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Paracamelus from the Late Pliocene of the Black Sea region

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Abstract - *The small camel* Paracamelus alutensis *is a typical representative of East European faunas of the Late Pliocene and the Early Pleistocene. This species is considered an endemic form of the Black Sea territory. Morphological features of* Paracamelus *and the accompanying fauna's structure testify about the inhabitance of this animal in steppe and forest-steppe landscapes. Particularities of the Late Pliocene and the Early Pleistocene faunas from the south of Eastern Europe distinguishing the Black Sea - Kazakhstanian province in Mediterranean zoogeographical subarea.*

Keywords: *Paracamelus*, Black Sea region, Late Pliocene

РЕЗЮМЁ - Мелкий верблюд *Paracamelus alutensis* является типичным представителем восточноевропейских фаун конца плиоцена - начала плейстоцена. Этот вид рассматривается как форма, эндемичная для территории Причерноморья. Морфологические признаки *Paracamelus* и состав сопутствующих фаун свидетельствуют об обитании этого животного в условиях степного и лесостепного ландшафтов. Особенности позднеплиоценовых и раннеплейстоценовых фаун юга Восточной Европы позволяют говорить о выделении причерноморско-казахстанской провинции в пределах Средиземноморской зоогеографической подобласти.

Paracamelus alutensis (Ştefănescu) was depicted by the lower jaw from Romania. It was found in deposits in the range dating from the Upper Pliocene to the Lower Pleistocene (Stefanescu 1895, 1910, Havesson 1954). Since then isolated remains of the Upper Pliocene small camels were described from the territory of Romania (Simionescu 1932, Stefanescu 1895, 1910, Ghenea & Radulescu 1963, Radulescu & Samson, 1990, 1996, 2001, Radulescu & Burlacu 1993), Ukraine (Alexeeva 1974, Topachevsky 1956, Pidoplichko & Topachevsky 1962, Topachevsky & Nesin, 1989), south of Russian Plain (Havesson 1954, Bajgusheva 1971, 1984, Alexeeva 1977a, b), Turkey (Kostopoulos & Sen 1999) (Fig.1). The most mass material was found in some localities of the Upper Pliocene alluvial Khapry layers. These strata are exposed along the north coast of the Taganrog gulf of the Sea of Azov and the left bank of the lower current of the Don River. (Vasilev 1969, The section of newest deposits…, 1976). More than 200 bones of *Paracamelus alutensis* are known from here, which is about 14% of the whole quantity of large vertebrate remains of the Khapry faunal complex. This association dates to the Late Pliocene and corresponds to the level of the typical middle Villafranchian Saint-Vallier faunal unit in the Western Europe (Vangengeim & Pevzner 1991). These orictocenosis includes: *Nyctereutes megamastoides* (Pomel), *Homotherium crenatidens* (Fabrini), *Anancus arvernensis alexeevae* (Bajguscheva), *Archidiskodon meridionalis gromovi* (Garutt et Alexeeva), *Hipparion* cf. *moriturum* Kretzoi, *Equus livenzovensis* Bajgusheva, *Elasmotherium* cf. *caucasicum* Borissiak, *Cervus* (*Rusa*) cf. *philisi* Shaub, *Eucladoceros* cf. *dicranios* Nesti, *Libralces* cf. *gallicus* Azzaroli and other forms.

The small mammal association from the Liventsovka sand pit (the parastratotype of Khapry faunistic complex) is characterized by the appearance of remains of *Mimomys praepliocaenicus* Rebeder, *Borsodia praehungaricus cotlovinensis* (Topachevsky & Scorik) and *Mimomys* ex gr. *reidi* Hinton (Tesakov 1993, 1995, Bajgusheva *et al.* 2001). This complex allows the correlation of the deposits with the middle Villafranchian and the lower part of MN 17 zone. Findings of "Psekups type" rodents in the upper layers of this pit testify that the age of Khapry complex is older than the terminal Pliocene (Bajgusheva *et al.* 2001).

In the *Paracamelus alutensis* remains collection, except for numerous teeth, jaws and limb bones, there is unique finding of an almost whole cranium and vertebral column. There are remains of large *Paracamelus* cf. *gigas* Schlosser in collection from Khapry deposits, too (Khohlovkina 1940, Gromov 1948, Havesson 1954, Bajgusheva 1971, Alexeeva 1977a).

Fig. 1 - Localities of *Paracamelus alutensis* Ştefănescu. 1 - Khapry; 2 - Liventsovka; 3 - Morskaya; 4 - Psekups (ALEXEEVA 1977 b); 5 - Tsymbal (HAVESSON 1954); 6 - Kairy (TOPACHEVSKIY 1956, PIDOPLICHKO & TOPACHEVSKIY 1962); 7 - Kryzhanovka (KHOMENKO 1915, HAVESSON 1954); 8 - Zhevakhova gora (ALEXEEVA 1974, 1977a); 9 - Dolinskoe (ALEXEEVA 1977); 10 - Tulucești (GHENEA & RADULESCU 1963); 11 - Slatina, Milcovu-2 (ŞTEFANESCU 1910, GHENEA 1970, RADULESCO & SAMSON 1990); 12 - Frătești (RADULESCU & BURLACU 1993), 13 - Sarikol Tepe (KOSTOPOULOS & SEN 1999).

The range of *P. alutensis* distribution is considered within the Late Pliocene - Early Pleistocene bounds. The majority of Alutensis camel localities is dating within these limits. The holotype of *P. alutensis* was discovered in Slatina area (Olteț Valley, Romania) in Quaternary sand-gravel layers near Milcovul de Jos. From the same place, the remains of elephant, rhinoceros and antelope were pointed (ŞTEFANESCU 1910, HAVESSON 1954). But there is no exact dating of these strata. There are known some Upper Pliocene small mammal sites from the Slatina neighborhood: Slatina 1 with *Dolomys milleri* Nehring, *Mimomys minor* Fejfar is referred to MN 16b zone; Slatina 2 is corresponding to upper Khapry layers includes *Dolomys ferui* Rădulescu & Samson, *Mimomys* cf. *livenzovicus* Alexandrova, *Borsodia* sp. - MN 17; Slatina 3 with *Mimomys* ex gr. *minor - coelodus* MN 17/MQ 1 (RADULESCU & SAMSON 1996).

There are several other localities with *P. alutensis* on the territory of Romania, from the interstream of Olteț and Argeș Rivers. Layers with small camels remains have several different ages ranging from Late Pliocene to Early Pleistocene. *Paracamelus* bones were discovered jointly with early and middle Villafranchian *Zygolophodon borsoni, Anancus arvernensis* ssp., *Archidiskodon meridionalis* ssp., *Stephanorhinus* cf. *etruscus, Equus stenonis* and *Leptobos* sp. (GHENEA 1970). *Alutensis camel* findings are known from another locality of the Dacic Basin - Milcovu 2 (Olteț Valley, Slatina area), too. *Dolomys milleri, Mimomys* ex gr. *stehlini - minor* were determinated from these magnetically reversed strata situated above deposits of normal polarity assigned to the Olduvai event (RADULESCO & SAMSON 1996, 2001). Rădulescu and Samson consider that *P. alutensis* coexisted with *Trogontherium boisvilletti, Canis etruscus, Pachycrocuta brevirostris, Archidiskodon meridionalis meridionalis, Equus stenonis mitilanensis, Mitilanotherium* sp., *Eucladoceros* sp., *Libralces gallicus* and *Megalovis latifrons* (RADULESCO & SAMSON 1990).

The fragment of a lower jaw of *P. alutensis* was depicted from Tulucești (eastern Romania). It was found with remains of the Middle and Late Pliocene *Zygolophodon borsoni*, *Anancus arvernensis* ssp., *Archidiskodon meridionalis* ssp. and *Cervus issiodorensis* (GHENEA & RADULESCU 1963).

A rich collection of the Early Pleistocene large mammals is known from the basal alluvial horizon of VIII terrace (upper Porat deposits) of the Danube River, near Dolinskoe (Rep. of Moldova). In this taphocenosis *Paracamelus alutensis* coexisted with *Trogontherium cuvieri, Archidiskodon meridionalis* ssp., *Palaeoloxodon antiquus* (?), *Equus* cf. *stenonis, Stephanorhinus etruscus, Elasmotherium* cf. *caucasicum, Bison suchovi, Eucladoceros* sp. and *Eucladoceros* cf. *orientalis* (ALEXEEVA 1977a).

Near a Kryzhanovka village (Odessa region, Ukraine) in the "kryzhanovka" stratum, the first phalanx of Alutensis camel was found jointly with *Eucion odessanus* (Odintov) and *Archidiskodon* m. *gromovi* (ALEXEEVA 1974, 1977). From different beds in this site, bones of *Anancus arvernensis, Archidiskodon meridionalis* ssp., *Hipparion* sp., *Equus stenonis, Stephanorhinus* sp., *Elasmotherium* cf. *caucasicum*, "*Alces* sp.", *Cervus* sp. and *Bovidae* gen. were collected. From the level with

camel remains, small mammals are known - *Ochotonoides kujalnicensis* Topachevsky et Scoric, *Citellus nogaici* Topachevsky, *Alactaga ucrainica* Gromov & Shevireva, *Microspalax odessanus* Topachevsky, *Plioscirtopoda* cf. *stepanovi* I. Gromov & Schevtshenko, *Apodemus* sp., *Parapodemus* sp., *Euxinomys* sp., *Phagapodemus* sp., *Allocricetus* cf. *bursae* Shaub, *Promimomys stehlini*, *Borsodia petenyii* Meh., *B. fejervaryi*, *Mimomys* ex gr. *pliocaenicus-polonicus*, *M. hintoni* Fejfar and *M. reidi* Hinton (Kryzhanovka-3 by A.S. Tesakov 1993). This association belongs to Psekups faunistic complex and is dating as terminal stage of the Villanyan (late Villafranchian).

From the Pliocene layers near Kotlovina village (Odessa region, Ukraine) the first phalanx of *Paracamelus* cf. *alutensis* was found together with Villafranchian *Anancus* cf. *arvernensis*, *Archidiskodon meridionalis gromovi*, *Equus* ex gr. *stenonis*, *Stephanorhinus etruscus*, *Eucladoceros* sp., Cervidae gen. indet., *Gazella* sp., *Vulpes* sp. and *Lycyaena* cf. *lunensis* Del Kamp (TOPACHEVSKY & NESIN 1989, LOGVINENKO 1998). Bones of large mammals in those localities were came chiefly from a big clastic bed. It contains the Kotlovina 2 association of small mammals. *Citellus* cf. *nogaici* Topachevski, *Allactaga ucrainica* I. Gromov & Schevchenko, *Nannospalax odessanus* (Topachevski), *Borsodia petenyii*, *B. feiervaryi*, *Mimomys pliocaenicus* F. Major, *M. hintoni* Feifar, *Dolomys nehringi* Kretzoi, *D. milleri* Nehring, *Pliomys jalpugensis* Nesin and *P.ucrainicus topachevskii* Nesin prevail in these layers (TOPACHEVSKY & NESIN 1989). This association correlates with upper liventsovian microteriofauna, which is dating as the late Villanyian (TESAKOV 1995).

From the middle bed of the Cherevichnoe locality, on the left bank of Hadjibey estuary (Odessa region, Ukraine) a few findings of *P. alutensis* are also known (LOGVINENKO 2000). Cherevichnoe - 2 is characterized by rodent association of "Khapry" type with the prevailing of *Villanyia petenyii, V. fejervaryi, Pliomys ucrainicus, Mimomys* cf. *pliocaenicus, M.hintoni* and *M. reidi* (TOPACHEVSKY *et al*. 1987, REKOVETS 1994).

From Kujalnik in the early Pleistocene deposits, the lower jaw of small camel was described. I. P. Khomenko attributed it to *P.* "*kujalnensis*" (Khomenko).

Among the findings from the Psekups site near Saratovskaya (Psekups river, Krasnodar region, Russia) were the joint remains of *Archidiskodon meridionalis meridionalis, Equus stenonis, Stephanorhinus* cf. *etruscus, Bison* cf. *suchovi, Eucladoceros orientalis* and the fragment of *Paracamelus* cf. *alutensis* scapula is also known (ALEXEEVA 1977b). From the strata of "red auburn-brown coarse gravels" in the middle part of the outcrop, near Saratovskaya, the fauna of rodents was described: *Mimomys* ex gr. *reidi* Hintoni, *Mimomys* sp. (large form), *Pitymyoides pitymyoides* (Janossy & van der Meulen), *Borsodia* sp., *Clethrionomys kretzoii* (Kow.), *Allocricetus* cf. *ehiki* Schaub, *Apodemus* sp., *Nannospalax* cf. *odessanus* Topachevsky, *Spermophilus* sp., *Beremendia fissidens* (Peteny), *Leporidae* gen. and *Petenyia hungarica* Kormos (TESAKOV 1995). The association of small mammals, shells of *Unio tamanensis* Ebers, and the reverse polarity of hosting beds testified about the late Villafranchian age of this fauna (VANGENGEIM & PEVZNER 1990). An animal complex from the Psekups strata corresponds to Seneze or Olivola Faunal Unit (the beginning of late Villafranchian of Italy).

The structure of mammal fauna from alluvial deposits near Kairy (Khreson region, Ukraine) allows it to be attributed to Psekups or slightly younger complex, but older than Taman one. *P. alutensis* in this taphocenosis coexists with *Archidiskodon meridionalis* ssp., large *Equus stenonis, Bos* sp. and *Bison* sp. The association of small mammal (*Desmana nogaica* Topachevsky et Paschkov, *Ochotona* sp., *Spermophilus nogaici* Topachevsky, *Sicista vinogradovi* Topachevsky, *Cricetus nannus* Schaub, *Villanyia fejervaryi* Kormos, *Lagurodon arankae* Kretzoi, *Prolagurus pannonicus* Kormos, *Eolagurus argyropuloi adventus* Rekovets, *Mimomys intermedius* Newton, *Allophaiomys pliocaenicus*) testifies to its age in the range of the Nogaisk stage, at the end of the Early Pleistocene (TOPACHEVSKY 1956, PIDOPLICHKO & TOPACHEVSKY 1962, ALEXEEVA 1977b, REKOVETS 1994).

Paracamelus cf. *alutensis* came in the stuff of the Late Pliocene complex from Turkey. The association of large mammals, including *Eucyon* cf. *odessanus*, *Pliocrocuta perrieri*, *Homotherium* sp., *Equus stenonis* and *Gazellospira* cf. *torticornis* allows the fauna attributed to the Sarikol Tepe (Ankara) to MN 17 zone (KOSTOPOULOS & SEN 1999).

The part of a small camel's humerus in the Taman fauna collection from the locality Tsymbal (Taman Peninsula) can attest that *P. alutensis* exists in this faunistic complex together with one of the latest representative of Anancus (VERESTCHAGIN 1957, DUBROVO 1963, ALEXEEVA 1974). Rodent association from this site, due of the evolutional level of *Clethrionomys hintonianus* (Kretzoi), is dated by A. S. Tesakov (TESAKOV 1996) as early Biharian (Early Pleistocene).

So the statigraphy range of Alutensis camel comprises the Late Pliocene - the Early Pleistocene (contemporaneous with Khapry, Psekups and the beginning of Taman faunistic complexes). That correspondes to the whole MN 17 and the beginning of MNQ 18 (MQ 1). However, it is possible that the first appearence of *P. alutensis* on the territory of the Black Sea region be dated to the end of the early Villafranchian (Middle Pliocene). The likely joint their findings together with *Zygolophodon borsoni* in Romania. The Alutensis camel becomes the most numerous in orictocenosis of the end of Pliocene.

Paracamelus alutensis differs from the representatives of genus Camelus - *C. knoblochi, Camelus bactrianus ferus* by its smallest size. It resembles small individuals of *C. dromedarius* L. by measurements. The cranium of little *Paracamelus* differs from the *Camelus* ones by several features:

-elongating facial cranium (face part is 77.4% from the base cranium length);

-different nasal bone shape;

-more concave palate;

-more advanced, forward choanas (they are on the level of the M^3 back in Camelus, and on the level of the M^2 back in *P. alutensis*);

-absence of facial crest;

-presence of well developed P_3;

-longer and comparative low branch of the lower jaw (the ratio of the breadth to the height of the jaw on the M_3 level is 61.6 in *Paracamelus alutensis* and 53.5 in *Camelus bactrianus*);

-longer symphysis of the lower jaw (Fig. 2).

The Alutensis camel from the Khapry sands has more slender limb bones (Table 1). Metapodiums are characterized by smaller bone width and higher bifurcation of articular condyles of distal epiphysis. There are some differences in development degree and position of tubercles on the bones in comparison with the Camelus ones. These features may testify about another method of the locomotion of these animals.

P. alutensis is smallest of all Plio-Pleistocene Eurasian Camelidae. Its essential features are large height in the withers and long limbs. This form has no serious morphological distinctions in the cranium, teeth and skeleton structure from *P. chersonensis alexejevi* (Havesson) from the Odessa karst caves (Lower Pliocene). They differ from each other mainly by size. It

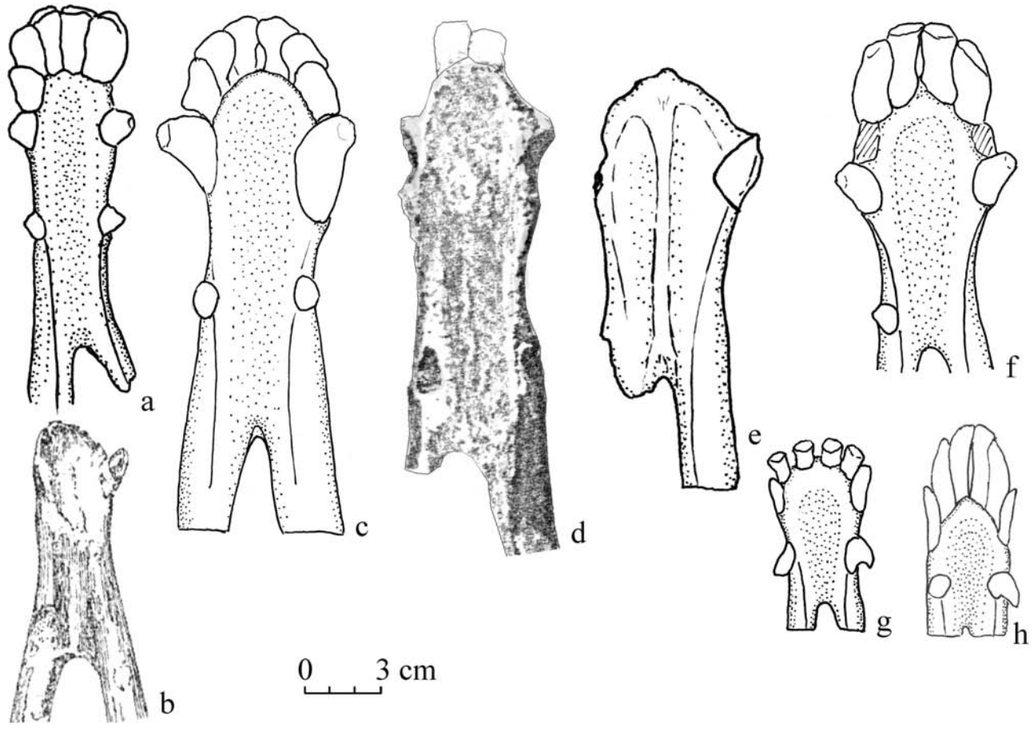

Fig. 2 - Crown view of the anterior portion of mandibles of *Paracamelus* and some recent Camelidae. a - *Paracamelus alutensis* from Milcovul de Jos, Romania (STEFANESCU 1910); b - *P. alutensis* from the Kujalnik coastal lake, Ukraine (KHOMENKO 1915, HAVESSON 1954); c - *P. chersonensis alexejevi* from Odessa catacombs, Ukraine, coll. Odessa university museum OGU 3263-51; d - *P. gigas* from Nihowan, China (TEILHARD & TRASSAERT 1937); e - *Camelus knoblochi*, Volga river, Russia, coll. Paleontological Institute PIN-113-131; f - *C. bactrianus*, coll. Moscow University museum MGU S-1812; g - *Lama guanicoe*, coll. Moscow University museum; h - *L. glama*, coll. Moscow University muzeum.

is considered that *P. chersonensis alexejevi* is the ancestor of *P.alutensis* (HAVESSON 1954, ALEXEEVA 1977a, BAJGUSHEVA 1984).

The lower jaw from the "kujalnik" deposits of the Black Sea region that was attributed by I. P. Khomenko (KHOMENKO 1912) to separate species *P. "kujalnensis"*. Its characteristics (in comparison with typical *P. alutensis*) are smaller symphysis length (Fig. 2b), a little higher lower jaw horizontal ramus and smaller dimensions (HAVESSON 1954). As it was shown on the collection from Khapry layer's base, all these features are very changeable and are the result of sexual and individual variability. The absence of front-exterior plicas on the lower teeth the Kujalnik finding does not prove another species. Such plicas are absent on 7 of 36 of specimens lower jaws from Liventsovka. This unstable dentition and mandible characteristics confirm the deduction of V. A. Topachevsky (TOPACHEVSKY 1956, BAJGUSHEVA 1971) that *P. kujalnensis* is the junior synonym of *P. alutensis*.

There are no findings with complete lower jaw symphysis in collection from Khapry beds. However the available material attests that the postcanine diastema is shorter than in Romanian one (Fig.2a), described by. Ştefănescu (1910). It is obvious that the depicted specimen was demaged in the P_1 area and it was reconstructed. It seems that the authentic mandible had no such length in that part.

Some interpret the presence of any Camelidae form in the Eurasian faunal list as an evidence of arid stations in ancient landscape and the drought-resistance of the faunistic complex. However, anatomical features of *Paracamelus alutensis* contradict this opinion. That camel had slender, long limbs and neck, an elongated facial part of the cranium, low crown teeth. Probably, the small camel of the Khapry complex was more spirited in comparison with recent Camelus, and had adaptations for feeding by foliage, and bought fodder. Differences in the postcranial structure of *P. alutensis* and Camelus on one hand and its resemblance with Lama on the other support the ability of the first one for a different locomotion type in comparison with recent Asian camel. Vertebral column characteristics of *P. alutensis* (the height and breadth resistance of the vertebral bodies) resemble to the Lama ones, in general. Recent lamas are able to run relatively quickly in the broken country. The amble probably is the adaptation of latest Camelus. This conversion to another type of movement reflects on the vertebral column and limb bones characters.

Possibly Paracamelus were typical inhabitants of steppe and forest-steppe landscapes, widely distributed in the north Black Sea and the Sea of Azov regions from the Late Pliocene (ANANOVA 1954, SUC 1984). Indirect confirmation for this may be the fact that for many of North American Camelinae such as *Aepycamelus, Hemiauchenia, Alforjas, Paleolama, Camelops, Procamelus, Megatylopus, Floridotragulines*, open savanna type landscapes were typical wildlife habitats (HONEY *et al.* 1998).

Table 1 - Slender indexes of metapodiums of some Camelidae: ratios of distal breadth to maximal length (Ind_1) and ratios of diaphis breadth to maximal length(Ind_2).

Bones		*Paracamelus*					*Camelus*			*Lama*
		alutensis	*gigas*	*alexejevi*	*trofimovi*	*longipes*	*knoblochi*	*bactrianus*	*dromedarius*	*glama*
		Khapry	China	Odessa	Kuruksay	Esekartkan	recent, coll. zool. mus. MSU, ZIN			
Metacarpus	Ind_1	21.5	-	23.9	20.4	-	31.1	26.8	25.45	20.7
	Ind_2	9.4	(9.9)	11.1	10.6	20.0	13.65	10.9	8.2	8.5
Metatarsus	Ind_1	20.0	19.15	20.3	(19.5)	23.95	25.6	21.5	19.6	19.55
	Ind_2	7.9	9.6	8.6	(9.35)	13.1	13.1	8.5	8.1	7.95

These arguments are confirmed by the general structure of Khapry taphocenosis. It consists of 44% animals of open landscapes, 45% inhabitances of forest-steppe and 10% mammals of coastal forests.

We can suggest that the appearence of the genus *Camelus* is connected with the increasing of the arid areas on the territory of Eurasia. Other steppe and forest-steppe inhabitants with a more competitive capacity - large deer and *Bison* perhaps forced the camels from their typical dwelling places. The appearance and mass spreading of the last ones happened towards the end of the Pliocene beginning of the Pleistocene. It was the age of *Paracamelus* extinction and large *Camelus* extension. Probably, their giant size (for example *P. gigas, C. praebactrianus*, and *C. knoblohi*) was the way of the surviving in their daily competition with other large herbivores. The camel's recent adaptations for living in arid conditions (humps, particulars of digestion, drinking a great deal of water and connecting with it the necessity in "camel's thorns" which includes plenty of salts) appeared later. These animals unspecific food requirements allowed them to exist in conditions unsuitable for other herbivores.

There are some other arguments that Alutensis camel could live in arid stations. Some of them are presented in the complex of jerboas and ostriches. Really, there are two forms of three-toed jerboas *Allactaga* sp., *Plioscirtopoda* sp. But recent *Allactaga* representatives have a wide ecological adaptations and, as a rule, is not a typical one for deserted associations. Some of them, such as *Allactaga major*, lived in the forest-steppe zone. *Plioscirtopoda* findings are known from the territory of the Black Sea and Sea of Azov regions (TESAKOV 2000), Kazakhstan and West Siberia. They indicates that its geographical range entered the abandoned Palearctic area and suggests the possibility of them inhabiting arid landscapes.

Large *Struthio* (*Pachystruthio* in Romania by RADULESCU & SAMSON 2001) were typical for the open landscapes of the eastern part of the Palearctic and for the south of East Europe beginning with the Late Miocene up to the Pleistocene (BURCHAK-ABRAMOVICH 1953, MIKHAILOV & KUROCHKIN 1988). Findings of ostrich's eggshells, of "epiornitoid type" are normal for the territory of the Mediterranean, northern Black Sea region, Transcaucasus and Turkey (MIHAILOV & KUROCHKIN 1988). This kind of shell shows the specific birds existence in conditions of that area in comparison with the Asian ones, which had "strutoid type". It is supposed that independent ostrich taxa inhabited the territory of the Sea of Azov region, Ukraine, Moldova and Romania in Pliocene (MIKHAILOV & KUROCHKIN 1988).

In the Late Pliocene East European faunas there are several zoogeographical groups:

1. Taxons with wide Palearctic spreading: *Nyctereutes, Pannonictis, Pliocrocuta, Homotherium, Acinonyx, Lynx, Anancus, Equus (Allohippus), Gazella, Cervus (Rusa),* and *Eucladoceros*.

2. Forms which were pertained to the western part of the Plaearctic and to the Mediterranean area, at first, in middle Villafranchian: *Archidiskodon, Hipparion moriturum, Equus (A.) stenonis, Sus strozzii, Arvernoceros* and *Libralces*.

3. Animals, whose areas were mainly connected with the Asian part of the Palearctic: *Elasmotherium, Paracamelus gigas*.

4. Small camel *Paracamelus alutensis* was an evidently endemical form for the Late Pliocene of the Black Sea territory (Fig. 1).

The Late Pliocene faunas of the Black Sea and the Sea of Azov regions along with West Kazakhstan and West Siberia, are united on the base of the abundance of *Archidiskodon* elephants, the presence of large *Paracamelus, Elasmotherium* and two horse species. Nevertheless, these were typical for Khapry type faunas *Paracamelus alutensis* and *Palaeotragus* (Yuorlovia). These forms were not known from Asia in this period. It is possible that some animals of open areas formed the indivisible areal which covered the Black Sea region and Kazakhstan until the Late Pliocene. Faunas of this age from the Black Sea region and the Nothern Caucasus were transitional between customary Mediterranean associations from one side and the Middle Asia and Kazakhstan from the other. That territory was on the western outskirt of *Struthio, Elasmotherium* and *Paracamelus* areals, which were widespread in Asia. There was the abundance of Villanyia, a variety of jerboas and gophers (TOPACHEVSKY *et al.* 1987).

From the territory of the East Europe, the most ancient archidiskodon elephants are known: - *Archidiskodon meridionalis rumanus* (Romania), *A. m.* cf. *gromovi* from the Caucasus (Kushkuna, Sablya, Masdok, Grosny), *A. m. gromovi* from the Sea of Azov region (TITOV 2001). In simultaneous localities from western part of Europe, Middle Asia and Kazakhstan findings of *Archidiskodon* are rare. In Western Europe elephants of this genus become typical on the level *A. m. meridionalis* in the late Villafranchian. In Central Asia such animals are quite uncommon (QUI 1995). Possibly, the penetration of this elephant's lineage to Europe has happened through Transcaucasus (ALEXEEVA 1977a). The marked difference between Villafranchian faunas of the western part of Northern Africa and South Europe is contradicted by the *Archidiskodon*'s migration from Africa through southwest Europe (BIBERSON 1970, MAGLIO 1973, GERAADS 1997, GERAADS *et al*. 1998).

The latest form *Hipparion moriturum*, with thin high enamel placation, was found in the eastern part of the Mediterranean and several territories, namely: Khapry (the Sea of Azov region), Shihovo (Transcaucasus) and Kishlang (Hungary). It was shown that this hipparion's form probably occupied intrazonal stations (TITOV 2000).

Numerous in the Pliocene, Hipparion and Anancus, were typical inhabitants of the forest-steppe zone of Eurasia. At the end of the Pliocene, these animals survived of limited areals in the western part of the Palearctic.

Beginning with the end of the Miocene until the end of Pliocene, giraffes of the genus *Palaeotragus* were typical for the territory of northern and eastern Mediterranean, Middle and Central Asia (GODINA 1979, Biostratigraphy of the Late Pliocene…, 1988). The subspecies *Palaeotragus* (Yuorlovia) had chiefly Asiatic spreading during the Pliocene. In the Early Pliocene representatives of this subgenus inhabited Transbaikal (Beregovaia), West Mongolia (Oshe), Kazakhstan (Pavlodar) and Turkey (Sinap). At the end of the Pliocene, this subgenus's

areal reduced considerably. Beggining with the Upper Pliocene *Palaeotragus* (Yuorlovia), is dicovered only from the Sea of Azov region and, probably, from Turkey (SICKENBERG & TOBIEN 1977, GODINA 1979, GODINA & BAJGUSHEVA 1985). Very likely this taxon is close to *Mitilanotherium* (*Macedonotherium*) founded in the middle Villafranchian localities of Greece and Romania.

At the end of the Pliocene, in the Eurasian steppes following the increase of aridisation, a decrease of typical savanna forms (giraffes, hipparions and archidiskodont elephants) occured. They were replaced by steppe fauna. The number of *Stephanorhinus, Coelodonta, Elasmotherium, Equus, Eucladoceros, Elaphurus, Cervus, Leptobos* and *Bison* grew.

Taking into account the ecological and geographical features, the landscapes of the Western Palearctic were more conservative as comparised with the Eastern part and were less exposed to the aridisation process, which was characteristic for Asia. It allowed the survival of some taxa, which were typical for complexes with a more ancient appearance and more humid habitat conditions (*Anancus, Hipparion, Palaeotragus/ Mitilanotherium*). Discoveries of ostrich, camel and elasmotherium's remains testify the climatic differences between the Black Sea and the Sea of Azov regions and other territory of Mediterranean zoogeographical subarea. Taking into account the faunistic associations of the Pliocene of the South Eastern Europe's features this area may be distinguished as a separate province.

Open landscapes of the northern Black Sea region came into contact with the mixed forest's boundary, which was nearly the local of the lower current of Don and Dniepr Rivers at the end of Pliocene - beginning of Pleistocene (GRIZHENKO 1952). For the Upper currents of Dniper, Dniester and Don forest-steppe and forest coenosis were typical (KRASNENKOV 1985, TESAKOV 1993). The western border of this zone was little to the west from Odessa Black Sea territory (TOPACHEVSKY & NESIN 1989). Taking into the consideration findings of the similar faunistic complexes, we can attribute to these provinces the open areas of Rep. of Moldova, Romania and Turkey (SICKENBERG & TOBIEN 1977). In the East, this association's areal was restricted by the coast of the Akchagyl basin.

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REFERENCES

Alexeeva L. I. (1974) Camels of Northern Black Sea territory and Transcaucasus. In: David A.I. (Ed.), *Mammals of the Late Cenozoic from the southwest of USSR*. Chişinău, "Shtiinca", :53-77, (in Russian).

Alexeeva L. I. (1977a) Teriofauna of the Early Anthropogene of East Europe, *Proceed. Geol. Inst.*, 300, Moscow, Nauka. 214 p. (in Russian).

Alexeeva L. I. (1977b) About the Psekups type fauna. In Nikiforova K.V. (Ed.), *Paleontological basis of the Anthropogene stratigraphy.* Geological Institute of the USSR Acad. of Sci., Moscow, :12-30 (in Russian).

Ananova E. N. (1954) Palinological data for the question of the steppe's origin on the south of European plain, *Botanical Journal*, 39 (3), Moscow. : 343-356 (in Russian).

Bajgusheva V. S. (1971) The fossil theriofauna of Liventsovka quarry (northeast of the Sea of Azov area), *Proceed. Zool. Inst*., 69 (49), Leningrad. :5-28 (in Russian).

Bajgusheva V. S. (1984) Late Neogene and Early Anthropogene faunas of proboscideans and hoofed from the Sea of Azov area, Ergenei and some their correlative relatives with Villafranchian faunas of East Europe, In Kamaletdinov M.A. (Ed.), *Anthropogene of Eurasia*. Moscow. :168-180 (in Russian).

Bajgusheva V. S. (1989) Khapry fauna of the Sea of Azov region and some philogenetic relationships of its representatives, *Materials of the 1 paleoteriologist conference*. Moscow, :8-9 (in Russian).

Bajgusheva V. S., Titov V. V., Tesakov A. S. (2001) The sequence of Plio-Pleistocene mammal faunas from the south Russian Plain (the Azov Region), *Bollet. Soc. Paleontolog. Italiana*. V. 40. N. 2. :133-138.

Biberson P. (1970) The problem of correlations between south Europe and North Africa during the Pleistocene, *Palaeogeography, Palaeoclimatol., Palaeoecol*., 8. :113-127.

Burchak-Abramovich N. I. (1953) Fossil ostriches from Caucasus and south of Ukraine, *Proc. Natur. Hist. museum*, Tbilisi, 7. 204 p.

Dubrovo I. A. (1963) *Anancus arvernensis* (Croizet et Jobert) from the Taman peninsula. *Bull. comm. research Quatern. period*, 28. Moscow. :158-161, (in Russian).

Geraads D. (1997) Carnivores du Pliocene terminal de Ahl al Oughlam (Casablanca, Maroc), *Geobios*, 30 (1), :127-164.

Geraads D., Amani P. F. (1998) Bovidae (Mammalia) du Pliocène final d'Ahl al Oughlam, Casablanca, Maroc, *Paläontologische Zeitschrift, Stuttgart*, 72(1-2), :191-205.

Ghenea C. (1970) Stratigraphy of the Upper Pliocene - Lower Pleistocene interval in the Dacic basin (Romania), *Palaeogeography, Palaeoclimatol., Palaeoecol.*, 8, :165-174.

Ghenea C., Rădulescu C. (1963) Contribuţii la cunoaşterea unei faune Villafranchiene în sudul podişului Moldovenesc. *Dări de Seamă ale Şedinţelor*, V. L/1. :165-171.

Godina A. J. (1979) Historical progress of giraffas Palaeotragus, *Proc. Paleontol. Inst*., 177, Moscow. 114 p.

Godina A. J., Bajgusheva V. S. (1985) The new species of Palaeotragus from the Upper Pliocene of the Sea of Azov region, *Paleontological Journal*, 3, Moscow., :84-89.

Grizhenko M. N. (1952) About paleogeography of Don River basin in Neogene and in Quaternary, *Matherials Quaternary USSR*, 3, Moscow, :145-157.

Gromov V. I. (1948) Paleontological and archeological basis of stratigraphy of continental Quaternary deposits from the USSR territory, *Proceed. Geol. Inst*., 64, Ser. Geol., 17. 520p. (in Russian).

Havesson J. I. (1954) Tertiary camels of the Eastern Hemisphere (genus Paracamelus), *Proceed. Paleontol. Inst., Moscow*, 67, :100-161 (in Russian).

Honey J. G., Harrison J. A., Prothero D. R., Stevens M. S. (1998) Camelidae, *Evolution of Tertiary Mammals of North America*. V. 1. Cambridge University Press. : 439-462.

Khohlovkina V. A. (1940) Terraces of Azov's coast between Rostov and Taganrog, *Proceed. Geol. Inst.*, 28, Geol.Ser., 8. :71-89, (in Russian).

Khomenko I. P. (1912) *Camelus bessarabiensis* and other fossil forms of the South Bessarabi, *Proceed. Bessarab. Soc. Natural*. Research, 3, Chişinău. :1-37.

Kostopoulos D. S., Sen S. (1999) Late Pliocene (Villafranchian) mammals from Sarikol Tepe, Ankara, Turkey, *Mitt. Bayer. Staatsslg. Palont. hist. Geol.* 39. München. : 165 - 202.

Krasnenkov R. V. (1985) Key sections / In Shik S.M. (Ed.), *Upper Pliocene of the upper current of Don River basin.* Voronezh. :6-11.

Logvinenko V. M. (2000) *Camelus* (Camelidae, Tylopoda) from the Pliocene and Eopleistocene of Ukraine, *Vestn. zool. Supl*. 14. :120-127, (in Ukranian).

Maglio V. J. (1973) Origin and evolution of the Elephantidae, *Transact. Amer. Philosoph*. Soc., 63, (3). Philadelphia. 149 p.

Mikhailov K. E., Kurochkin E. N. (1988) Eggshell of fossil Struthioniformes from Palearctic and its place in the system of conceptions about Ratitae evolution, *Proc. Soviet-Mongolian Paleont. Expedition*, 34. Moscow. :43-65, (in Russian).

Pidoplichko I. G., Topachevskiy V. A. (1962) The significance of mammal's remains for paleontological basis of the Neogene and Anthropogene stratigraphy, *Proc. comm. research. Quatern. period*, 20, Moscow. :98-107, (in Russian).

Pidoplichko I. G., Topachevsky V. A. (1962) The significance of mammal remains for paleontological basis of Neogene and Anthropogene stratigraphy, *Proc. comm. research. Quatern. period*, 20, :98-107 (in Russian).

Qiu Z., Qui Z. (1995) Chronological sequence and subdivision of Chinese Neogene mammalian faunas. *Palaeogeogr., Palaeoclimat., Palaeoecol*., 116. : 41-70.

Radulesco C., Samson P. (1990) The Plio-Pleistocene mammalian succession of the Oltet Valley, Dacic basin, Romania, *Quartärpalaeontologie*, 8. : 225-232.

Rădulescu C., Burlacu D. (1993) On the presence of *Paracamelus alutensis* (Gr. Stefanescu) (Camelidae, Mammalia) at Frăteşti (Giurgiu Dept., Romania), *An. Univ. Bucuresti, Geol.,* 42. : 65-68.

Radulescu C., Samson P. M. (1996) Pliocene and Early *Pleistocene arvicolids* (Rodentia, Mammalia) of the Dacic Basin, Rumania, *Acta zool. cracov*., 39 (1). : 401-406.

Radulescu C., Samson P. M. (2001) Biochronology and evolution of the Early Pliocene to the Early Pleistocene mammalian faunas of Romania, *Boll. Soc. Paleontologica Italiana*, 40 (2). :285-291.

Rekovetz L. I. (1994) Small mammals from the Anthropogene of the south of East Europe. Kiev, "*Naukova dumka*". 371p. (in Russian).

Sickenberg O., Tobien H. (1977) Late Pliocene mammals and Plio-Pleistocene boundaries in Turkey. *Bull. comm. research. Quatern. period*, 47, Moscow. :29-36 (in Russian).

Simionescu I. (1932) Tretiäre und Pleistozäne Camelidae in Rumänien, *Acad. Roum. Bull. Sect. Scient.* 1-2, Bucureşti, :1-8.

Ştefanescu G. (1895) Camilă fosilă din Romania, *Muz. Geol. Pal. Bucuresti*. : 89-123.

Ştefanescu G. (1910) Camila fosila din Romania. Este stramoasa camilelor Dromadera si Camila salbatica din Africa, *Anuarul Muzeului de Geologie si Paleontologie*, Iv. Bucuresti. : 46-70.

Suc J. P. (1984) Origin and evolution of the Mediterranean vegetation and climate in Europe, *Nature*, 307 (2). :429-432.

Teilhard de Chardin P., Trassaert M. (1937) The Pliocene Camelidae, Giraffidae, and Cervidae of southeastern *Shansi. Pal. Sinica*, (n.s. C), 1, :1-68.

Tesakov A. S. (1993) Late Pliocene and Early Pleistocene small mammals from the south of Eastern Europe: *Stratigraphy. Geological Correlation*, 1(3), Moscow. : 92-96.

Tesakov A. S. (1995) Evolution of small mammal communities from the south of Eastern Europe near the Plio-Pleistocene boundary, *Acta zool. cracov*., 38 (1), Krakow, :121-127.

Tesakov A. S. (1996) Evolution of bank voles (Cletionomys, Arvicolinae) in the Late Pliocene and Early Pleistocene of eastern Europe, *Acta zool. cracov*., 39 (1), Krakow. :541-547.

Tesakov A. S. (2000) New data on Plio-Pleistocene jerboas of the genus Plioscirtopoda from Eastern Europe (Mammalia, Dipodida). *Zoosystematica Rossica*, 9, :237-244.

Titov V. V. (2000) Hipparion remains from the localities of the Khapry fauna (Late Pliocene, northeastern part of the Sea of Azov area, *VM-Novitates*, 4, 16 p.

Titov V. V. (2001) Most ancient elephants from the south of Russia, *La Terra degli Elefanti, Proceedings of the First International Congress*, Rome, :152-156

Topachevsky V. A. (1956) Remains of small camel (*Paracamelus alutensis*) from the Upper Pliocene deposits of the south of Ukraine, *Proc. Inst. Zool*., 13, Kiev, :93-100 (in Russian).

Topachevsky V. A., Nesin V. A. (1989) *Rodents of Moldova and Khapry faunistic complexes from Kotlovina*. Kiev, Naukova dumka. 136 p. (in Russian).

Topachevsky V. A., Skorik A. F., Rekovets L. I. (1987) *Rodents of the Upper Neogene and Early Anthropogene deposits of Hadjibey*. Kiev. 208 p. (in Russian).

Vangengeim E. A., Pevzner M. A., Tesakov A. S. (1990) Magneto- and biostratigraphy researches in the stratoregion of Psekups Faunal complex, *Bull. comm. research Quatern. period*, 59. Moscow, :81-93 (in Russian).

Vangengeim E. A., Pevzner M. A. (1991) Villafranchian of the USSR: biological and magnetostratigraphy, *Paleogeography and biostratigraphy of Pliocene and Anthropogene.* Moscow, :124-145 (in Russian).

Vasilev J. M. (1969) *The forming of Anthropogene deposits of glacial and outglacial zones*. Moscow, 182 p. (in Russian).

Verestchagin N. K. (1957) Mammal remains of the Lower Quaternary deposits of Taman peninsula, *Proc. Inst. Zool.,* 22, Leningrad, : 9-49, (in Russian).

*** The section of newest deposits of the northeastern Sea of Azov region, 1976, Markov K.K. (ed.). Moscow. 158 p.

*** Biostratigraphy of the Late Pliocene Early Pleistocene of Tadjikistan (by mammal fauna), Nikiforova K.V (Ed.), Moscow, *Nauka*, 1988. 128 p.