

## Fossil Giraffidae from the Marāgheh area, N.W. Iran

By DIRK PIETER BOSSCHA ERDBRINK\*)

With 2 text figures and plate 7

### Abstract

Description of fossil Giraffid remains collected at four Turolian localities to the East of Marāgheh, N. W. Iran, in 1973. The recovered specimens are attributed to three different species: *Palaeotragus coelophrys* (RODLER & WEITHOFER, 1890) BOHLIN, 1926; *Helladotherium duvernoyi* (GAUDRY & LARTET, 1856) GAUDRY, 1860; and *Samotherium boissieri* FORSYTH MAJOR, 1888.

### Résumé

Des dents et des os de Girafidés fossiles, trouvés en 1973 à quatre endroits fossilifères tuoliennes à l'Est de Marāgheh en Iran, sont décrits comme appartenant à trois espèces : *Palaeotragus coelophrys* (RODLER & WEITHOFER, 1890) BOHLIN, 1926; *Helladotherium duvernoyi* (GAUDRY & LARTET, 1856) GAUDRY, 1860; et *Samotherium boissieri* FORSYTH MAJOR, 1888.

### Kurzfassung

Beschreibung von den im Jahre 1973 an vier verschiedenen Lokalitäten, östlich von Marāgheh, Iran, gefundenen Überresten von Giraffidae. Sie werden drei Spezies zugeschrieben: *Palaeotragus coelophrys* (RODLER & WEITHOFER, 1890) BOHLIN, 1926, *Helladotherium duvernoyi* (GAUDRY & LARTET, 1856) GAUDRY, 1860 und *Samotherium boissieri* FORSYTH MAJOR, 1888. Das Alter der Ablagerungen an den vier Fundstellen ist das Turolium.

---

\*) Dr. D. P. BOSSCHA ERDBRINK, Laboratorium voor Zoölogische Oecologie en Taxonomie der Rijksuniversiteit Utrecht, Plompetorengracht 9—11, 3512 CA Utrecht, the Netherlands.

## Introduction

Among the material collected between August and November, 1973, at four out of a number of localities to the East of the town of Marāgheh in N. W. Iran by a party consisting of Dr. N. SCHMIDT-KITTLER, of the Institute for Paleontology and historical Geology of Munich University, Mr. S. A. P. L. CLOETINGH of the Vening Meinesz Laboratory for Geophysical Research of Utrecht University, and the author, some 24 items, remains of 22 to 16 individual specimens, have been identified as fossil Giraffidae. These were collected in addition to other Giraffid material from two more localities, Aliābād and Mordaq, in the same area. This has already been described in two previous papers (BOSSCHA ERDBRINK, 1976 a and b): *Decennatherium crusafonti*, from presumably Vallesian deposits with an age of approximately 12.5 Ma, and *Samotherium mongoliense nowruzi*, having a still older, probably Aragonian (upper Vindobonian) age.

The remains described in the present paper have been recovered at a locality known to our party as K 2, not far North of a bridle path between the villages of Kerjābād (= Kirdjava) and Qartāvol (= Gartaul) and just to the West of the watershed between the two valleys containing each village; at another locality nearby, K 1, just East of the same watershed and also North of the bridle path; at a locality approximately 2 km N. of the village of Aliābād (= Aliawa), locally called Gūzgūnēh (indicated by the letter G in figure 1a in BOSSCHA ERDBRINK et al., 1976) in the upper part of a gully system probably near a locality where DE MECQUENEM collected prior to 1908, indicated on his "Carte des Gisements de Vertébrés" in his 1908 paper as Sou You Dere, i. e. the valley of the brook; and at a locality near the village of Shoylavand (= Chollövend), as an isolated find in red tuff containing lapilli and (at its base) round stones having a diameter of 4 cm. As can be checked on the compound stratigraphical columns, figure 2 in the cited 1976 paper by BOSSCHA ERDBRINK et al., three of the four localities (K 2, Gūzgūnēh, Shoylavand) may be considered as stratigraphically contemporaneous, while K 1 lies somewhat higher and is therefore slightly younger. Above the level with the fossils of K 1, at the watershed between K 1 and K 2, lies our party's paleomagnetic site III. Potassium-Argon absolute dating has provided an age of  $8.7 \pm 0.4$  Ma for the samples from this site, which moreover proved to be of reversed magnetic polarity. As a result this age is further restricted at between 8.4 and 8.7 Ma (see table I and figure 5 in BOSSCHA ERDBRINK et al., 1976). It follows from this that the fossils described in the present paper are necessarily slightly older. Those from the locality K 1 may be of nearly the same age as the trachytic breccia of site III, being situated only slightly lower, but the fossils from the other three, still appreciably lower localities may well have an estimated age nearer to 9.0 Ma. This would make them approximately contemporaneous with the fossils from the Samos 1—4 units (amongst which are the finds from the Samos quarry 1 site, having an age lying between  $8.9 \pm 0.9$  Ma and  $8.0 \pm 0.8$  Ma) according to VAN COUVERING and MILLER (1971) and, as is usually inferred from faunal comparisons only, also with "the" fauna from Pikermi.

The complete material forms part of the Bavarian State collection for Paleontology and historical Geology at Munich; the numbering system prevalent in that collection has therefore been followed.

In an earlier paper (BOSSCHA ERDBRINK, 1977) I have advanced a number of



arguments for the identification of the two species *Samotherium neumayri*, described from Marāgheh, and *S. sinense* with the original species from Samos, *Samotherium boissieri* FORSYTH MAJOR, 1888. Large, intermediate and (relatively) small individuals of this animal are known to occur together at many of the (Turolian) fossil localities where they have been collected. If such a procedure is felt to be necessary, one might designate the large variety as the sub species *sinense*, the intermediate one as the sub species *neumayri* and the small form as the sub species *boissieri*. Likewise, the identity is argued of the Turolian *Helladotherium* from Marāgheh, described by De Mecquenem as the species *gaudryi*, with the original form known from Pikermi, *Helladotherium duvernoyi* (GAUDRY & LARTET, 1856) GAUDRY, 1860, as well as with *H. grande* (PILGRIM, 1911) from the Salt Range in Pakistan. The relatively large Turolian *Palaeotragus coelophrys* (RODLER & WEITHOFER, 1890) BOHLIN, 1926, from Marāgheh and from a large number of other localities is considered by me to be a good species, distinct from its contemporary the smaller *P. rouenii* GAUDRY, 1861, from Pikermi and from a number of other, also exclusively westerly localities.

## Description and identification

Nine items comprise dental material, which will be treated first:

1973 XXI 59 from the locality K 2 is a  $M_3$  dexter in the very first stage of wear, which has recently lost half of its third posterior lobe while the roots are wanting also due to recent damage. The brownish-grey enamel is finely wrinkled all over. Fairly clear traces of a basal cingulum are present along the lingual side, the front of the molar and at the vestibular base of the anterior lobe (i. e. at the base of the anterior crescent, the protoconid, when the nomenclature used by PATTON, 1969, is followed). In the valley between this protoconid and the hypoconid two accessorial conulids have developed, probably out of the cingulum. These rise up to about a quarter of the height of the neighbouring conids. Behind the hypoconid, in the valley separating it from the third, largely broken-off lobe, another conulid rises up to nearly the same height. Very indistinct traces of the cingulum around the base of the hypoconulid can rather be felt by touching the enamel, than seen. Apart from the median ribs on the lingual sides of the crests (the metaconid and the entoconid), which are not very pronounced, these sides are rather flat. The metaconid stands slightly obliquely in front of the entoconid, giving rise to what is termed in German a "Kulissenstellung". This feature is repeated by the entoconid with respect to the posterior, or third lobe.

Although there exist decided differences, such as the larger size of the specimen from Marāgheh, one cannot but agree that there is a certain likeness with the  $M_3$  of the stratigraphically older *Giraffokeryx punjabiensis* from Chinji (see PILGRIM, 1911, Pl. I, fig. 4: the specimen Ind. Mus. No B. 493). This, and its size, already constitute sufficient arguments to assign 1973 XXI 59 to the Turolian *Palaeotragus coelophrys* (RODLER & WEITHOFER, 1890) BOHLIN, 1926, known to occur in the Marāgheh area. The measurements of the molar, even the height of its enamel, agree very well with the data given by BOHLIN (1926, p. 30) for a number of individuals of *P. cf. coelophrys*.



Another fossil from locality K 2, numbered 1973 XXI 61, is an isolated P<sup>3</sup>dexter, complete but for its two vestibular roots, which have broken off, the single lingual root being present. Its dark grey enamel is finely wrinkled. A barely perceptible cingulum surrounds the whole tooth, which is practically unworn. A curious enamel enclosure is to be seen at the postero-internal side of the occlusal surface, corresponding with the hypocone. This resembles a similar feature in the P<sup>3</sup> of *Helladotherium grande* from Dhok Pathan, Ind. Mus. No. B. 512, pictured by PILGRIM (op. cit.) on Pl. III, figs. 2 and 2 a. As there, and also in the case of the (smaller, having the size of the presently described fossil) *Palaeotragus cf. coelophrys*, ex D (from lok. 70 in Shansi?) pictured by BOHLIN (1926, Pl. II, figs. 1 and 2), the space between crescent and crest is deeply excavated, true dentine apparently being absent. The weak single vertical rib on the vestibular side of the crest is not symmetrically placed: it stands at about one third of the total length of the premolar from the anterior end. A similar situation exists, almost exactly repeated, in the P<sup>3</sup>dexter of an otherwise slightly different, and stratigraphically somewhat older, *Palaeotragus* sp. from Hostalets de Pierola in Spain, as pictured by CRUSAFONT (1952, Pl. XVIII, figs. 1, 1 a and 1 b). Its size together with the described morphological particularity are sufficient for an identification as *Palaeotragus coelophrys* (RODLER & WEITHOFER, 1890) BOHLIN, 1926.

1973 XXI 60, also from K 2, is most probably the posterior half of a M<sup>2</sup> (or, less likely, a M<sup>1</sup>) dexter, having dark grey enamel which is finely to moderately wrinkled. The tooth is moderately worn and has therefore belonged to an adult individual of medium age at the time of death. Faint traces of a very indistinct cingulum are barely discernible at the external and internal bases of the half molar. A number of warts, pustulate conules, are developed from this basal cingulum along the anterior lingual base of the posterior crescent (hypocone) where it has originally formed one side of the median lingual valley. The central rib on the vestibular side of the posterior crest (metacone) is only weakly developed, less strongly than the posterior and anterior vertical flanges bordering this same crest on its vestibular side. Part of the posterior enamel wall between posterior crest and crescent has recently broken away, while the two roots of this posterior half molar have also been lost. The space between crest and crescent, when seen occlusally, is deep and open, there being no filling of dentine or cement. This space has an open connection on its anterior side with the now absent anterior half of the molar, where posterior crest and crescent do not join each other. The two are connected at the posterior side of the tooth.

---

Fig. 1: a. internal, and e. external face of 1973 XXI 62: os malleolare dexter of *Samotherium boissieri sinense* from K 2. — b. proximal articular, c. anterior, and i. posterior aspects of 1973 XXI 51: astragale dexter of *Samotherium boissieri sinense* (perhaps the same individual as 1973 XXI 62) from K 2. — d. upper (cranial side towards upper margin of plate), and f. anterior aspects of 1973 XXI 48: atlas of *Samotherium boissieri sinense* from K 2. — g. upper (cranial side towards upper margin of plate), and h. anterior aspects of 1973 XXI 49: atlas of *Palaeotragus coelophrys* from K 2.





There is a marked resemblance with the posterior halves of  $M^1$  and  $M^2$  of the *Helladotherium grande* depicted in Pilgrim's already cited paper on Pl. III, figs. 1 and 1 a, although no definite traces remain of the more or less characteristic thickening of the enamel ridge on the posterior slope of the hypocone, when viewed occlusally, because it is this part of the enamel wall in the K 2 fossil which has partly broken off. These morphological considerations, together with the measurable dimensions of this half molar, point towards an identification of the item as *Helladotherium duvernoyi* (GAUDRY & LARTET, 1856) GAUDRY, 1860.

1973 XXI 58 is an item consisting of an almost complete  $P_3$  sinister, from which only half of the posterior root is absent owing to recent damage. It was collected at K 2. The premolar sits in a fragment of its mandibula composed of the tabula externa; thus the roots are visible from the lingual side. The tip of the posterior root of the otherwise absent  $P_2$  is still present. The bone and the enamel are greyish brown, while the enamel of the tooth is very finely wrinkled. A narrow and fairly deep excavation starts in the occlusal surface at a point near the anterior conid (paraconid), runs in a posterior direction separating proto- and metaconid, and opens outward lingually between meta- and entoconid. Behind the main cuspid of the entoconid a very small transverse excavation, also opening up lingually, has caused the formation of an accessory cuspid behind the entoconid. A cement-filled vertical fold forms a more or less distinct border on the vestibular side between protoconid and hypoconid. A small stylid at the anterior lingual side of the premolar forms the antero-internal corner. There are no traces of a basal cingulum. The tooth is only moderately worn. It has belonged to a young but adult individual.

In a morphological sense there are resemblances with the  $P_3$  of *Palaeotragus microdon*, *P. cf. coelophrys* and "*P. decipiens*" as figured by BOHLIN (1926, Pl. III, figs. 3—5 and Pl. IV, fig. 8), but also with the  $P_3$  dexter of *Samotherium cf. neumayri* pictured there in textfig. 58. The size of this element almost matches that of the presently described fossil. Most resemblances, however, lie with the  $P_3$  described by RODLER & WEITHOFER (1890) as belonging to *Alcicephalus neumayri* from Marāgheh (op. cit., pp. 759-760 and Pl. III, figs. 3 and 4); the main difference being the lesser degree of wrinkling of the enamel in the fossil collected in 1973. I do not hesitate to ascribe this item to *Samotherium boissieri* FORSYTH MAJOR, 1888.

1973 XXI 69, from Shoylavand, and 1973 XXI 85, from Güzgünēh, both being  $DP_4$ , will be described here together. The first find, still in a mandibular fragment (with parts of the internal and external tabulae) is practically complete. Only the inner (lingual) half of the most anterior of the three lobes of this  $DP_4$  dexter has recently broken off. The colour of the bone and of the moderately wrinkled enamel is greyish white, mottled with black. There are no traces of a basal cingulum and in the two external valleys between the three lobes only minute swellings tend to indicate a propensity to form accessory tubercles near the base. The tooth is somewhat less than half-worn. When seen from below no traces can be seen of a presence of an unerupted permanent  $P_4$  still in the jaw. Viewed occlusally, the "mark" between crescent and crest of the posterior lobe stands open lingually at the back of the tooth. Each of the lingual vertical enamel borders of the three lobes slightly overlaps the next one to the back, again causing the



already mentioned “Kulissenstellung”. This deciduous molar very nearly is a copy of the DP<sub>4</sub> of *Alcicephalus neumayri* pictured by RODLER & WEITHOFER (1890, Pl. III, figs. 5 and 6), having almost the same size, and also of the same tooth of *Samotherium sinense* figured by BOHLIN (1926, Pl. VII, fig. 3).

These morphological points are matched by those discernible in 1973 XXI 85, a DP<sub>4</sub>sinister. This entirely unworn tooth, having a greyish brown colour and moderately wrinkled enamel, is complete but without its roots. There probably have been a single root in front, one or two roots under the central lobe, and two combined roots under the posterior lobe. Again, no traces of a basal cingulum exist, but here an accessory tubercle in the posterior valley on the lingual side of the tooth is clearly developed and another one, in the anterior valley, is at least indicated.

Possibly, even probably, belonging to the same individual from Güzgünēh, because of the exactly identical state of preservation, is 1973 XXI 84, a small fragment (mainly tabula interna, but also a little bit of the external table) of mandible containing an unerupted M<sub>2</sub> (or perhaps M<sub>1</sub>) sinister. Comparison with Pl. III, fig. 1 in RODLER & WEITHOFER (1890) shows the great resemblance of this fossil with the M<sub>2</sub> of *Alcicephalus neumayri*. The enamel is moderately to finely wrinkled, and it has the same colour of 1973 XXI 85. The lingual enamel walls of its two lobes are again arranged in a “Kulissenstellung”. No traces of a basal cingulum can be observed (but part of the hinder side of the posterior lobe has broken off).

1973 XXI 86 is a large fragment of a much worn M<sup>1</sup>sinister, which must have belonged to an old individual. What is left of the enamel has a greyish brown colour, while the occlusal dentine surfaces and the roots are somewhat darker. The enamel of this tooth from Güzgünēh is finely wrinkled. The molar has possessed four roots, but only the postero-internal one now remains; the other three have broken off due to recent damage. This has also caused the disappearance of the antero-internal corner of the tooth and of its entire vestibular portion. Only the two moderately deep excavations between crescents and crests, and the posterior crescent (the hypocone) have been preserved in their entirety. So has the valley between anterior and posterior crescent, which has only barely escaped being worn down totally. What is left of this molar very much resembles the M<sup>1</sup>sinister in the maxilla of *Alcicephalus neumayri* pictured by RODLER & WEITHOFER (op. cit., Pl. II, fig. 2) although there the figured individual has a much less worn dentition. In neither case traces of basal cingula appear to exist.

The last dental fragment to be described here, 1973 XXI 87, also from Güzgünēh, consists of the nearly entire external (vestibular) enamel wall, together with the distal and postero-internal corner, of a P<sup>4</sup>sinister without any traces of wear. The rest of the tooth, except for a fragment of the posterior root, has recently broken off. The enamel has a greyish brown colour and is finely wrinkled. The form of this fragment, and the amount of projection of the median and the two lateral ribs on the external wall, very much conform to that of the P<sup>4</sup> of *Alcicephalus neumayri* pictured on Pl. II, figs. 1 and 2 in the cited paper by RODLER & WEITHOFER.

It will be clear that the items 1973 XXI 69, 84, 85, 86 and 87 have to be identified as belonging to *Samotherium boissieri* FORSYTH MAJOR, 1888.

The following table contains the measurements taken from the described dental elements, which have been indicated by their last catalogue number only (for the sake of brevity the prefix 1973 XXI has been omitted).

Table 1. Measurements of teeth in millimetres.

	P <sup>3</sup> d, 61	P <sup>4</sup> s, 87	M <sup>1</sup> s, 86	M <sup>2</sup> d, 60	DP <sup>4</sup> d, 69	DP <sup>4</sup> s, 85	P <sup>3</sup> s, 58	M <sup>2</sup> s, 84	M <sup>3</sup> d, 59
max. length	26.3	26.3	39.1	44.4 (=2x 22.2)	41.3	47.8	26.7	45.8	37.8
max. width, ant. 1.	—	—	—	—	13.7	14.5	—	± 13.2	18.0
max. width, p. lobe	—	—	38.2	—	19.1	19.1	—	13.4	12.0
max. width, cent. 1.	—	—	—	—	18.5	19.4	—	—	22.7
max. width	26.2	21.7	—	38.7	—	—	20.4	—	—
enamel height	28.0	31.2	10.3*	27.1*	21.4*	24.6*	24.5	39.0	25.0

\* = measured over posterior lobe, vertically

Among the postcranial remains of Giraffidae from the Marāgheh area, a pair of first cervical vertebrae from the locality K 2, showing an almost identical state of preservation and having a dirty white colour with small brown and black spots, strike one immediately by their difference in size and in morphological features. The largest of the two is 1973 XXI 48. The atlas is slightly damaged while it has suffered some postmortal deformation, possibly prior to its fossilization. The left half of the vertebra has been slightly compressed and at the same time it appears to have somewhat shifted in a caudal direction. The edges of both alae and the left lower side of the caudal edge have been lost long ago, perhaps even before fossilization. Likewise, the outer edge of the articulation for the left occipital condyle shows certain curious attrition marks, when compared with the outer edge of the cup for the right condyle, which is somewhat more complete. Very probably these are to be explained as ancient gnawing marks made by some carnivore. On the ventral side of the vertebra, the ventral tubercle, a feature occupying a position as far posterior as in the recent *Giraffa*, has recently broken off.

The hypothetical central axis to be projected sagittally through the main neural canal forms a very sharp angle with the theoretical plane horizontally bisecting the centres of the left and right condylar articulations. The value of this angle lies between 20 and 30 degrees. The caudal face of the vertebra forms a nearly flat plane from which the pronounced axial articulations jut out caudally, separated by a relatively broad non-articular area. A strong ridge inside the neural canal indicates the limit to which the odontoid process of the axis has penetrated, a feature also present in *Giraffa*. The anterior margin of the neural arch, seen from above, is squarely and deeply emarginate while its posterior (or caudal) margin is only very superficially scalloped in the mesial sagittal region. Again, gnawing



marks can be seen immediately to the left of this last-mentioned area. The anterior ventral edge of the atlas is deeply emarginate with a small extra concavity at its (sagittal) centre. There is no trace of a keel or spine there, the base of the already mentioned ventral tubercle starting to rise from the surface slightly more caudally. The posterior ventral margin is straight but for the (missing) alar projections to the right and left. The atlantic fossa is shallow and broad on each side and contains an alar foramen near its outer edge, approximately at equal distances (6.5 cm) from the ventral mesial base for the tubercle and from the posterior and anterior edges of the vertebra in front of and to the back of these foramina. On the dorsal surface an elongate but not strongly pronounced tubercle, bounded in front by a sharp but shallow keel, can be observed in the mesial plane. To each side of this keel an oval deep concavity contains the exits of the alar and the intervertebral foramina, as in *Giraffa*.

The second of the two fossil vertebrae from K 2, numbered 1973 XXI 49, is the smaller one of the two and also somewhat more complete. It has apparently not suffered postmortal deformation and only minor recent damage. The ventral tubercle is placed as much posteriorly as in no. 48, but here it has broken off and so have the extremities of the caudal alar projections on each side. The value of the angle between the axis of the neural canal and the plane through the condylar articulations in a horizontal direction, is markedly higher in this specimen, indicating that the animal held its head at a different angle relative to its neck compared with the specimen of number 48. Here its value may be estimated at some 45 degrees. Other differences are: a far more pronounced dorsal tubercle in the mesial line of the dorsal surface, which is formed as a double keel or spine in front of this tubercle and ending at the point of the deep V-like emargination of the anterior margin of the neural arch; very little non-articular distance between the articulations for the axis at the caudal face of the atlas, while, inside the neural canal, the anterior margin of the area once occupied by the odontoid process of the axis is only slightly less strongly marked by a ridge in comparison with no. 48; relatively deeper atlantic fossae with alar foramina opening there, on the ventral surface, into these at their anterior (cranial) distal margins; far broader bony bridgelike separations between the exits of the alar and intervertebral foramina into common oval concavities on the dorsal surface, again at about equal distances to the mesial dorsal spine and to the anterior and posterior edges of the vertebra (some 4.5 cm). These bony bridges lie sunken in the oval hollows. The anterior ventral emargination of this atlas copies that of no. 48, and here also no traces exist of a keel or spine in front. The posterior ventral margin is nearly straight to very shallowly concave (because of the caudal alar projections).

In the following table some measurements of the two collected specimens are compared with measurements taken from papers by CHURCHER (1970), whom I have largely followed, BOHLIN (1926, pp. 56—57) and the well-known work by GAUDRY (1862—1867, pp. 253—258).

The first apparent conclusion to be gathered from this table is the fact that the two animals to which these atlases belonged, although mutually different both in a morphological sense, as well as in absolute size, have been considerably larger than the early, Vindobonian, precursors at Fort Ternan, and they even equalled and surpassed the Chinese *Samotherium* which is usually considered to be a very large representative of its genus. It is a pity that only so very little fossil atlases

Table 2. Comparison of measurements of first cervical vertebrae collected at locality K 2 with data from literature.

	No. 48	No. 49	<i>H. du-</i> <i>ver-</i> <i>noyi</i> (2 sp.)	<i>S. sin-</i> <i>ense</i>	<i>S. emi-</i> <i>nens</i>	<i>Pal.</i> <i>prima-</i> <i>evus</i>	<i>S. a-</i> <i>fri-</i> <i>canum</i>
Transv. width, cranial side	+ 170	132	—	144	120	102	120—130
Transv. width, caudal side	+ 136	134.5	+ 129	—	—	108.7	118—149
Max. prox./distal length	130	+ 130	115	± 102	85	+ 85	110—120
Prox./dist. length over facets(?)	123(?)	87(?)	—	—	—	75	83—87
Transv. width over condyl. facets	150	111.5	135	—	—	78.8	78—85
Dorsoventr. depth of same	68.5	51	—	—	—	31.3	35—36
Dorsoventr. height over arches	+ 110.5	+ 96	—	—	—	52.6	63—66
Transv. width of axial facets	129	98	—	—	—	70.4	75—80
Dorsoventr. depth of same	65.5	53	—	—	—	34.1	41—44
Length in midventral line	63	54	—	64	—	42.1	57—58
Transv. diam. of neural canal, cranially	60.5	56.5	—	—	—	34.6	38—47
Dorsoventral diameter of same	40.5	39.5	—	—	—	21.8	25—27
Transv. diam. of neural canal, caudally	67.5	49.5	—	—	—	33.2	35—39
Dorsoventral diameter of same	56	48	—	—	—	± 32.3	32—36

In this table the data for *Samotherium africanum*, taken from CHURCHER, p. 77, table XX, have been compiled by me from three specimens while the figures given there have been rounded off because only the gaining of a general impression is envisaged. In the figures for *Samotherium sinense* and *S. eminens*, taken from Bohlin, only figures giving a „transverse width“, without stating whether this is meant cranial or caudal, are obtainable.

have been collected and described up to the present. Large size brings to mind the possibility that perhaps *Helladotherium duvernoyi* might be implicated. However, both the (few) dimensions of two atlases given by GAUDRY, as well as the excellent figure (Pl. XLII, fig. 3) show that there can be no question of an identifi-



cation with this animal. Its atlas, seen from the side, was much higher in a sagittal (dorso-ventral) sense. On the other hand, BOHLIN's textfigures 67 and 68 of the atlas of *S. sinense*, and CHURCHER's figures 79—81 of that of *S. africanum* show the appreciable dorso-ventral flattening which is apparently characteristic for the atlas of *Samotherium*. The somewhat bovine aspect of the vertebra, alluded to by BOHLIN (op. cit., p. 57), may be expressed by dividing the first measurement of each vertebra by its third one in the table. For *S. sinense* and *S. eminens* values (exactly identical!) of 1.41 are found, for number 48 a value exceeding 1.30, but for no. 49 only 1.01; for *Helladotherium* 1.12, for *Palaeotragus primaevus* 1.2 and for *S. africanum* values of 1.09, 1.005 and 1.18.

The circumstance that the value found in the case of number 48 approaches those of *S. sinense/eminens*, together with the morphological resemblance existing between number 48 and the figured atlases of *Samotherium sinense* and (in a lesser degree) *S. africanum*, are sufficient reasons for the identification of atlas 1973 XXI 48 as belonging to (a very large specimen of) *Samotherium boissieri* F. MAJOR, 1888.

Atlas number 49 shows a very great degree of resemblance with the atlas of *Palaeotragus primaevus* figured by CHURCHER (op. cit., figures 14—18). Especially the side view (fig. 18) is almost identical from a morphological point of view. The much lower values found for what might be called the "bovine index", see above, in the cases of this atlas, that of *P. primaevus* and those of the still primitive (and therefore more closely allied, when the theory is accepted that *Samotherium* and *Palaeotragus* stem from a common ancestor resembling *Giraffokeryx*) *S. africanum*, all point to an identification of 1973 XXI 49 as the atlas of *Palaeotragus coelophrys* (RODLER & WEITHOFER, 1890) BOHLIN, 1926.

Among the material collected in 1973 at the locality K 2 are two astragali. The first of these, 1973 XXI 51, is a complete specimen of the right side, quite large in size and greyish white with black spots. On the lateral proximal part of the "roll", the tibial articulation, one may discern traces of the former presence of a ligament forming the connection with the malleolus. The thickness of the bone on the mesial side exceeds that on the outside (see BOHLIN, 1926, p. 69), while below the midline, in its posterior aspect, one encounters a pronounced, broad groove along the outer edge, intended for a mesial protuberance in the posterior part of the naviculocuboid (= centrotarsale). The internal border between the articular facettes for the calcaneum and the naviculocuboid on the posterior face of this astragalus is a partly indistinct, not straight but weaving line.

The second astragalus, 1973 XXI 52, of the left side, was found together with part of the distal epiphysis of its tibia (the lateral part of which is missing), numbered 1973 XXI 54. It is a more uniformly greyish piece of bone than number 51. The tibial fragment is brownish grey. The aspect of the proximal part of this epiphyseal fragment clearly shows that the animal to which it belonged was immature. There are some five distinct foramina nutricia on the anterior face of the epiphysis. The astragalus itself is incomplete as well. Its distal part on the anterior side is absent owing to recent damage, and so is part of the lateral anterior side. What is present of the mesial and distal faces is rather flat without pronounced keels, facettes or other features. The caput astragali impresses one as being relatively low. The short remaining upper part of the mesial border along the facette for the calcaneum on the posterior face of the astragalus is a straight line.

Table 3. Measurements of astragali from K 2 compared with data taken from publications by GAUDRY and BOHLIN.

	<i>Samotherium sinense</i> (BOHLIN)							<i>S. emi- nens</i> 102/II
	No. 1 young	2	3	4	5	6	7	
Maximum height on mesial side	104	105	103	103	102	94	93	—
Maximum height on lateral side	—	120	112	117	114	110	103	111
Lateral-mesial width at distal end	69	77	68	75	72	70	66?	64
Lateral-mesial width at proximal end	—	—	—	—	—	—	—	—
Maximum sagittal thickness (± in centre of bone)	56	58	62	67	64	61	58	58
„Indiche de anchura“ (Crusafont)	—	—	—	—	—	—	—	—
„Index 2“	—	±0.64	±0.61	±0.64	±0.63	±0.64	±0.64	±0.58

	<i>P. microdon</i>			<i>P. cf. coelo- phrys</i> Lok. 78	1973 XXI 51	1973 XXI 52	<i>Hellado- therium duvernoyi</i> (GAUDRY)
	116	108	Gr.r.				
Maximum height on mesial side	56	—	63	67	97	—	—
Maximum height on lateral side	—	69?	71	75	115	90	104
Lateral-mesial width at distal end	38	40	45+	47	73	—	—
Lateral-mesial width at proximal end	—	—	—	—	80	62	75
Maximum sagittal thickness (± in centre of bone)	34	—	39	44	68	56	—
„Indiche de anchura“ (Crusafont)	—	—	—	—	0.696	0.69	0.721
„Index 2“	—	±0.58	±0.63	±0.63	0.634	—	—

No traces are present of any bordering line or ridge between facettes for naviculocuboid and calcaneum.

While only a single measurement could be taken from the tibial epiphyseal fragment 1973 XXI 54, namely its maximum sagittal diameter at the mesial side, being 68 mm, a number of measurements taken from the two astragali and compared with measurements given by GAUDRY (1862—1867, p. 259) for the astragalus of *Helladotherium duvernoyi*, and by BOHLIN (1926, pp. 18, 25 and 69)



for the astragali of *Palaeotragus microdon*, *P. cf. coelophrys* and *Samotherium sinense*, respectively, have been combined by me in table 3. As I have done in my 1976-a paper on *Decennatherium crusafonti*, I again computed the “indiche de anchura” following CRUSAFONT (1966, p. 67), this being the lateral-mesial width at the proximal end of the bone, divided by its maximum height taken on the lateral side; however, as Bohlin has not given the lateral-mesial width at the proximal end, but only that at the distal end, which is almost always a slightly lesser value, I have also computed an index using that in combination with the maximum lateral height (“index 2”).

It has been assumed by me that the values given by Gaudry as “longueur” and “largeur” are the maximum measurable dimensions of the astragalus; as these are usually the maximum height on the lateral side and the lateral-mesial width at the proximal end, I feel justified in computing the “indiche de anchura” from them. It will be seen that its value, in *Helladotherium*, is considerably more than that in *Samotherium*, where it appears to be the same in both specimens from K 2; while “index 2”, also in the case of *Samotherium*, is remarkably constant somewhere near 0.63—0.64, being suddenly lower only in *S. “eminens”*, in which it approaches the few values computed for *Palaeotragus*. It is mainly this argument, coupled with the morphological points of resemblance between number 51 and the description given by Bohlin (op. cit., p. 69), which, in my opinion, suffices to conclude that both astragali have to be identified as belonging to *Samotherium boissieri* F. MAJOR, 1888. Number 51 must have been a large individual (as in the case of the atlas no. 48), while number 52, and perforce also number 54, was an immature individual of smaller dimensions.

There exists a very great possibility that item number 1973 XXI 55, the distal part of a calcaneum of the left side, found at K 2 also and showing a colouring and a state of preservation identical to that of number 1973 XXI 54, has belonged to the same individual. The articulation for this calcaneum on to astragalus number 52 fits almost perfectly.

The upper, proximal or most posterior part with the tuber calcanei of this bone has broken off long ago, and the slightly hollowed shaft in which some cracks appear while, in front, a wedge of bone has recently been lost, has probably been subjected to recent thermal (solar) erosion while lying at or near the surface. Notwithstanding this circumstance one may observe that the articular facette for the naviculocuboid shows a minute part in front which is directed outwards, from there gradually turning inward more to the back, as in the description given by BOHLIN (1926, p. 70), where it is stated that this facette is directed uniformly inward in the genus *Giraffa*, but in the described manner in *Samotherium*. Quite at the back of this facette it is not prolonged in a posterior sense, again in contrast to the situation in *Giraffa*, but agreeing with that in *Samotherium*.

Still obtainable measurements from this fragment, which may be compared with measurements given by BOHLIN (op. cit., p. 18 and p. 70) for *Palaeotragus microdon* and *S. sinense*, and by RODLER & WEITHOFER (1890, p. 765) for *Alcicephalus neumayri* and *A. coelophrys*, are:

Maximum height (= depth), over facette for malleolus	82 mm
Maximum width (over sustentaculum astragali)	64 mm
Total length of remaining fragment	125 mm, indicating that



the complete calcaneum has been markedly longer. The first measurement varies from 78 to 100 mm in *Samotherium* and from 57 to 76 mm in *Palaeotragus*, according to the data given by the cited authors; the second measurement from 58 to 61? mm in *Samotherium* (BOHLIN) and from 33 to 41 mm in *Palaeotragus* (BOHLIN), while the total length of the bone runs from 188 to 225 mm in *Samotherium* and from 130 to 178 mm in *Palaeotragus*. From this it is clear that 1973 XXI 55 should be identified as *Samotherium boissieri* F. MAJOR, 1888.

Another possible combination is that of the already described large astragalus 1973 XXI 51 with item 1973 XXI 62, a malleolar bone of the right side, which appears to fit the articulation for it on 1973 XXI 51. This os malleolare, or os fibularis, displays only a single articular facette for the tibia, having a graceful wavelike or saddlelike surface on its upper side. There is a fair degree of resemblance with the os malleolare figured and described by BOHLIN (op. cit., p. 50, fig. 61) as *S. cf. neumayri*; from BOHLIN's remarks on pp. 67—68 it follows that there exists a variability within *Samotherium* with regard to the presence of a single or of two articular facettes for the tibia on the upper side of the malleolar bone. DE MECQUENEM's statement (1924, p. 25) that *Helladotherium* always possesses two such facettes, but *Giraffa*, *Okapia*, "*Alcicephalus*" (= *Samotherium*), "*Achtiaria*" (= *Palaeotragus*) only a single one, should therefore be taken cum grano salis. The following measurements of this bone from locality K 2 were taken by me, which agree well with those given by BOHLIN (op. cit., p. 68):

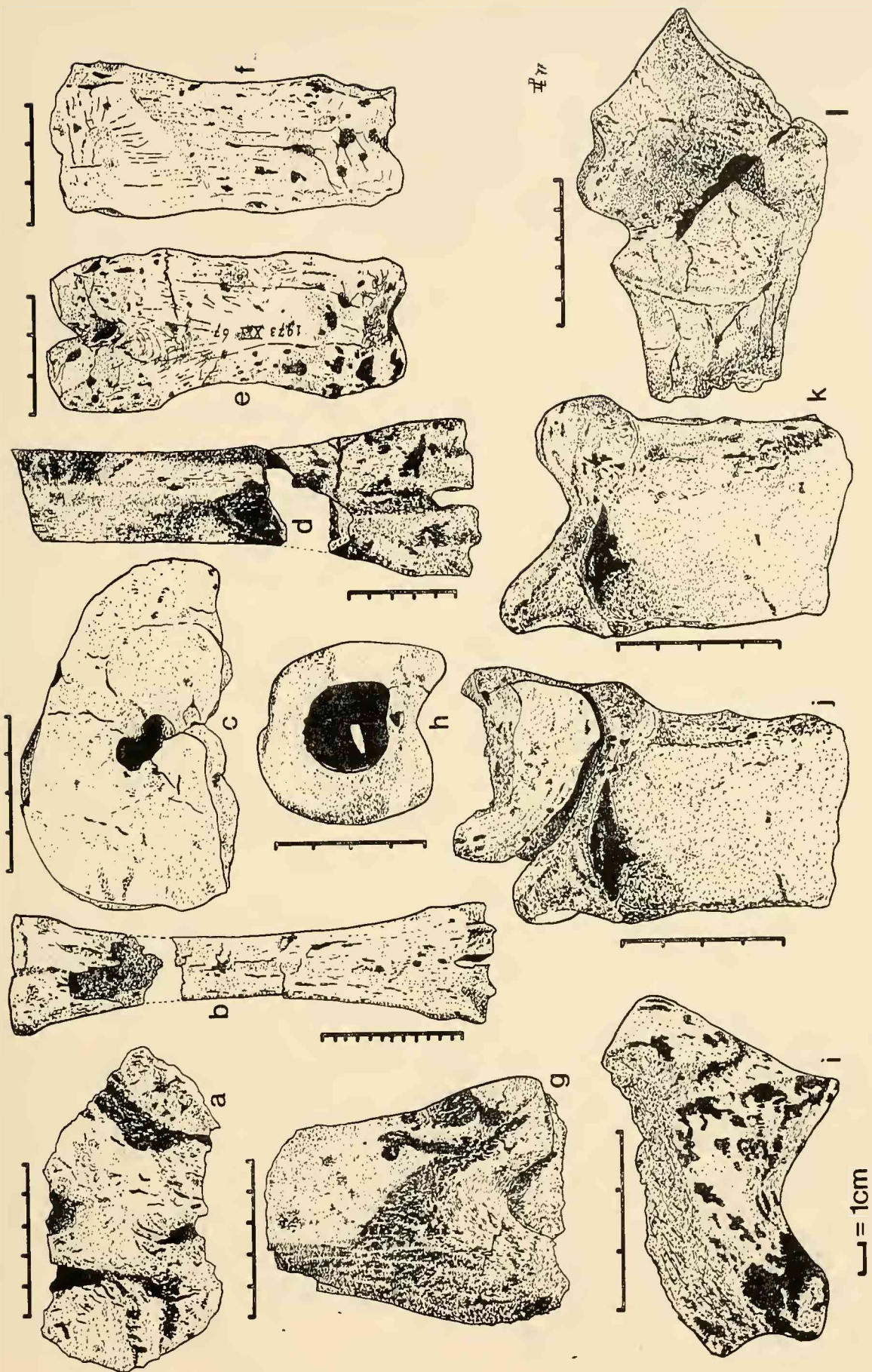
Height	45 mm
Transversal width	29 mm
Sagittal (= antero-posterior) width	59 mm

At the locality K 2 two fragmentary cannonbones have been collected, each one a metacarpale III/IV of the right side. The first of these, 1973 XXI 50, consists of the nearly complete distal extremity with part of the adjoining shaft

---

Fig. 2: a. proximal diaphyseal surface (with gnawing marks?) of 1973 XXI 53, radius sinister of subadult *Palaeotragus coelophrys* from K 2. — b. posterior aspect of metacarpale 3/4 dexter, 1973 XXI 50, of *Samotherium boissieri neumayri* from K 2 (proximal part, 50A, and distal part, 50B, placed at estimated natural distance from each other). — c. face of proximal articulation of 1973 XXI 50B (see fig. b.). — d. anterior aspect of metacarpale 3/4 dexter, 1973 XXI 57, of *Samotherium boissieri boissieri* from K 2. — h. distal face of diaphysis of 1973 XXI 57B (see fig. d.). — e. posterior, and f. anterior aspects of 1973 XXI 67: phalanx I of posterior 4th toe, left side, of *Samotherium boissieri boissieri* from K 1. — g. posterior aspect of distal fragment of humerus dexter, 1973 XXI 56, of *Samotherium boissieri boissieri* from K 2. — i. external aspect of lower part of lunate of the right side, 1973 XXI 63, of *Samotherium boissieri sinense* from K 2. — j. and k. posterior aspects of 1973 XXI 52, astragalus, and 1973 XXI 54 (distal fragment of) tibia, of the left side, fitting together, of *Samotherium boissieri boissieri* from K 2. — l. internal aspect of 1973 XXI 55, part of a calcaneum of the left side, which may have belonged to the same individual as 1973 XXI 52 and 1973 XXI 54 from K 2.







(numbered 1973 XXI 50 A), and of the entire proximal extremity with only a very small part of the diaphysis (more of it at the anterior side than at the back) still adhering (1973 XXI 50 B). Two small slivers of bone have recently broken off from the innermost two pulley-like rolls of the distal extremity. The colour of the fossil is dirty white with brown streaks and black spots. A horizontal section of the distal part of the diaphysis shows it to be uniformly convex at its anterior, mesial and lateral sides, and shallowly concave posteriorly without any visible outward traces of the vascular groove between the third and the fourth metacarpal. There exists a certain resemblance with fig. 138, p. 86, in BOHLIN (op. cit.), of a metacarpus of *Samotherium boissieri*. Too little of the diaphysis at the proximal end remains to observe whether this groove would have been present there. The proximal articular facette for the magnum is somewhat concave, while that for the unciform is practically flat. As in *Giraffa*, the posterior margin of this last facette continues that of the one for the magnum, when seen on top of the proximal articulation of the bone, there being a minute step between the two facettes when seen from the posterior face. At the posterior lateral side, some 15 mm below the plane of the unciform facette, a small rectangular bony outgrowth probably represents a facette for a rudimentary fifth metacarpal, more or less as has been described and illustrated by BOHLIN (1926, pp. 137—138, fig. 215 b). The synovial foramen is developed as a narrow fossa, with a foramen at its lower end, comparable to the situation sometimes present in *Giraffa*. The head of metacarpal III bears a single metacarpal tuberosity, again as in the recent species.

The second cannonbone is slightly smaller. It also consists of two fragments, a complete distal articulation with a small part of the shaft still attached (number 1973 XXI 57 A), and a portion of the diaphyseal shaft (1973 XXI 57 B), which, at a single spot on the inner posterior corner (viewed as a horizontal section), fits on to the line of breaking of the most distal fragment 57 A. The preservation and colour of the bone are nearly those of 1973 XXI 50, only the colour being somewhat darker. The transverse horizontal section of this bone shows it to be slightly less flattened (anteroposteriorly) than number 50, while here the fusion between the third and fourth metacarpals is easily observable on the outside as a vertical shallow fluted groove bisecting the convex anterior surface of the cannonbone. The posterior surface is pronouncedly concave, more so than in number 50. The anteroposterior width of the diaphysis is less than the transverse width (see BOHLIN, 1926, p. 99).

As this property alone, according to BOHLIN, basing himself on the features described by him of the metacarpal cannonbones of *Palaeotragus* (op. cit., p. 16) and of *Samotherium* (op. cit., p. 50 and pp. 64—66), suffices to distinguish the bone in question of *Samotherium* from that of *Palaeotragus* (in which the anteroposterior width is equal to the transverse width, or exceeds it), it is already possible to identify 1973 XXI 50 as well as 1973 XXI 57 as belonging to individuals of *Samotherium boissieri* F. MAJOR, 1888. A number of measurements taken from the two bones collected at K 2 have been arranged in the following table 4, combined with some comparable measurements from RODLER & WEITHOFER (1890, p. 765) and from BOHLIN (1926, pp. 16 and 65-66):



Table 4. Measurements of metacarpalia III/IV.

	no. 50 K 2	no. 57 K 2	RODLER & WEITHOFER, Marāgheh <i>A. neumayri</i> <i>A. coelophrys</i>	
max. length (Bosold I)	± 380—400	—	—	340 (1 ex)
length of remaining part	—	230	—	—
max. transv. width, dist. artic. (B IV)	96	79	95—104 (5 ex)	79—87 (6 ex)
max. a.-p. width, distal artic. (B VII)	56	43	—	—
max. transv. width, prox. artic. (B III)	91	—	92—97 (2 ex)	76—80 (3 ex)
max. a.-p. width, prox. artic. (B VI)	56	—	—	—
transv. width, shaft, min. value (B V)	53	47	55 (1 ex)	45 (1 ex)
a.-p. width at same place	42	41	—	—
Index B IV/B VII × 100	171.4	183.7	—	—
Index B V/B I × 100	13.95	—	—	13.24 (1 ex)

	BOHLIN <i>P. microdon</i>	<i>S. sinense</i> 6 ex.	<i>S. emi-</i> <i>nens</i> 1 ex.	<i>S. bois-</i> <i>sieri</i> 1 ex.	GAUDRY (p. 258) <i>H. duver-</i> <i>noyi</i>
max. length (Bosold I)	368—430 (3 ex)	425—466 (?)	430	410	420
length of remaining part	—	—	—	—	—
max. transv. width, dist. artic. (B IV)	50—57 (4 ex)	92—115	100	100	100
max. a.-p. width, distal artic. (B VII)	—	—	—	—	—
max. transv. width, prox. artic. (B III)	48—55 (4 ex)	89—100	95	90	109
max. a.-p. width, prox. artic. (B VI)	32—41 (4 ex)	49—63	62	—	—
transv. width, shaft, min. value (B V)	—	—	—	—	—
a.-p. width at same place	—	—	—	—	—
Index B IV/B VII × 100	—	—	—	—	—
Index B V/B I × 100	—	—	—	—	—

The indication B I, B III, etc. in the table stands for certain measurements advocated by BOSOLD (1968) when measuring bones of the extremities of *Artiodactyla*; in a previous paper (ERDBRINK, 1973) I have used this set of measurements.

Also from the locality K 2 is 1973 XXI 53, a 19 cm long proximal fragment of a radius of the left side, having a dirty white colour with grey and black spots and red-brown streaks, while the peripheral surface of the bone some 4 cm below the proximal end is finely wrinkled. The proximal epiphysis is absent and the form of the proximal diaphyseal surface indicates that the individual to which this bone belonged was not yet fully grown, there still having been a cartilaginous connection. I find it very hard to decide whether one might interpret some of the fairly deep grooves here as marks of gnawing by predators, but this possibility certainly exists. Although the epiphysis is no longer present, one easily observes what BOHLIN (op. cit., p. 60) has called the maximal transversal expansion of the external (lateral) part of the proximal articulation together with the flattened and transversally extended form of the shaft as compared to the radius of the recent *Giraffa*. Contact between ulna and radius in the semilunar notch has evidently been free, as in *Giraffa*. The diaphysis appears to have been very lightly convex in front and flat at the back, when seen in horizontal section.

The following three measurements (in mm) of this bone fragment can be given:

Maximum transversal width at proximal end of diaphysis	99
Sagittal width at mesial side at the same place	46
Sagittal width at lateral side at the same place	54

RODLER & WEITHOFER (1890, p. 765) give as values for the "obere Breite", i. e. (probably) the transversal width at the proximal end, of the radius for *Alcicephalus neumayri* 137, 140 and 145 mm, and for *A. coelophrys* 115 and 120 mm; BOHLIN (op. cit., p. 15, p. 61) mentions values of 62, 81, 81 and 90 mm for this measurement in *Palaeotragus microdon* and of 146 (*S. eminens*), 152 (*S. boissieri*), 150, 162? and 168 mm (*S. sinense*) in *Samotherium*. From this it will be clear that an identification of the bone as one belonging to *Palaeotragus coelophrys* (RODLER & WEITHOFER, 1890) BOHLIN, 1926, is a reasonable feasibility.

1973 XXI 64 is probably a fragment of the distal extremity of an ulna sinistra, found at the locality K 2. It is red brown in colour. No other measurements of this 4 cm long fragment can be given than an approximated transversal width of 37 mm and a sagittal width somewhat exceeding 23 mm. These relatively modest dimensions may constitute an argument for the identification with the same species as 1973 XXI 53, perhaps even with the same individual.

1973 XXI 56, found at K 2 and rather dark in colour with several completely black areas, is a distal fragment of a humerus of the right side consisting of a proximal portion of the shaft with the trochlear bases still present, while the trochlea itself and the lateral and mesial epicondyls have broken off. The individual must therefore have been an adult animal, as there are no traces to be seen anywhere that epiphysis and diaphysis have not been completely fused. A horizontal section



of the diaphysis is circular. At the back the olecranon fossa is almost completely present. There are three small nutritional foramina in its approximative centre. In front one sees three or four shallowly concave areas, together representing the coronoid fossa. The septum between olecranon and coronoid fossae, having a thickness of some 7 mm, has also been preserved. There is no supertrochlear perforation. At the base of the lateral epicondylus, on the lateral side of the bone, a longitudinal tubercular ridge can be observed. The surface of the bone above the mesial epicondyle appears to be completely smooth. The posterior and distal faces of the lateral epicondyle have very probably formed a right angle with each other, which has, in any case, not exceeded  $90^\circ$  in value (see BOHLIN, op. cit., pp. 14 and 60). The following measurements could be taken:

Distance between lateral and mesial epicondyli	> 90 mm
Distal sagittal width of diaphysis (not at narrowest spot)	66 mm
Distal transversal width at same place	59 mm
Circumference at same place	200 mm

In view of the measurements to be gathered from several authors (RODLER & WEITHOFER, op. cit., p. 765: "Rollenbreite" of the humerus of *A. neumayri*: 125 mm and of *A. coelophrys*: 89 mm. BOHLIN, op. cit., p. 14: width of trochlea of *P. microdon*: 64—85 mm, minimal circumference of humeral diaphysis of same: 123—136 mm; and p. 60, width of trochlea of *Samotherium*: 109—140? mm, minimal circumference of humeral diaphysis of same: 220—252 mm. GAUDRY, 1862—1867, p. 258, width of inferior articulation of *Helladotherium duvernoyi*, humerus: 131 mm, and circumference at centre of humeral shaft of same: 260 mm) an identification of the item as the humerus dexter of a *Samotherium boissieri* FORSYTH MAJOR, 1888, of rather modest dimensions, appears to be most probable, despite the fact that Bohlin seems to regard the presence of the mentioned longitudinal tubercular ridge at the base of the lateral epicondyle as a diagnostic character for *Helladotherium* and *Giraffa*.

With considerable hesitation the last Giraffid (?) bone fragment collected at locality K 2 and numbered 1973 XXI 63, having a dirty white colour with brown and black spots, is identified here as the distal half of a lunate (= intermedium) of the right side. Its only remaining complete articular facette has a saddle-like form, assumedly forming the articulation with the unciform, with its broadest portion lying at the back. There are certain resemblances with, but also marked differences from, textfigures 59 and 60 in BOHLIN (op. cit., p. 50), and plate XXX, figures 2 and 2a, in CRUSAFONT's thesis (op. cit.). As measurements from this item the assumed sagittal width of the mentioned articular (saddle-like) facette can be given as 45 mm, its transversal width as 33 mm, while the maximal (still) measurable length of the bone is 61 mm, the largest width (assumedly in front) 37 mm and the still measurable height 41 mm. Measurements gathered from BOHLIN's publication show that this bone in *Palaeotragus microdon* is considerably smaller (op. cit., p. 15: length 38—40 mm, width 24—28 mm, height 29—31 mm). For *Samotherium* (ibid., p. 50: sagittal length 56 mm, max. width in front: 42 mm, height in front: 43 mm) as well as for *Helladotherium* (GAUDRY, 1862—1867, p. 258, semi-lunaire, hauteur: 43 mm, largeur: 46 mm) the dimensions are more or less comparable. The anterior face of this bone in *Helladotherium* appears to be smooth



on Pl. XLIII, fig. 4 in Gaudry's famous monography, while in *Samotherium* (Bohlin's already cited textfigures 59 and 60) a more or less transverse groove, also present in the fossil from K 2, is clearly visible. An identification (provisionally) as *Samotherium boissieri* F. MAJOR, 1888, seems justified.

Two more fossil Giraffid bones complete the collection made in 1973. To all probability they belong together and are from a single individual. They were collected at the locality K 1 and show the typical state of preservation of the fossils from this site: a certain brittleness (countered by impregnation with a colourless epoxyresin) together with a bony white colour. Round black spots having a diameter of 1 to 2 mm are scattered all over the white surfaces.

1973 XXI 67 is a complete first phalanx. The posterior aspect of the upper part of the bone almost copies that of a first phalanx of *Samotherium sinense* pictured by BOHLIN (op. cit., p. 72, fig. 129). The following measurements in mm can be given, in which the directions given by BOSOLD (1968) have been followed:

Peripheral length (BOSOLD 1)	89
Transversal width at proximal end (BOSOLD 2)	41
Transversal width at distal end (BOSOLD 3)	32.5
Minimum transversal width of diaphysis (BOSOLD 4)	33.5
Sagittal width at proximal end (BOSOLD 5)	45
Sagittal width at distal end (BOSOLD 6)	31
Index I ( $B\ 2/B\ 1 \times 100$ )	46.07
Index II ( $B\ 2/B\ 5 \times 100$ )	91.11

The length of the inner muscular rugosity (a value given by BOHLIN) is approximately 30 mm. The index used by BOHLIN (op. cit., p. 73) can be computed as being  $B\ 2 \times 1000/B\ 1 = 41\ 00/94 = 436$ , which identifies this first phalanx as belonging to one of the posterior extremities. The asymmetrical form of the proximal articular facette shows that this must be the first phalanx of the fourth toe of the left hind extremity. Measurements given by BOHLIN (op. cit., p. 20) for *Palaeotragus microdon* are appreciably smaller in every respect, while the measurements of the first phalanx of *Helladotherium* given by him (op. cit., p. 152) exceed those given here while the bone is also relatively shorter and stockier. The only possible identification of this bone is: *Samotherium boissieri* F. MAJOR, 1888, the animal in question having had modest dimensions.

1973 XXI 65 appears to be the most mesial sesamoid bone (i. e. the one at the right side) of the left hind extremity at the border between the cannonbone and the first phalanx, as comparison with skeletons of an Okapi and a Red Deer in the Utrecht Zoological Museum have shown me. Its measurements are: height 35 mm; sagittal width 30.5 mm; transversal width 22 mm. The same identification as that in the case of 1973 XXI 67 is applicable here also; the item must have belonged to the same individual.

The items described in the preceding determination have been arranged by me in the following table, facilitating a rapid survey of the entire Turolian Giraffid material collected in 1973. The reader will have observed that I have consequently refrained from a subspecific identification of all items ascribed to *Samotherium*



*boissieri*. Table 5, in which possible combinations of items having belonged to single individuals (marked with a ?), as well as combinations where this circumstance cannot be doubted, have been indicated, demonstrates that a minimum number of five *S. boissieri neumayri* (being of medium size), one of four *S. boissieri boissieri* (modest size), and one of three *S. boissieri sinense* (large to very large size, equivalent to Bohlin's "var. *major*") may be distinguished. As it appears to be highly unlikely, for ecological reasons, that three subspecies of one species have lived together inside a small region of some 15 by 5 km roughly at the same time, this illustrates the reason why, in my opinion, a distinction of three separate subspecies mainly based upon size differences, although theoretically possible, appears to be impractical and not necessary.

Very little, if not almost nothing, is known about a possible sexual size dimorphism in *Samotherium boissieri*. The presence of large and small forms and individuals also at Samos and among Bohlin's Chinese material does not contradict such a possibility.

Table 5. Survey of Turolian Giraffid finds collected in 1973.

Number	Locality	Item	Determination
1973 XXI 59	K 2	M <sub>3</sub> d.	? <i>Palaeotragus coelophrys</i>
1973 XXI 61	K 2	p <sup>3</sup> d.	
1973 XXI 60	K 2	M <sup>2</sup> d. (half)	<i>Helladotherium duvernoyi</i>
1973 XXI 58	K 2	P <sub>3</sub> s.	<i>Samotherium boissieri neumayri</i>
1973 XXI 69	Shoylav.	DP <sub>4</sub> d.	<i>Samotherium boissieri neumayri</i>
1973 XXI 85	Güzgün.	DP <sub>4</sub> s.	? <i>Samotherium boissieri neumayri</i>
1973 XXI 84	Güzgün.	M <sub>2</sub> s.	
1973 XXI 86	Güzgün.	M <sup>1</sup> s. (fragm.)	? <i>Samotherium boissieri neumayri</i>
1973 XXI 87		P <sup>4</sup> s. (fragm.)	
1973 XXI 48	K 2	atlas	<i>Samotherium boissieri sinense</i>
1973 XXI 49	K 2	atlas	<i>Palaeotragus coelophrys</i>
1973 XXI 51	K 2	astrag. d.	? <i>Samotherium boissieri sinense</i>
1973 XXI 62	K 2	os mall. d.	
1973 XXI 52	K 2	astrag. s.	? <i>Samotherium boissieri boissieri</i>
1973 XXI 54	K 2	tibia s. (fr.)	
1973 XXI 55	K 2	calcan. s.	
1973 XXI 50	K 2	m. c. 3/4 d.	<i>Samotherium boissieri neumayri</i>
1973 XXI 57	K 2	m. c. 3/4 d.	<i>Samotherium boissieri boissieri</i>
1973 XXI 53	K 2	prox. rad. s.	? <i>Palaeotragus coelophrys</i>
1973 XXI 64	K 2	dist. ulna s.	
1973 XXI 56	K 2	hum. d. (fragm.)	<i>Samotherium boissieri boissieri</i>
1973 XXI 63	K 2	lunate d. (fr.)	<i>Samotherium boissieri sinense</i>
1973 XXI 67	K 1	phal. I p. 4 s.	<i>Samotherium boissieri boissieri</i>
1973 XXI 65	K 1	sesam. I p. 4 s.	

## Acknowledgements

As in the previous papers on the results of the exploratory voyage to Iran in 1973, I should like to thank the Authorities of the Scientific Affairs Division of the North Atlantic Treaty Organization at Brussels for providing the financial support (Grant no. 661) of this venture. My grateful thanks are due to His Excellency Mr. F. Bagherzadeh, Director General, Iranian Centre for Archaeological Research at Tehran, for according me formal permission to investigate the region around Marāgheh; to the several Authorities and friends from the Universities of Tabriz and Tehran mentioned in the previous papers, for their most welcome aid and practical support; to the Authorities at the Imperial Iranian Embassy at The Hague for the aid and advice given me in organizing the voyage; and to the Authorities at the Royal Netherlands Embassy at Tehran, in particular to His Excellency Mr. P. A. E. Renardel de Lavalette, His Excellency Mr. G. van Vloten, and to Drs. H. J. Nijhof, for the kind hospitality, aid and important advice received before, during and after my stay in Iran.

Many thanks are also due to Mr. H. van Kooten, official artist of the Zoological Laboratory of Utrecht University, and to his staff, for providing and for aiding with the design of the illustrations to this paper; and to the several Preparators of the Institute of Paleontology and historical Geology at Munich University, who have patiently toiled at the reconstruction of many fragmentary specimens described here.

## References

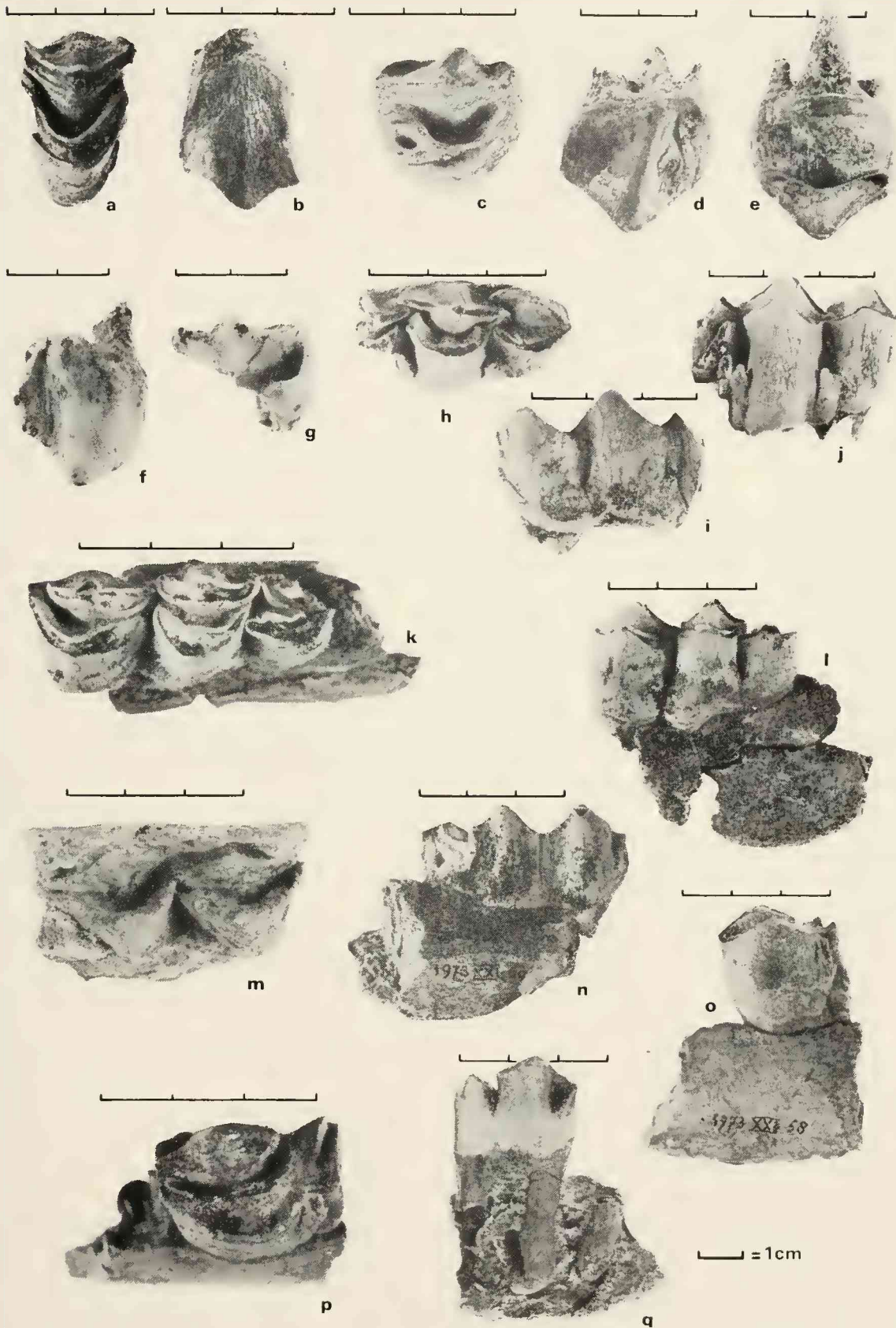
- BOHLIN, B. (1926): Die Familie Giraffidae. — *Pal. Sinica*, Ser. C, 4, 1: 178 pp.; Peking.
- BOSOLD, K. (1968): Geschlechts- und Gattungsunterschiede an Metapodien und Phalangen mitteleuropäischer Wildwiederkäuer. — *Säugetierk. Mitt.*, XVI: pp. 93—153; München.
- BOSSCHA ERDBRINK, D. P., PRIEM, H. N. A., HEBEDA, E. H., CUP, C., DANKERS, P. & CLOETINGH, S. A. P. L. (1976): The bone bearing beds near Marāgheh in N. W. Iran. — I & II. *Proc. Kon. Ned. Akad. v. Wet.*, Amsterdam, Ser. B, 79, 2: pp. 85—113.
- BOSSCHA ERDBRINK, D. P. (1976 a): A fossil Giraffine from the Marāgheh region in N. W. Iran. — *Mitt. Bayer. Staatsslg. Pal. hist. Geol.*, 16: 29—40; München.
- BOSSCHA ERDBRINK, D. P. (1976 b): Early *Samotherium* and early *Oioceros* from an Uppermost Vindobonian fossiliferous pocket at Mordaq near Marāgheh in N. W. Iran. — *Mitt. Bayer. Staatsslg. Pal. hist. Geol.*, 16: 41—52; München.
- BOSSCHA ERDBRINK, D. P. (1977): On the distribution in time and space of three Giraffid genera with Turolian representatives at Marāgheh in N. W. Iran. — *Proc. Kon. Ned. Akad. v. Wet.*, Amsterdam, Ser. B, 80, 5, pp. 337—355.
- CHURCHER, C. S. (1970): Two new Upper Miocene Giraffids from Fort Ternan, Kenya, East Africa: *Palaeotragus primaevus* n. sp. and *Samotherium africanum* n. sp. — *Fossil Vertebrates of Africa*, 2: 1—106; London/New York.
- CRUSAFONT PAIRÓ, M. (1952): Los jiráfidos fósiles de España. — Thesis, Mem. y Com. Inst. Geol. Barcelona, VIII: 239 pp.; Barcelona.
- CRUSAFONT PAIRÓ, M. (1966): Caracterización del Pontense en el afloramiento terciario de Campisábalos (Guadalajara). — *Notas y Com. Inst. Geol. y Min. de España*, 85: 61—70.
- ERDBRINK, D. P. (1973): A collection of mammalian fossils from S. E. Shansi, China. IV. Cervidae. — *Publ. Nat. hist. Gen. in Limburg*, XXIII, 1/2: 83 pp.; Maastricht.



- FORSYTH MAJOR, C. I. (1888): Sur un gisement d'ossements fossiles dans l'île de Samos. — Ctes. Rend. hebd. d. séanc. de l'Acad. d. Sc., 107: 1178—1182; Paris.
- GAUDRY, A. & LARTET, E. (1856): Résultats des recherches paléontologiques entreprises dans l'Attique sous les auspices de l'Académie. — Ctes Rend. hebd. d. séanc. de l'Acad. d. Sc., 43: 271—274; Paris.
- GAUDRY, A. (1860): Résultats des fouilles exécutées en Grèce sous les auspices de l'Académie. — Ctes Rend. hebd. d. séanc. de l'Acad. d. Sc., 51: 802—804; Paris.
- GAUDRY, A. (1862—1867): Animaux fossiles et Géologie de l'Attique, d'après les recherches faites en 1855—56 et en 1860 sous les auspices de l'Académie des Sciences. — 2 vols.; Paris.
- MECQUENEM, R. DE (1908): Contribution à l'étude du gisement des vertébrés de Maragha et de ses environs. — Ann. d'hist. nat., 1: 27—79; Paris.
- MECQUENEM, R. DE (1924—1925): Contribution à l'étude des fossiles de Maragha. — Ann. Paléont., 13—14: 135—160, 1—35; Paris.
- PATTON, Th. H. (1969): Miocene and Pliocene Artiodactyls, Texas Gulf Coastal Plain. — Bull. Florida State Mus., Biol. Sc., 14, 2: 115—226.
- PILGRIM, G. E. (1911): The fossil Giraffidae of India. — Mem. Geol. Surv. India, Pal. Indica, N. S., IV, 1: 29 pp.; Calcutta.
- RODLER, A. & WEITHOFER, K. A. (1890): Die Wiederkäuer der Fauna von Maragha. — Denkschr. kais. Akad. Wiss., Math.-Naturwiss. Cl., II, 57: 753—772; Wien.
- VAN COUVERING, J. A. & MILLER, J. A. (1971): Late Miocene Marine and Non-marine Time Scale in Europe. — Nature, 230: 559—563.

## Plate 7

- a. occlusal, and b. vestibular aspects of 1973 XXI 60: M<sup>2</sup> (or M<sup>1</sup>) dexter, fragmentary, of *Helladotherium duvernoyi* from K 2.
- c. occlusal, d. vestibular, and e. lingual aspects of 1973 XXI 61: P<sup>3</sup>dexter of *Palaeotragus coelophrys* from K 2.
- f. vestibular, and g. occlusal aspects of 1973 XXI 87: fragment of P<sup>4</sup>sinister of *Samotherium boissieri neumayri* from Güzgünéh.
- h. occlusal, i. lingual, and j. vestibular aspects of 1973 XXI 59: M<sup>3</sup>dexter of *Palaeotragus coelophrys* from K 2.
- k. occlusal, l. vestibular, and n. lingual aspects of 1973 XXI 69: DP<sup>4</sup>dexter in mandibular fragment of *Samotherium boissieri neumayri* from Shoylavand.
- m. occlusal view of 1973 XXI 84: unerupted M<sup>2</sup>(or M<sup>1</sup>) sinister of *Samotherium boissieri neumayri* from Güzgünéh.
- p. occlusal, q. lingual, and o. vestibular aspects of 1973 XXI 58: P<sup>3</sup>sinister in mandibular fragment of *Samotherium boissieri neumayri* from K 2.





# ZOBODAT - [www.zobodat.at](http://www.zobodat.at)

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Mitteilungen der Bayerischen Staatssammlung für Paläontologie und Histor. Geologie](#)

Jahr/Year: 1978

Band/Volume: [18](#)

Autor(en)/Author(s): Bosscha Erdbrink Dirk Pieter

Artikel/Article: [Fossil Giraffidae from the Maragheh area, N.W. Iran 93-115](#)