THE LOWER MIOCENE ARTIODACTYLS OF TAGAI BAY, OLHON ISLAND, LAKE BAIKAL (RUSSIA)

by

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CONTENT

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ABSTRACT

The mammalian fauna of the Tagai locality of Olhon Island in Lake Baikal contains six artiodactyls: *Amphitragulus boulangeri*, *Lagomeryx parvulus*, *Stephanocemas* sp., *Palaeomeryx kaupi*, *Orygotherium* aff. *escheri*, and *Brachyodus intermedius*. They are reported from Eastern Siberia for the first time. A description of teeth and limb-bones are given. An analysis of the systematic composition of the Tagai fauna allows it to be correlated with European faunas of the second part of the Early Miocene (Orleanian, MN 3-4) and permit suggestion of the existance of a united European-Siberian zoogeographical sub-area in the middle latitudes of Eurasia at that time.

RESUME

la faune de mammifères de la localité de Tagai sur l'île Olhon dans le lac Baïkal comprend six artiodactyles: *Amphitragulus boulangeri*, *Lagomeryx parvulus*, *Stephanocemas* sp., *Palaeomeryx kaupi*, *Orygotherium* aff. *escheri* et *Brachyodus intermedius*. Ils sont signalés pour la première fois en Sibérie orientale. Une description des dents et du squelette appendiculaire est donnée. Une analyse de la composition systématique de la faune de Tagai permet de la corréler avec les faunes européennes de la seconde partie du Miocène inférieur (Orléanien, MN 3-4); cette composition suggère l'existence d'une sous-unité zoogéographique réunissant l'Europe et la Sibérie dans les latitudes moyennes d'Eurasie pour cette période.

INTRODUCTION

The Tagai locality is situated on the north of Olhon Island in Lake Baikal in the northeastern part of Tagai Bay abou 6 km southwest of Huzhir village. The first vertebrate fossils (fishes, amphibiens, reptiles, birds and mammals) were discovered there in 1955. Abundant remains of mammals were collected there in 1957 and 1958 by an expedition of the Institute of the Earth Crust of the Siberian Department of the Russian Academy of Sciences under N.A. Logachev. The remains were found in lake deposits of the Chalagai siute, undercut by an abrasion cliff about 20 m in height. The geology of the outcrop was studied by Logachev (Logachev *et al.*, 1964). In 1982 the locality was visited by the author. The remains of mammals have been determined by I.M. Gromov (Insectivora and Rodentia), V.I. Gromova (Carnivora and Equidae), E.I. Beliajeva (Rhinocerotidae) and B.A. Trofimov (Artiodactyla) (Logachev *et al.*, 1964). The Tagai fauna had first been thought to be of Middle Miocene or Middle to Upper Miocene in age, and the Chalagai suite, based on these paleontological and the geological data, were regarded as either Middle Miocene-Lower Pliocene (Logachev *et al.*, 1964) or Middle Miocene-Middle Pliocene age (Adamenko *et al.*, 1986).

The remains of mammals were originally referred to: *Proscalops* sp., *Talpa* sp., *Procaprolagus* sp., *Monosaulax* sp. nov., *Cricetodon* cf. *sansaniensis*, Mustelidae, Felidae, *Anchitherium* sp., *Metaschizotherium* (?) sp., *Dicerorhinus* sp., *Palaeomeryx* sp., and Bovidae (Logachev *et al.*, 1964).

A re-examination of the Tagai artiodactyl remains, stored at the Paleontological Institute of the Russian Academy of Sciences (PIN coll. n° 4338), reveals the presence of at least six species, described below, hitherto unknown in Eastern Siberia. The following artiodactyls were identified: *Amphitragulus boulangeri*, *Lagomeryx parvulus*, *Stephanocemas* sp., *Palaeomeryx* cf. *kaupi*, *Orygotherium* aff. *escheri*, and *Brachyodus intermedius*. They indicate a Lower Miocene age for the fauna and have permitted a relocation of the lower boundary of the Chalagai suite to the end of the Lower Miocene (Vislobokova, 1990).

GEOLOGY AND TAPHONOMY OF THE TAGAI LOCALITY

The mammalian remains are associated with inter-layers of calcareous green clays of the Chalagai suite that alternate with sands, siltstones, and limestones. The sediments of the Chalagai suite lie upon the weathered crust of the archean crystal basement, they are succeeded by deposits of Pliocene age. The Chalagai sediments accumulated in shallow lakes and marshes which were dry in times. They were deposited in small hollows that were surrounded by the low elevations (Logachev *et al.*, 1964). The deposits of the suite are interpreted as having a suberial, mainly lake-marsh origin.

There are three bone-bearing horizons of the Chalagai suite, being about 12 m

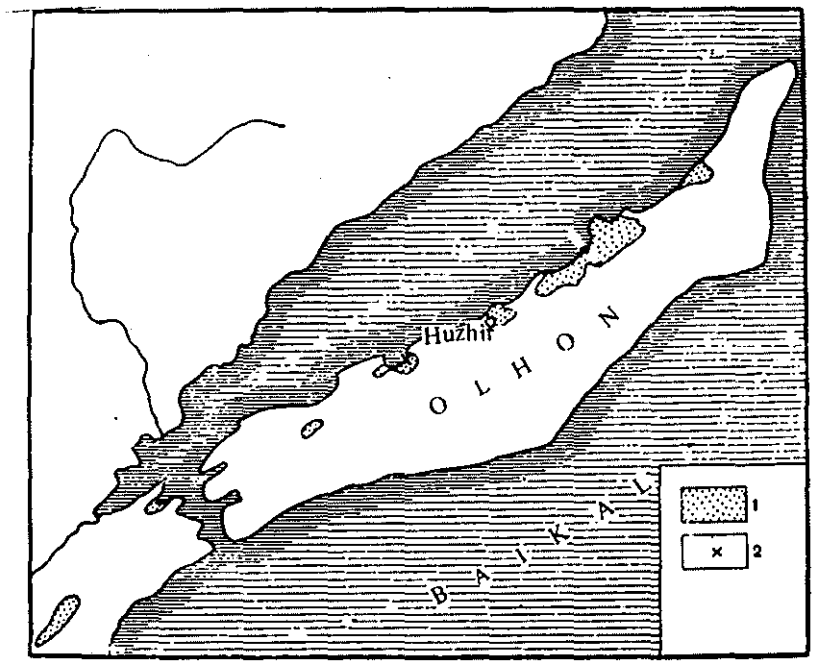


Figure 1.— Location map of Tagai (Logachev *et al.*, 1964). 1: Neogene deposits, 2: localiy.

		A. boulangeri			*A. elegans*	*A. aurelianensis*	*A. gracilis*	
		Tagai Bay	Saint-Gerand le-Puy	Vordersdorf (Thenius, 1950)	Saint-Gerand-le-Puy	Artenay (Mayet, 1908)	Montaigu-le-Blin	Saint-Gerand-le-Puy
M^2	L	7.8 - 8	–	–	–	–	7.5	–
	W	9.0 - 9.5	–	–	–	–	8.6	–
M_1	L	7.5 - 8.7	8	7.5	10.3	12	–	6.8
	W	5.3 - 5.7	6.2	–	6.8	–	–	5.2

Table 1.– Measurements in mm of M^2 and M_1 of *Amphitragulus*. L: length, W: width.

Humerus	DT dist.	19.4	
	DAP dist.	14.0	
Radius	DT prox.	17.4	
	DAP prox.	11	
Metacarpal	DT prox.	14	
	DAP prox.	10.8	
Tibia	DT dist.	15.5	16.5
	DAP dist.	12.0	12.4

Astragalus	L	18.5	20
	DT	12	13
	DAP	11.2	11.5
Navico-cuboid	L	16.2	
	DT	15.7	
	DAP	15	
Phalange I	L	22.5	24.8
Phalange II	L	14.5	16.2
Phalange III	L	13.8	15

Table 2.— Measurements in mm of the limb-bones of *Amphitragulus boulangeri* Pomel, 1853. DT: transverse diameter; DAP: antero-posterior diameter; L: length.

thick in the Tagai locality (layers 3, 5 and 7) all of which contain the same fossils (figs. 1, 2). Thus, one can assume that they were deposited within a short geological interval. The Tagai section is crowned by eluvial sediments (fig. 2, layer 1). The bones are yellowish-white in colour, some of them with traces of ferrugination and Mn-dendrites. Most of the bones were desintegrated before accumulation. The remains are disarticulated and fragmentary. Common elements include portion of jaws, limb-bones, and isolated teeth. Some bones of artiodactyls have been gnawed by predators.

Among the large mammalian remains, artiodactyls were the most abundent, not only in the number of species, but also in the quantity of their remains.

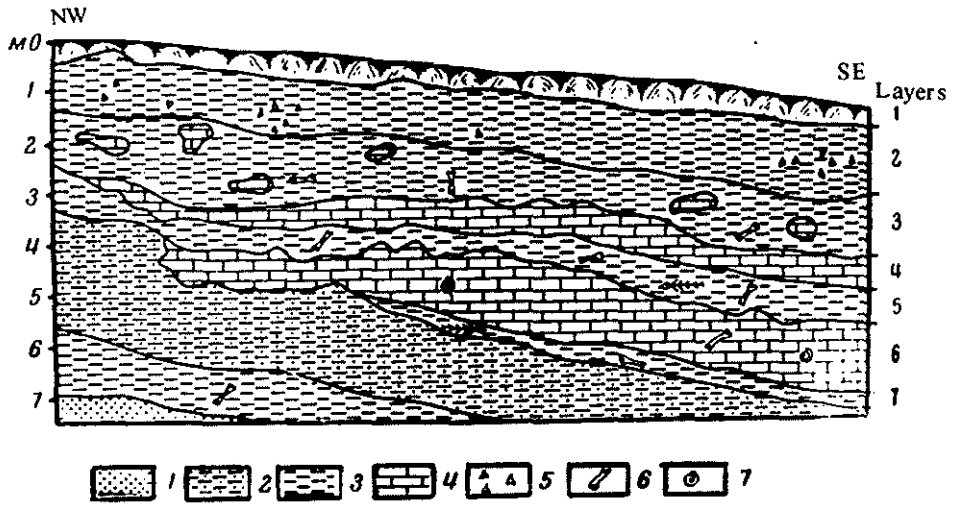


Figure 2.— Geological section of the Tagai outcrop (Logachev *et al.*, 1964). **1**: sand; **2**: sandy clay; **3**: clay; **4**: limestone; **5**: rubble; **6**: mammalian remains; **7**: mollusks.

DESCRIPTIONS

Order **ARTIODACTYLA** OWEN, 1848
Suborder **RUMINANTIA** SCOPOLI, 1777
Family **CERVIDAE** GRAY, 1821
Subfamily **DREMOTHERIINAE** GINSBURG & HEINTZ, 1966

Genus ***AMPHITRAGULUS*** POMEL, 1846

Amphitragulus boulangeri POMEL, 1853
(Pl. 1, figs. 1-9; tabs. 1, 2)

Material: Molars: two M^2, n° 4338/1, 4338/25; three M_1, n° 4338/2, 4338/23, 4338/24: limb-bones: distal end of humerus, n° 4338/3; proximal end of radius, n° 4338/36 proximal end of metacarpal, n° 4338/8; two distal ends of tibia, n° 4338/4, 4338/9; two astragali, n° 4338/5, 4338/6; navico-cuboid, n° 4338/7; incomplete calcaneum, n°

4338/10; distal trochlea of metapodials, n° 4338/18, 4338/19; four first phalanges n° 4338/11, 4338/12, 4338/13, 4338/21; two second phalanges, n° 4338/15, 4338/22; three third phalanges, n° 4338/16, 4338/17, 4338/20.

Description

The molars are small and very brachyodont. M^2 has a well developed parastyle, mesostyle and pillar of a paracone. The last one is in the shape of anteriorly bending fold. The metastyle and pillar of a metacone are almost not pronounced. A cingulum and *Palaeomeryx* fold on M_1 are present. The ectostilid is small and pillar-shaped. The differences between the heights of the lingual and labial selenes on the upper molar and those between the heights of the labial selenes on the lower molar are considerable.

The humerus has a low, shallow fossa coronoidea. The distal trochlea of the humerus narrows slightly in the direction of its lateral end. The index of narrowing of the distal trochlea of the humerus (the relation of the antero-posterior diameter of its medial end to the width of the throchlea along its long axis) is 0.8. The fovea capitis radii of the radius strongly inclined anteriorly. The metacarpal has a rounded-triangular proximal articular surface and lateral grooves for metapodials II and V. On the tibia, the anterior concavity of the facet for articulation with the fibula is narrow. The sulcus for the tendon leading to the musculus flexor digitorum longus on the postero-medial surface of the bone is deep, with sharp edges. The astragalus has a petal-shaped projection of the posterio-medial edges of the medial part of the proximal trochlea, and a sharp highly situated cuboid facet for the navico-cuboid on the posterior side, lying slightly lower than a third of the height of the bone on its posterior side. The navico-cuboid is high. Its posterior facet for metatarsal is small and short and does not reach the middle of the distal surface of the bone, anteriorly uplifted. The sulcus for the tendon leading to the musculus peroneus longus behind the anterior facet for the metatarsus is narrow and deep and is situated in a horizontal plane. The posterior lower medial angle is extended slightly backward. The third phalange is low and narrow with a pointed anterior end of the sole.

Comparison

Differs from *A. elegans* POMEL, 1846 and *A. aurelianensis* MAYET, 1908 by its relatively smaller size, and from *A. gracilis* POMEL, 1853 by its relatively larger size.

Notes

Ginsburg & Morales (1989) referred *A. boulangeri* and *A. gracilis* to the new genus *Pomelomeryx*. The following diagnostic features of *Pomelomeryx* have been pointed out: a very weak inclination of the external wall of the crown, and an isolated protocone on P^2 and P^3; a weakly reduced metaconule on M^3; weak inclination of the external wall and a short anterior part of the crowns on P_3 and P_4; a confluence of Mt V and canon bone.

For a more accurate definition of the systematic position of *A. boulangeri* and *A. gracilis* it is necessary to obtain more reliable morphological information. It seems to be more expedient to retain these species in the composition of the genus *Amphitragulus* until such information found.

		L. parvulus			*L. meyeri*	*L. praestans*	*L. colberti*	*L. primaevus*
		Tagai Bay	Statzling (Roger,1898)	Göriach (Thenius,1950)	Göriach (Hofmann, 1893)	Savigné-sur-Lathan (Gingburg *et al.*,1965)	Shanwang (Teilhard,1939)	Chiton-Gol (Teilhard, 1926)
P^3	L	7.8	–	7	–	–	–	–
	W	7	–	5.9	–	–	–	–
M^1	L	9	–	6.9	–	–	–	–
	W	9.8	–	5.9	–	–	–	–
P_4	L	9	5	6.0 - 6.4	8.1 - 8.9	11.5 – 13	12.5	6.3
	W	6.9	–	3.5 - 3.7	4.8 - 5.8	5.4 - 8.2	6	–
M_1	L	10	5.5	6	8.7 - 9.8	12.0 - 13.5	–	7
	W	7.9	–	4.5	6.1 - 7.3	8.2 - 9.2	–	–
M_3	L	13.9	9	8.4	13.8 - 15.7	18.0 - 20.3	19	11
	W	6.9	–	4.4	7.0 - 7.7	8.4 - 10.0	10	–

Table 3.— Measurements in mm of the teeth of *Lagomeryx*.

Humerus	DT dist.	18.5	18.7
	DAP dist.	17.8	17.9
Radius	DT prox.	17.4	17.9
	DAP prox.	10.9	11
Tibia	DT dist.	20.4	20.5
	DAP dist.	15	15

Astragalus	L	22	22.4
	DT	13.5	14.2
	DAP	13.5	13.5
Navico-cuboid	L	17.4	
	DT	16.9	
	DAP	17.1	

Table 4.— Measurements in mm of the limb-bones of *Lagomeryx parvulus* (Roger, 1898).

Subfamily **LAGOMERYCINAE** PILGRIM, 1941

Genus ***LAGOMERYX*** ROGER, 1904

Lagomeryx parvulus (ROGER, 1898)

(Pl. 1, figs. 10-18; tabs. 3, 4)

Material: Fragment of lower jaw, n° 4338/30; molars: P^3, n° 4338/27; M^1, n° 4338/28; P_4, n° 4338/112; M_1, n° 4338/16; M_3, n° 4338/29; limb-bones: two fragments of scapula, n° 4338/31, 32; distal end of humerus, n° 4338/33; proximal end of radius, n° 4338/36; proximal end of ulna, n° 4338/38; two distal ends of tibia, n° 4338/42, 4338/43; two fragmental calcanea, n° 4338/44, 4338/45; two navico-cuboids, n° 4338/49, 4338/51; four astragali, n° 4338/46, 4338/47, n° 4338/48, n° 4338/116; distal trochlea of metapodials, n° 4338/52, 4338/53.

Description

The diastema of the lower jaw is long. Molars are brachyodont, with a weak cingulum. The crown of P^3 is asymetrical with deep median sulcus on the lingual side situated close to the anterior edge of the crown. M^1 with a small parastyle, metastyle and pillar of paracone and well developed mesostyle. The index of hypsodonty of P_4 is 0.604. A Palaeomeryx fold is well developed. The stage of molarization of P_4 is high: the metaconide is enlarged in antero-posterior direction and is confluent anteriorly with the paraconid. The ala of the paraconid on P_4 is longer than that of parastylid. The former forms arc convex towards the metaconid. The lingual wall of the talonid is completely developed.

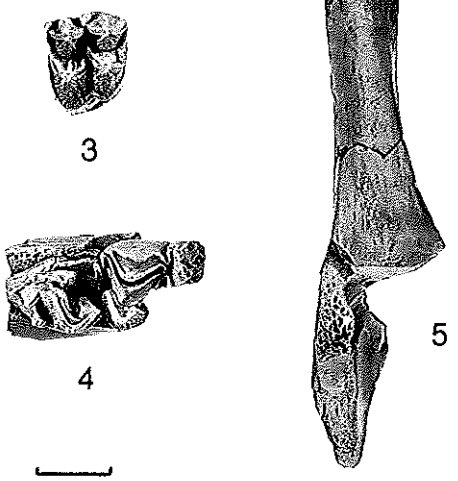


Figure 3.— Left M^3 of *Stephanocemas* sp., n° 4338/125. Scale bar = 1 cm.

Figure 4.— Fragment of the right jaw with destroyed M_1 and M_2 of *Palaeomeryx* cf. *kaupi* VON MEYER, 1834; n° 4338/123; occlusal view.

Figure 5.— Incomplete right calcaneum of *Palaeomeryx* cf. *kaupi* VON MEYER, 1834, n° 4338/124; anterior view.

The distal trochlea of the humerus narrows strongly towards its lateral end. The index of narrowing is 0.6. The index of inflation is 0.83. The anterior concavity of the facet for the fibula on the tibia is only slightly narrower than the posterior concavity of this facet. Sulcus for a tendon of the musculus peroneus on the inferior side of the navico-cuboid is wide and gently descends to the posterior medial facet. The cuboid facet on the posterior side of the astragalus is a very low-situated. The keel on the distal trochleas of the median metapodials are very slightly outlined anteriorly and are projected very strongly posteriorly.

Comparison

Differs from *L. meyeri* (HOFMANN, 1893), *L. praestens* STEHLIN, 1937 and *L. colberti* (YOUNG, 1937) by high stage of molarization of P_4. Besides, it differs from *L. praestans* and *L. colberti* by its smaller size and from *L. primaevus* (TEILHARD, 1926) by its larger size and smaller hypsodonty.

Subfamily **MUNTIACINAE** POCOCK, 1923
Tribe **DICROCERINI** SIMPSON, 1945

Genus ***STEPHANOCEMAS*** COLBERT, 1936

Stephanocemas sp.
(Fig. 3)

Material: M^3, n° 4338/125.

Description and **comparison**

M^3 is medium in size (L: 11.6, W: 13.2). The paracone is prominent. The cingulum is present on the anterior and posterior sides of the crown and labially. The fold of protocone is absent. The enamel is rugulose. By its morphology and dimention M^3 is close to that of *Stephanocemas* from Bézian (Gers, France), which had been referred to *S. elegantulus* (ROGER, 1904) by Ginsburg & Bulot (1987).

Family **PALAEOMERYCIDAE** LYDEKKER, 1883

Genus ***PALAEOMERYX*** MEYER, 1834

Palaeomeryx cf. ***kaupi*** MEYER, 1834
(Fig. 4)

Material: Fragment of lower jaw with incomplete M_1 and M_2, n° 4338/123; limb-bones: incomplete calcaneum, n° 4338/124; distal trochleas of metapodials, n° 4338/100, 101, 121, 122.

Description and **comparison**

A very poor preserved M_1 and M_2 do not differ by their morphology and sizes from those of *P. kaupi* MEYER, 1834. The width of M_1 is 12.7, and its calculated length

is approximately about 17. Differs from *P. lathanensis* GISNBURG, 1985 and from *P. magnus* (LARTET, 1851) by the smaller size.

Family indet.

Genus ***ORYGOTHERIUM*** MEYER, 1838

Orygotherium aff. ***escheri*** MEYER, 1838

(Pl. 2, figs. 1-14; tabs. 5, 6; figs. 6-12)

Material: Molars: P^2, n° 4338/56; M^1, n° 4338/63; two M^2, n° 4338/58, 4338/65; four M^3, n° 4338/57, 4338/62, 4338/64, 4338/66; four M_1, n° 4338/71, 4338/72, 4338/73, 4338/79; two M_2, n° 4338/75, 4338/76; M_3, n° 4338/60; fragments of the lower jaw with P_2–M_1, n° 4338/61; P_3–P_4, n° 4338/67; M_1–M_2, n° 4338/68; M_1–M_3, n° 4338/59; M_3, n° 4338/69; limb-bones: two distal ends of humerus, 4338/81, 4338/94; two proximal ends of radius, n° 4338/80, 4338/90; two distal ends of tibia, n° 4338/96, 4338/99; eigth astragali, n° 4338/77, 4338/83, 4338/84, 4338/86, 4338/87, 4338/117, 4338/118, 4338/119; two incomplete calcaneum, n° 4338/92, 4338/93; fragments of metapodials, n° 4338/97, 4338/102; second phalanges, n° 4338/115; third phalanges, n° 4338/116.

Description

The crowns of the upper molars are very low. They narrow strongly towards the occlusal surface and enlarged labially. The cingulum is powerful. It is particularly well developed at the lingual anterior edge of the crown. The entostyle is flattened. The pillar of paracone, parastyle and mesostyle are well developed. On the worn teeth, the pillar of the paracone makes a strong fold directed forward. The parastyle and mesostyle are very wide. On M^3, the metastyle is bent anteriorly. Molarization of P_4 is weak: the metaconide is only slightly enlarged. Pillars of metaconid and endoconid and *Palaeomeryx* fold are strong. The cingulum on the posterior side of the crowns makes a pocket-like fold approximately parallel to the flattened ectostylid and *Palaeomeryx* fold.

The medial parts of distal trochleas of the humerus and tibia and fovea capitis radii of the radius are very enlarged antero-posteriorly. The index of narrowing of the distal trochlea of the humerus is 0.628. The index of its inflation is 0.796. The facet for the fibula on the tibia is narrow and raises anteriorly. The sulcus for the tendon of the musculus flexor digitorum longus is not deep. The cuboid facet on the posterior side of the astragalus is highly-situated. The metatarsal gully was closed. The third palange is low, with a long narrow sole.

Comparison

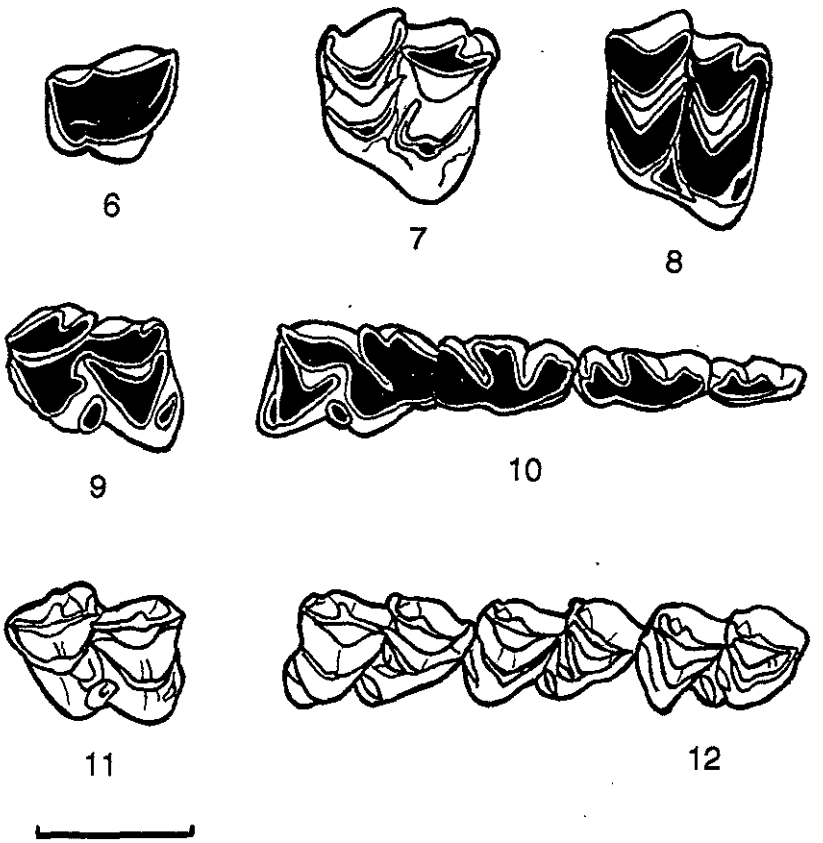
Most close to *O. escheri* MEYER, 1838, but differs from it by some primitive features of the dentition: molars have lower crowns and shorter fold of paracone, than those of *O. escheri.*

		O. aff. *escheri*		*O. escheri*	
		Tagai Bay		Käpfnach (Hofmann, 1893)	Göriach (Thenius,1950)
P^2	L	9.1	(1)	–	–
	W	7.8	(1)	–	–
M^1	L	10.5 – 11.4	(2)	–	8.2
	W	12.2 – 13	(2)	–	10.7
M^2	L	11	(1)	–	10
	W	13.8	(1)	–	11.5
M^3	L	12	(1)	–	10.5
	W	13	(1)	–	11.2
P_2	L	6.7	(1)	–	5.8
	W	3.3	(1)	3.4	3.2
P_3	L	8.3 – 8.5	(2)	7.6	7.6
	W	4.3 – 4.5	(2)	4.0	4.5
P_4	L	9.3 – 9.4	(2)	8	–
	W	5.6 – 6	(2)	5	–
M_1	L	9.0 – 11.2	(7)	–	9.1
	W	6.0 – 9.4	(7)	–	6.6
M_2	L	10.0 – 11.8	(4)	9.8	9
	W	7.5 – 10	(4)	7.2	6.9
M_3	L	13.9	(1)	14	12.2
	W	7.4	(1)	–	7

Table 5.— Measurements in mm of the teeth of *Orygotherium*.

Humerus	DT dist.	23.5	Tibia	DT dist.	24.5	
	DAP dist.	18.2		DAP dist.	20.2	
Radius	DT prox.	21.8	Astragalus	L	29.1	29.8
	DAP prox.	15.2		DT	16.9	18.1
				DAP	17.3	17.4

Table 6.— Measurements in mm of the limb-bones of *Orygotherium* aff. *escheri* Meyer, 1838.



Figures 6–12.— Teeth of *Orygotherium* aff. *escheri* MEYER, 1838; occlusal view. Scale bar = 1 cm.

Fig. 6.— Left P^2; n° 4338/56.
Fig. 7.— Right M^3; n° 4338/57.
Fig. 8.— Right M^3; n° 4338/66.
Fig. 9.— Left M_1; n° 4338/79.
Fig. 10.— Fragment of the right lower jaw with P_2–M_1, n° 4338/61.
Fig. 11.— Left M_2; n° 4338/76.
Fig. 12.— Fragment of the right lower jaw with M_1–M_3, n° 4338/59.

Notes

The genus and species were described on a fragment of a lower jaw from the Brown Coal of Käphnach, Switzerland. According to Thenius (1950), *Orygotherium* is known only from two European localities: in addition to the type locality, it has been found in Göriach, Austria.

The peculiar structure of the teeth and limb-bones distinguish it from all representatives of both of these group. The features characterizing *Orygotherium* are in particular: strong development of the pillar of a paracone on the upper molars, forming a fold on the wearing teeth; a very strong cingulum on the posterior side of the crown on the lower molars, forming an additional pillar parallel to an ectostylid on the wearing teeth; relatively slight flattening of the articular surfaces of the humerus, radius and tibia.

Suborder **SUIFORMES** JAEKEL, 1911
Family **ANTHRACOTHERIIDAE** GILL, 1872
Genus ***BRACHYODUS*** DEPÉRET, 1895

Brachyodus intermedius MAYET, 1908
(Pl. 2, fig. 15; tab. 7)

Material: M_3, n° 4338/104; first phalange, N 4338/105, second phalange, N 4338/106; third phalange, N 4338/107.

Description and **comparison**

M_3 is brachyodont with slight selenodonty. The metaconid is conic with a slight selene. A *Brachyodus* fold is present. The talonid is wide, elongated, with one cusp.

It is close to *B. intermedius* MAYET, 1908 by its dimension. Differs from *B. onoideus* by the smaller size.

		B. intermedius		*B. onoideus*
		Tagai Bay	Chitenay (Mayet, 1908)	Chilleurs (Mayet, 1908)
M_3	L	43.3	42	50
	W	21.4	22	29

Table 7.— Measurements of M_3 of *Brachyodus*.

THE ENVIRONMENT AND GEOGRAPHIC DISTRIBUTION OF THE TAGAI MAMMALS

The Tagai fauna is dominated by animals of rather woody habitates. Among the ruminants, the borwsers predominant (*Amphitragulus*, *Stephanocemas*, *Orygotherium*, and *Palaeomeryx*) and the grazers are not numerous (*Lagomeryx parvulus*).

Palynologically, the Chalagai suits is characterized by a spectrum of the broad-leaved-coniferous forest type (Logachev *et al.*, 1964). The main part of the spectrum belongs to coniferous trees: *Picea*, *Abies*, *Tsuga*, and *Larix*. The pollen of broad-leaved trees comprises not more than 30 % of the sample, with *Alnus* and *Betula* predominant. Other elements of the broadleaved flora include: *Fagus*, *Carpinus*, *Castanea* and *Quercus*. The pollen of herbs and shrubs are not numerous but are very diverse, represented by Graminaceae, Cyperaceae, Compositae, Chenopodiaceae, Nymphaeceae, Ranunculaceae, and Onagnaceae. Judging from the composition of the pollen spectrum, forest steppe landscapes were present in the Tagai area during the end of the Early Miocene, with open areas intermixed with woodlands.

The saturation of carbonates and weak gypsogenous of the Chalagai deposits and the presence of limestone in it indicate a warm semi-arid climate at the time of sedimentation (Logachev *et al.*, 1964).

On the whole, the Tagai fauna shows a predominance of the form widespread within the Palaearctic region, such as *Talpa*, *Cricetodon*, *Anchitherium*, *Dicerorhinus*, *Amphitragulus*, *Lagomeryx*, *Staphanocemas*, and *Palaeomeryx*. Most of the species existed in an ample territory extended from France to the south of Eastern Siberia: *Amphitragulus boulangeri*, *Lagomeryx parvulus*, *Palaeomeryx* cf. *kaupi*, and *Brachyodus intermedius* (fig. 13). Similarity of the Tagai fauna with those of Europe suggest the existence of a united Europe-Siberian paleozoogeographical sub-area in the Palaearctic region during that time. It was stretched in the middle latitudes of Eurasia. The southern boundary of the sub-area did not evidently fall furthur south than 40°northern latitude, and in west it extended along the northern coast of Paratethys.

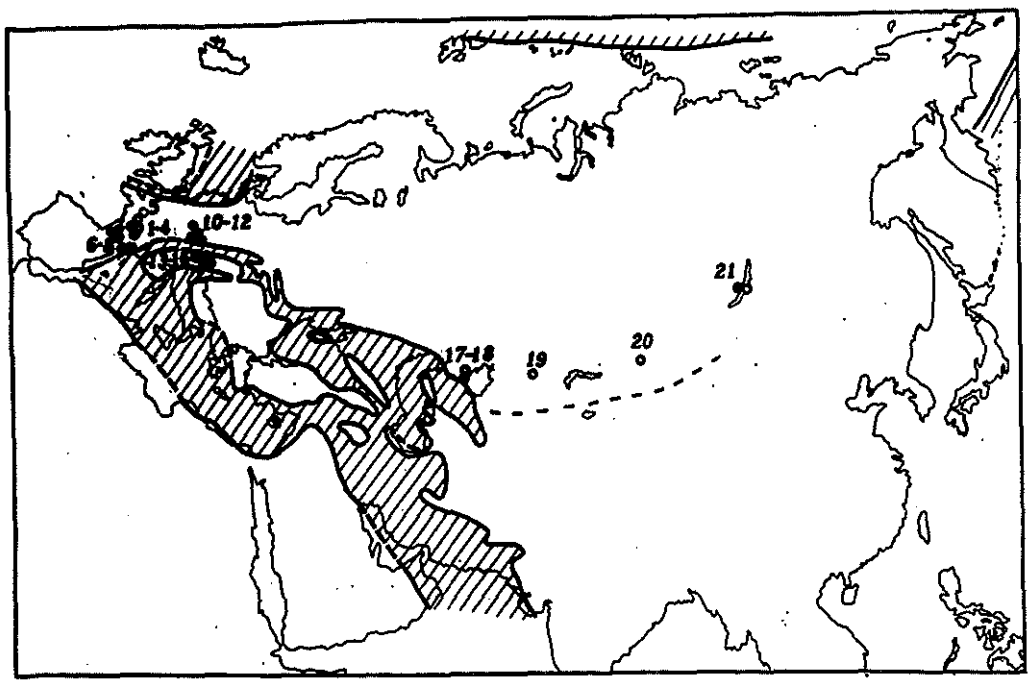


Figure 13.— Main localities of deer. 1: Saint-Gérand-le-Puy; 2: Laugnac; 3: Beilleaux; 4: Baigneaux-en-Beauce; 5: Langy; 6: Estrepouy; 7: Rimbez; 8: Sos; 9: Chitenay; 10: Steinberg ; 11: Wintershof-West; 12: Sandelshausen; 13: Vordersdorf; 14: Göriach; 15: Neudorf; 16: Brunn-Vösendorf; 17: Kozhasai; 18: Bestube; 19: Kizil-Kija; 20: Ashutas; 21: Tagai.
White circle: sites of *Amphitragulus boulangeri* POMEL, 1853; black circle: those of *Lagomeryx parvulus* (ROGER, 1898).

THE STRATIGRAPHIC POSITION OF THE TAGAI FAUNA

Most of the mammalian genera represented in the Tagai fauna originated in the Early Miocene: *Talpa*, *Cricetodon*, *Anchitherium*, *Lagomeryx*, and *Palaeomeryx* (fig. 14). The presence in the fauna of the genus *Procaprolagus*, typical for the Oligocene of Asia, gives it an archaic appearance. The genera *Dicerorhinus*, *Amphitragulus*, and *Brachyodus* also appeared in the Oligocene. According to Mein (1979), the association of "*Anchitherium-Brachyodus*" was typical for zone MN 3 in Europe. The coexistance of *Amphitragulus* and *Lagomeryx* usual for faunas of the Orleanian.

It is evident that the Tagai fauna could not be more ancient than zone MN 3, as the lower stratigraphic limits of the majority of its genera and its three species (*Lagomeryx parvulus*, *Paleomeryx* cf. *kaupi* and *Brachyodus intermedius*) coincide with that zone (fig. 15). The stratigraphic distribution of *L. parvulus* ranges from the Lower Miocene to the base of the Middle Miocene (Orleanian-Lower Astaracian, zones MN 3-6). (Roger, 1904; Stehlin, 1937; Thenius, 1950; Obergfell, 1957; Ginsburg, 1967; Heizmann *et al.*, 1980). The most ancient remains of that species were found in

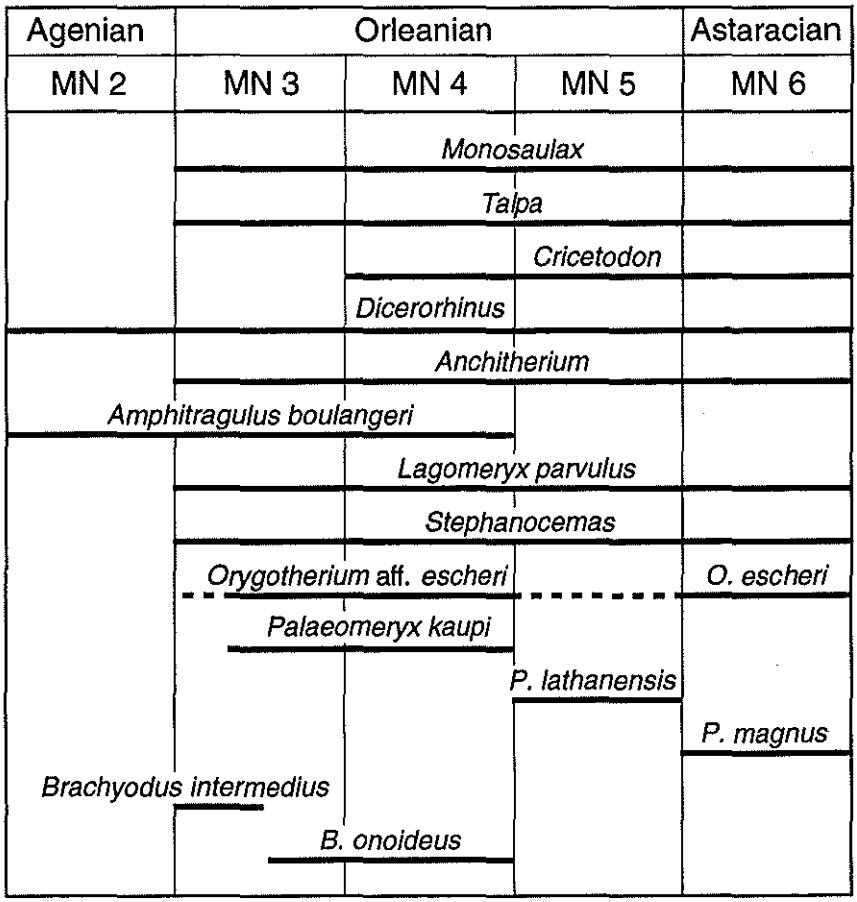


Figure 14.— Stratigraphic distribution of some mammals.

		Amphitragulus boulangeri	*Lagomeryx parvulus*	*Stephanocemas*	*Orygotherium escheri*	*Palaeomeryx kaupi*	*Brachyodus intermedius*
MN 6	Göriach	·	+	·	+	·	·
MN 5	Sos	·	+	·	·	·	·
	Rimez	·	+	·	·	·	·
MN 4	Pontlevoy-Thenay	·	·	·	·	+	·
	Baigneaux	·	+	·	·	+	·
	Bezian	·	·	+	·	+	·
	Kizil-Kija	+	·	·	·	·	·
	Tagai	+	+	+	aff.	cf.	+
MN 3	Bestube	+	·	+	·	·	·
	Chilleur	·	·	·	·	+	·
	Wintershof-West	cf.	+	·	·	aff.	·
	Beilleaux	cf.	·	·	·	·	+
	Estrepouy	·	+	·	·	·	·
	Chitenay	cf.	·	·	·	+	+
	Ashutas	+	·	·	·	·	·
MN 2	Laugnac	+	·	·	·	·	·
	Saint-Gerand-le-Puy	+	·	·	·	·	·
	Kozhasai	+	·	·	·	·	·

Figure 15.— Distribution of the Tagai artiodactyls.

Wintershof-West, Germany, and its analogues, the earliest having come from Brown Coals at Göriach, Austria, and from a number of other localities in Austria and Germany, having similar geological age (Thenius 1950; Mein, 1990). *B. intermedius* is typical in Europe only for the bottom of the Orleanian (zone MN 3a). Its remains have been found in the localities of Chitenay and Beilleaux, France (Mayet, 1908; Ginsburg *et al.*, 1988). The stratigraphic distribution of *Palaeomeryx kaupi* is limited by the Lower Orleanian (zones MN 3b-4) (Ginsburg, 1985). The presence in the Tagai fauna of *Cricetodon* suggests that it should be correlated most probably, with zone MN 4 but not with zone MN 3, as the appearance of that genus is usually associated with the first (Mein, 1979, 1990).

The upper stratigraphic limit of the Tagai fauna is determined by the presence of the species *Amphitragulus boulangeri* and of the genus *Brachyodus* whose distribution does not exceed zone MN 4. The oldest remains of *A. boulangeri* are known in Europe

from Saint-Gérand-le-Puy, and from other localities of similar age. And the earlier ones are from Beilleaux, France, and from Wintershof-West, Germany, and Vordersdorf, Austria (Hofmann, 1888; Thenius, 1950; Ginsburg *et al.*, 1987).

Thus, analysis of the Tagai fauna demonstrates its resemblance with faunas of the beginning of the Orleanian (zones MN 3-4). The fauna of Wintershof-West, with *Anchitherium aurelianense*, *Amphitragulus* cf. *boulangeri*, *Lagomeryx parvulus*, *Palaeomeryx* aff. *kaupi* (Oberfgell, 1957; Mein, 1990), is possibly the closest analogue of the Tagai fauna in Central Europe. In Western Europe the fauna from Chitenay and its analogues, with *Anchitherium aurelianense*, *Palaeomeryx kaupi* and *Brachyodus intermedius* (Mayet, 1908), correspond to it.

In Russia, the fauna of Bestube, Usturt, which is correlated with zone MN 3 or MN 4 (Gabunia, 1981, 1986), is apparently also close to the Tagai fauna. In the composition of the Bestube fauna from the sandstones with *Rzehakia socialis* were in particular determined: *Dicerorhinus* sp., *Amphitragulus boulangeri*, *Lagomeryx* sp., and *Stephanocemas aralensis* (Abdrachmanova, 1973; Beliajeva, 1974; Gabunia, 1986; Vislobokova, 1990).

CONCLUSIONS

The artiodactyls remains from the Chalagai suite of the Tagai locality, Olhon Island (Baikal) belong to *Amphitragulus boulangeri*, *Lagomeryx parvulus*, *Stephanocemas* sp., *Palaeomeryx* cf. *kaupi*, *Orygotherium* aff. *escheri*, and *Brachyodus intermedius*.

Analysis of the stratigraphical distribution of the species of artiodactyls from the Tagai fauna and the genera and species of the other mammals has allowed a more precise definition of the age of that fauna and of the base of the Chalagai suite. Data on considerable latitudinal extension of the ranges of the Tagai mammals provides a basis for paleozoogeographical reconstructions.

The Tagai artiodactyls indicate a Lower Miocene age for the fauna and for the base of the Chalagai suite. That fauna existed during the second part of the Early Miocene in semi-arid climate. It corresponds to the Early Orleanian faunas of Europe (zones MN 3-4).

Olhon Island is the easternmost point at which *Amphitragulus boulangeri*, *Lagomeryx parvulus* and *Palaeomeryx* cf. *kaupi* have been found. They were widely distributed in the Early Miocene faunas of Europe. The presence of these species on Olhon Island so as that of *Orygotherium* aff. *escheri* indicate a great resemblance the Early Miocene faunas of Europe to those of the southern part of Eastern Siberia and permit suggestion of the existence of a single united zoogeographical sub-area which stretched in the middle latitudes of Eurasia from France to its eastern districts. The southern boundary apparently did not fall south of 40° northern latitude.

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LEGENDS OF PLATES

PLATE 1

Amphitragulus boulangeri POMEL, 1853

Fig. 1.— Left M^2; n° 4338/1; occlusal view; x 2.

Fig. 2.— Right M_1; n° 4338/2; occlusal view; x 2.

Fig. 3.— Distal end of left humerus; n° 4338/3, anterior view.

Fig. 4.— Proximal end of right radius; n° 4338/36; a: anterior view, b: upper view.

Fig. 5.— Proximal end of right metacarpal; n° 4338/8; anterior view.

Fig. 6.— Distal end of left tibia; n° 4338/4; a: anterior view, b: inferior view.

Fig. 7.— Left astragalus; n° 4338/5; anterior view.

Fig. 8.— Left navico-cuboid; n° 4338/7; anterior view.

Fig. 9.— First phalange, n° 4338/11; anterior view.

Lagomeryx parvulus (ROGER, 1898)

Fig. 10.— Left P^3; n° 4338/27; occlusal view; x 2.

Fig. 11.— Left M^1; n° 4338/28; occlusal view; x 2.

Fig. 12.— Left P_4; n° 4338/112; occlusal view; x 2.

Fig. 13.— Right M_3; n° 4338/29; occlusal view; x 2.

Fig. 14.— Fragment of lower jaw; n° 4338/30; external view.

Fig. 15.— Distal end of right humerus; n° 4338/33, anterior view.

Fig. 16.— Distal end of left tibia; n° 4338/43: a: anterior view, b: posterior view.

Fig. 17.— Right astragalus; n° 4338/48; anterior view.

Fig. 18.— Right navico-cuboid; n° 4338; anterior view.

Coll. PIN, Moscow; Tagai Bay, Olhon Island, Lake Baikal (Russia). Figures 3-9 and 14-18 are given in natural sizes.

PLATE 2

Orygotherium aff. *escheri* MEYER, 1838

Fig. 1.— Left P^2; n° 4338/56; occlusal view; x 2.

Fig. 2.— Right M^3; n° 4338/57; occlusal view; x 2.

Fig. 3.— Right M^2; n° 4338/65; occlusal view; x 2.

Fig. 4.— Fragment of right lower jaw with M_1–M_3; n° 4338/59; occlusal view; x 2.

Fig. 5.— Left M_2; n° 4338/76; occlusal view; x 2.

Fig. 6.— Left M_1; n° 4338/79; occlusal view; x 2.

Fig. 7.— Right M_3; n° 4338/60; occlusal view; x 2.

Fig. 8.— Fragment of right lower jaw with P_2–M_1; n° 4338/61; occlusal view; x 2.

Fig. 9.— Distal end of right humerus; n° 4338/81; anterior view.

Fig. 10.— Proximal end of left radius; n° 4338/80; a: anterior view, b: upper view.

Fig. 11.— Distal end of left tibia; n° 4338/96; a: anterior view, b: inferior view.

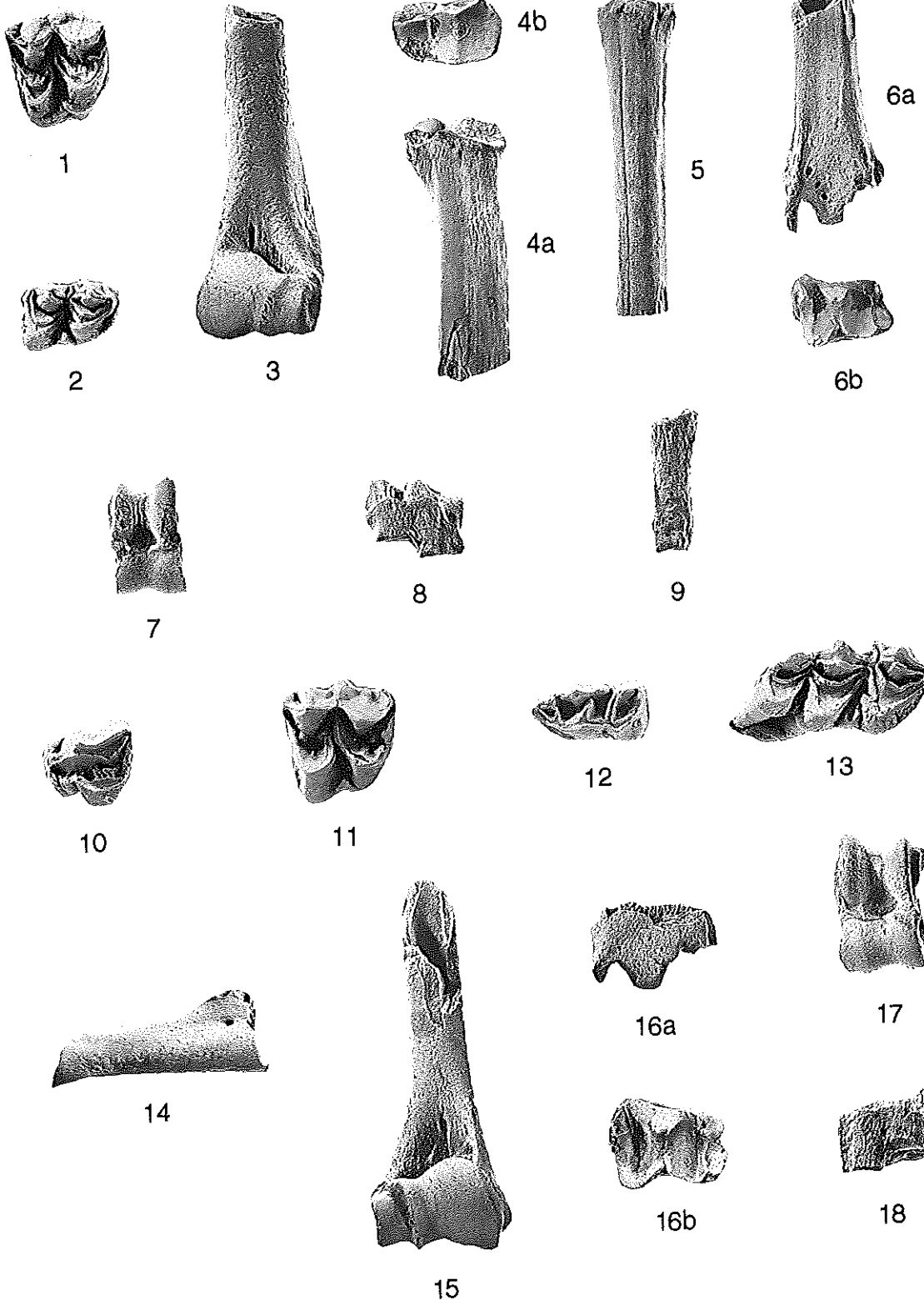
Fig. 12.— Left astragalus; n° 4338/77; anterior view.

Fig. 13.— Second phalange; n° 4338/115; anterior view.

Fig. 14.— Third phalange; n° 4338/116; a: external view, b: internal view, c: inferior view.

Fig. 15.— *Brachyodus intermedius* MAYET, 1908; left M_3; n° 4338/104, occlusal view.

Coll. PIN, Moscow; Tagai Bay, Olhon Island, Lake Baikal (Russia). Figures 9-15 are given in natural sizes.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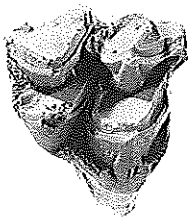

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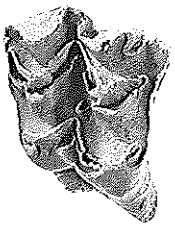

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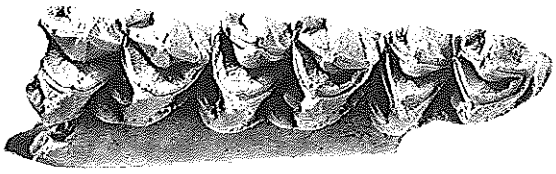

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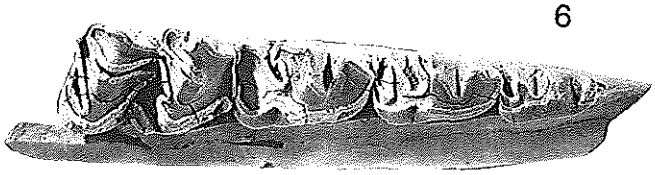

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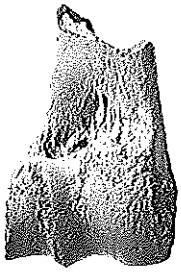

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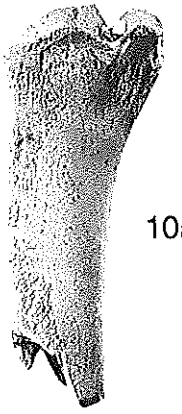

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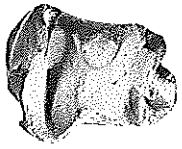

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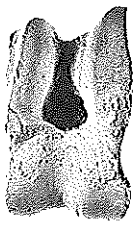

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