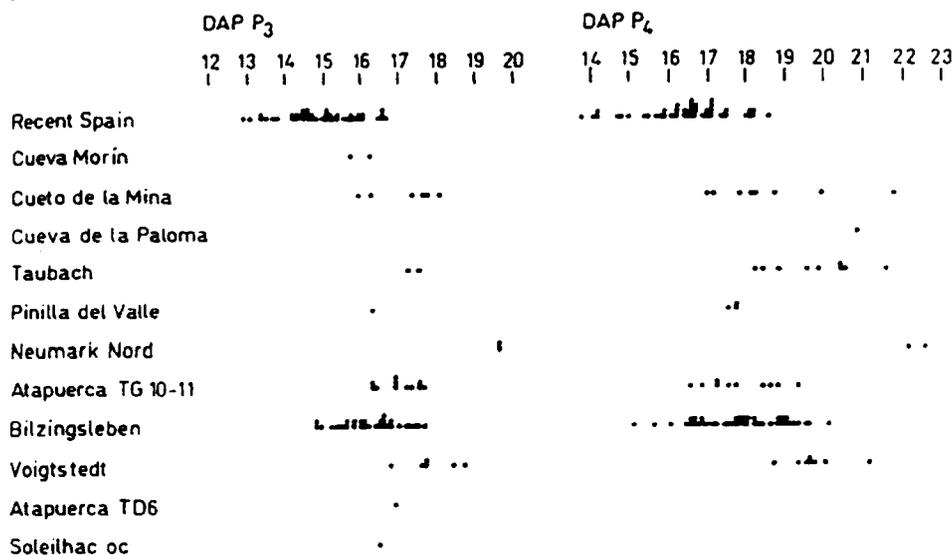


Figure 8

Variation in length (DAP) of the third and fourth lower premolars through time in *Cervus elaphus*. The localities are in approximate order from old to young: Soleilhac oc (= old collections; MCP). Atapuerca TD6 (temporarily in MNCN). Voigtstedt (IQW). Bilzingsleben (FBFSUJB). Atapuerca TG10-11 (MB). Neumark Nord (FBFSUJB). Pinilla del Valle (UCM). Taubach (IQW). Cueva de la Paloma (MNCN). Cueto de la Mina (MNCN). Cueva Morin (MNCN). Recent Spain (MNCN). Measurements in mm.

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J. van der Made

Museo Nacional de Ciencias Naturales

c. José Gutiérrez Abascal 2

28006 Madrid, España.

Figures and Plates: J. v. d. Made

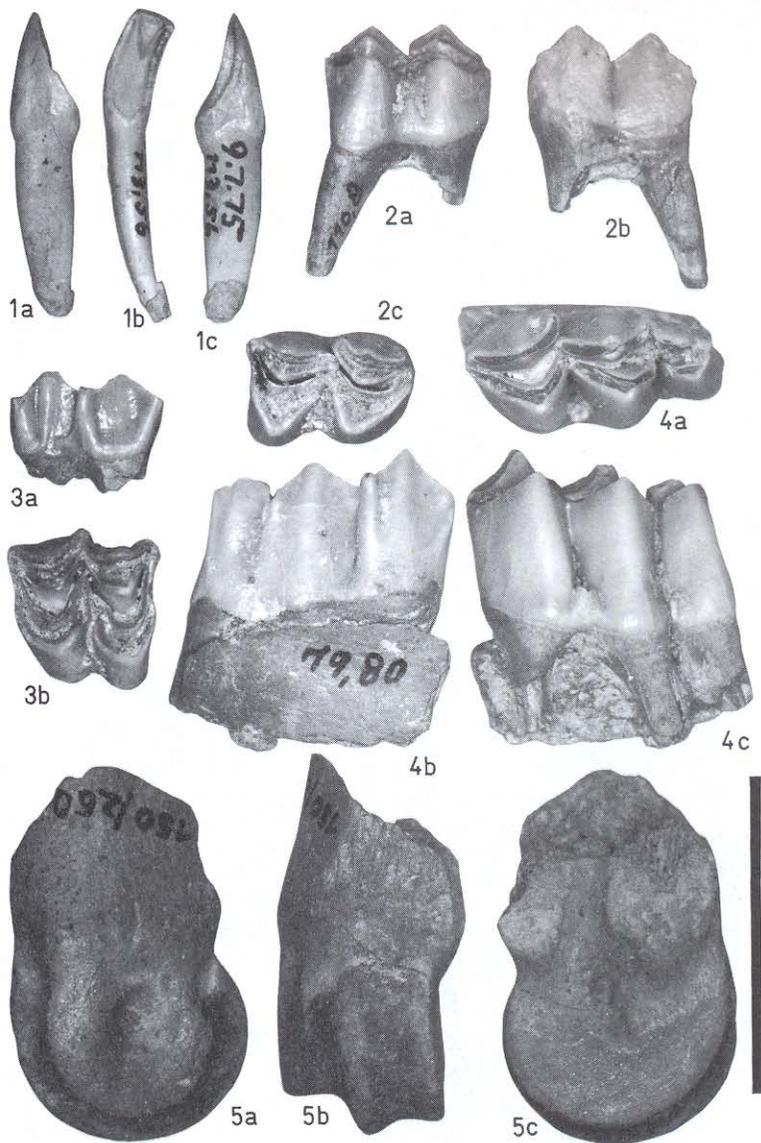


Plate I

Dama dama clactoniana from Bilzingsleben.

1) 113/56, right I_3 ; a) mesial, b) lingual, and c) distal views.

Capreolus cf. *suessenbornensis* from Bilzingsleben.

2) 110/8, right M_2 ; a) buccal, b) lingual, and c) occlusal views.

3) 113/54, right $M^{1/2}$; a) buccal, and b) occlusal views.

4) 79/80, left M_3 ; a) occlusal, b) lingual, and c) buccal views.

5) 150/260, distal pulley of the metatarsal; a) external, b) anterior, and c) internal views.

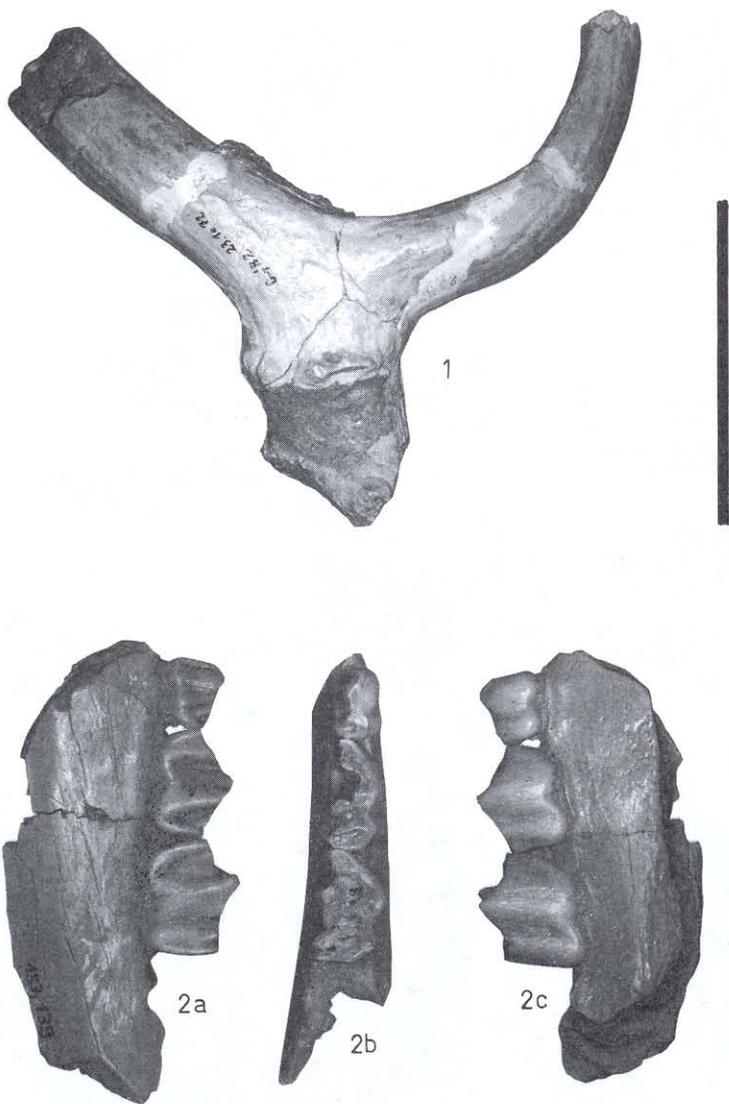


Plate 2

Dama dama clactoniana from Bilzingsleben.

1) 99/24, right M^3 ; a) buccal, and b) occlusal views.

2) 99/55, left P_4 ; a) occlusal, b) lingual, and c) buccal views.

3) 43/4, left P_4 ; a) occlusal, b) lingual, and c) buccal views.

Capreolus cf. *suessenbornensis* from Bilzingsleben.

4) 79/56, right astragalus; a) anterior, and b) posterior views.

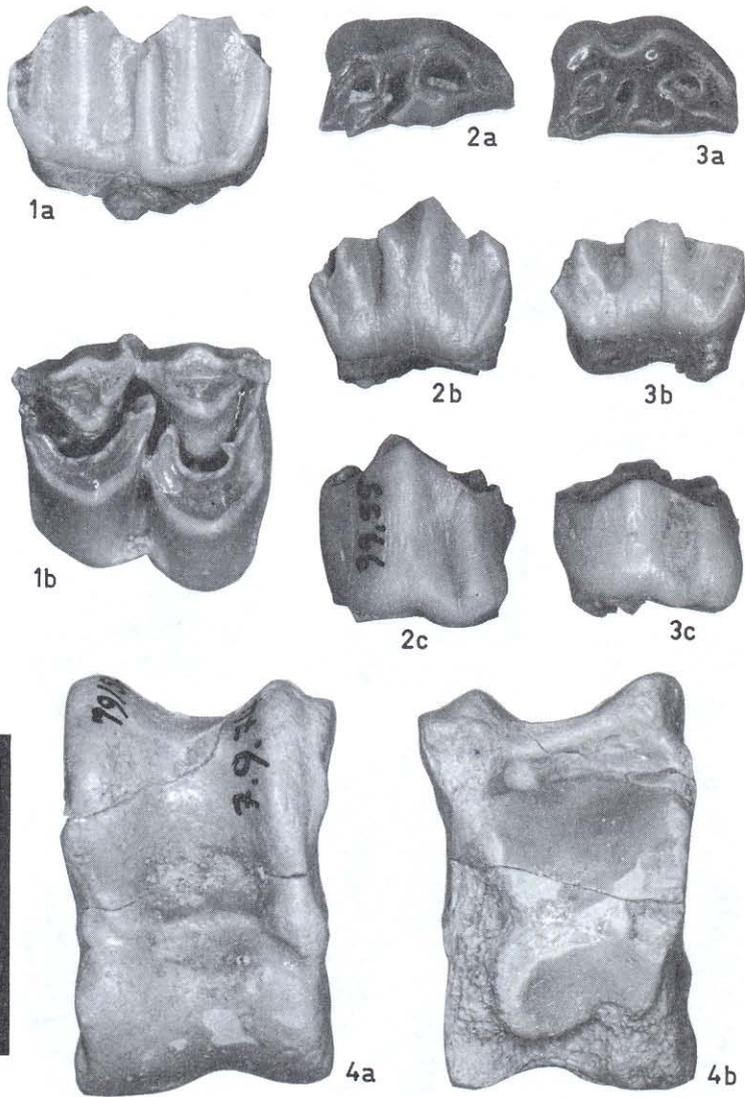


Plate 3

Dama dama clactoniana from Bilzingsleben.

1) 83B/2, left antler; internal view.

Cervus elphus from Bilzingsleben.

2) 157/139, right mandible with $P_{2,4}$; a) lingual, b) occlusal, and c) buccal views.

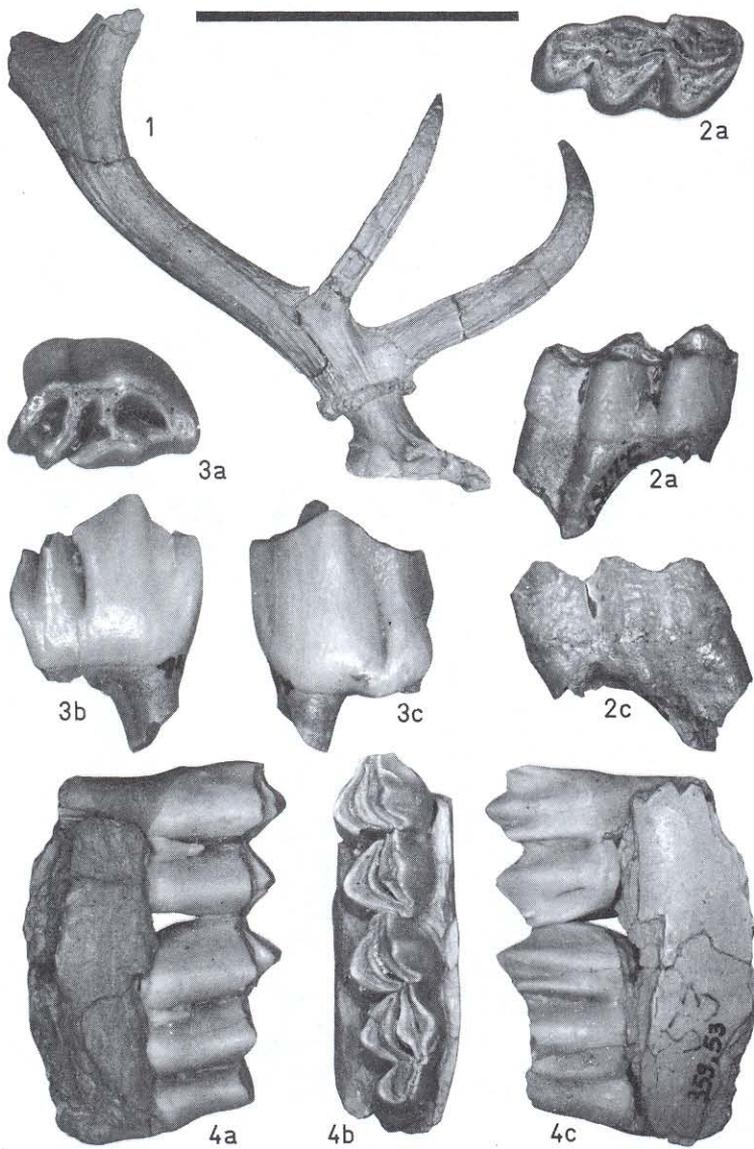


Plate 4

Cervus elphus from Bilzingsleben.

1) 228/47, right antler; external view.

4) 359/53 left mandible with $M_{2,3}$; a) buccal, b) occlusal, and c) lingual views.

Capreolus cf. *suessenbornensis* from Bilzingsleben.

2) 113/55, right M_3 ; a) occlusal, b) buccal, and c) lingual views.

Dama dama clactoniana from Bilzingsleben.

3) 142/64, left P_4 ; a) occlusal, b) lingual, and c) buccal views.