About teeth of *Deinotherium giganteum* Kaup from eastern Paratethys*

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ABSTRACT: Teeth and lower jaws of a partial skeleton of *Deinotherium* from the Lower Don region (south of Russia) are described. The skeleton was discovered in Late Miocene alluvial sands which age was determined as terminal Meotian – Lower Pontian. The sample was attributed to *Deinotherium giganteum* which is typical for Late Miocene basing on dental characteristics and teeth size. It is shown that findings of *D. giganteum* from Eastern Europe are slightly bigger than other known representatives of that species from Western Europe.
Key-words: *Eastern Paratethys, Deinotherium gigantum, Late Miocene, dental characteristics.*

ΠΕΡΙΛΗΨΗ: Τα δόντια και η κάτω σιαγώνα ενός τμήματος του σκελετού του *Deinotherium* από την περιοχή Lower Don (νότια Ρωσία) περιγράφονται. Ο σκελετός βρέθηκε μέσα σε αλλουβιακές άμμους του Ανωτέρου Μειοκαίνου και χρονολογήθηκε ως Ανώτερο Μαιότιο – Κατώτερο Πόντιο. Το δείγμα αποδόθηκε στο *Deinotherium giganteum* το οποίο είναι τυπικό για το Ανώτερο Μειόκαινο βάσει των οδοντικών χαρακτηριστικών και του μεγέθους των δοντιών. Αποδεικνύεται ότι τα ευρήματα του *D. giganteum* από την Ανατολική Ευρώπη είναι ελαφρώς μεγαλύτερα από άλλους γνωστούς αντιπροσώπους αυτού του είδους από τη υτική Ευρώπη.
Λέξεις-κλειδιά: *Ανατολική Παρατηθύς, Deinotherium gigantum, Ανώτερο Μειόκαινο, οδοντικά χαρακτηριστικά.*

INTRODUCTION

In August of 1982 some bones of large *Deinotherium* were excavated in the Obuhovka sand pit (Fig. 1). That locality is situated on the high terrace of the Paleo-Don in 1.5 km to the west from Yanov khutor (Rostov region, Russia) on the right bank of the Grushevka River (the confluent of the Tuzlov River). The excavations were realized by collaborators of Azov local museum. Most part of bones was laid in anatomical sequence (Fig. 2). Skeleton was destroyed partly during its extracting. This find is important because of well preserved teeth were discovered jointly with the most part of the postcranial elements. There were some short publications about this finding (BAJGUSHEVA & TISHKOV, 1998; BAJGUSHEVA, 1998). Nowadays all remains were restored and the specimen is exhibiting in Azov local museum (Northeast Sea of Azov Region, Russia).

Fig. 1. The geographical position of *Deinotherium* locality in Obuhovka sand pit in the Lower Don Region.

GEOLOGY AND STRATIGRAPHY OF THE LOCALITY

Deinotherium's remains were discovered in the sand thickness under the Upper Miocene Lower Pontian limestone on the depth 5.4 – 7.1 m. Those beds were considered to Meotian stage of Eastern Paratethys on the base of their stratigraphic location between Lower Pontian and Sarmatian deposits (ZHIZHCHENKO *et al*., 1940). V.V. BOGATCHEV

* Σχετικά με τα δόντια του *Deinotherium giganteum* KAUP από την Ανατολική Παρατηθύ.

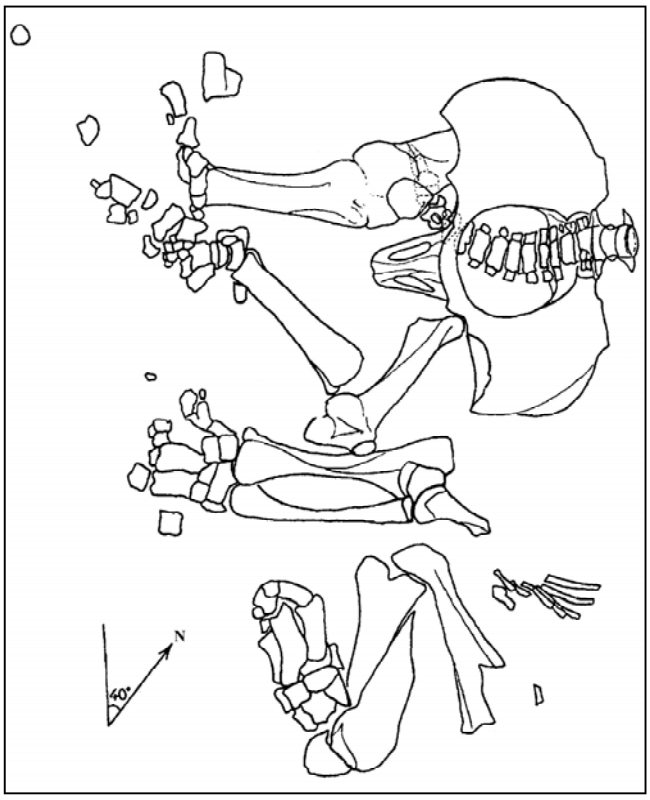

Fig. 2. The scheme of the disposition of *Deinotherium giganteum* remains at the excavated area of Obuhovka sand pit in 1982.

(1941) determined remains of *Mammut borsoni*, "*Palaeoryx longicephalus*" and *Deinotherium gigantissimum* from those sands and dated them by the same age. These alluvium layers were attributed to the Upper Sarmatian-Meotian Yanov formation of Lower Don Region by G.N. RODZIANKO (1986). Not far from this place near Aksay town (Rostov Region, Russia) in the similar stratigraphic position in arenaceous limestone which are situated between Upper Sarmatian and Lower Pontian limestone the Lower Meotian mollusk's fauna was discovered. V.S. BAJGUSHEVA determined some specimens from these beds which were collected earlier and now they are kept in the collection of Novocherkassk museum of Don Cossacks History (NMDCH). There teeth of *Mammut borsoni* are prevailed (NMDCH, No. 89, 103, 314, 317, 326). There are remains of *Deinotherium* (NMDCH, No. 310) and *Diceros* cf. *pachignatus* (NMDCH, No. 225).

It seems that the animal association from Yanov sand formation refers to Late Meotian-Pontian Tavrian Faunal Unit of Northern Black Sea Region (by KOROTKEVICH, 1988). In this complex the first appearance of *Mammut borsoni* is recorded. According to E.L. KOROTKEVICH (1988), in earlier associations remains of *Turicius turicensis* (= *Zygolophodon turicensis*) and *Tetralophodont longirostris* were typical (in Novoelizavetovsky and Belkinsky Faunal subcomplexes of Early and Middle Meotian) or mastodon's finds were rare and unrepresentative (Cherevichansky mammal subcomplex of Meotian). Unfortunately Tavrian Faunal Unit is insufficiently studied. There are no representative localities of that age in Northern Black Sea Region. Few finds are known from Lower Pontian limestone only.

Based on biostratigraphy data we suppose the age of Yanov formation sands as pre-Pontian or terminal Meotian. According to M.A. PEVZNER *et al*. (2003) these deposits are correlated with the upper part of the Tortonian and with an upper part of Zone MN12.

PALEONTOLOGY

Order PROBOSCIDEA ILLIGER, 1811
Family Deinotheriidae BONAPARTE, 1845
Genus *Denotherium* KAUP, 1829
Deinotherium giganteum KAUP, 1829

Material:

Cranium's fragments with 2 upper teeth M^2 and M^3, lower jaws with teeth without tusks, 4 cervical, 12 tail vertebras, sacrum, costae fragments, and a part of right scapula, entire pelvis, and almost all bones of extremities. Collection of Azov historical-archeological and paleontological museum (AMZ, No. KP-26579).

Description

Upper jaw:

The left maxilla with M^2 and M^3 and roots of M^1 are preserved. Above roots of destroyed M^1 in the upper jaw there is the significant depression (150.0x130.0 mm). The anterior edge of choana is on the level of the first loph of M^3. The labial surface of the bone over teeth is relief and repeats root's outlines. The adjoining of M^2 and M^3 is incomplete. The crown of M^3 is situated at the angle to the previous tooth (Plate 1).

The alveolar length of M^1 is about 120.0 mm, width – 90.0 mm. In the crown of M^2 the labial length (94.6 mm) is smaller than lingual one (104.0 mm). The width of the anterior loph (protoloph) is 114.6 mm and posterior one (metaloph) – 113.4 mm. The front cingulum is on the all area of the touching with M^1. The posterior cingulum is more slender than the anterior one. The roughness of enamel is situated on the inner side between lophs. The same roughness is seen on the posterior part of both lophs. On the caudal part of the crown it is joined with the posterior cingulum. The labial part of the crown is higher than lingual one. The occlusial surface of tooth is grinding off obliquely. The enamel thickness is 5.2 mm.

M^3 is less erased than M^2. In comparison with M^2 it is narrower caudally. The chewing surface is grinding off obliquely. Lophs are drawn together, more on the external part of the crown. Labial and lingual sides of lophs are turned

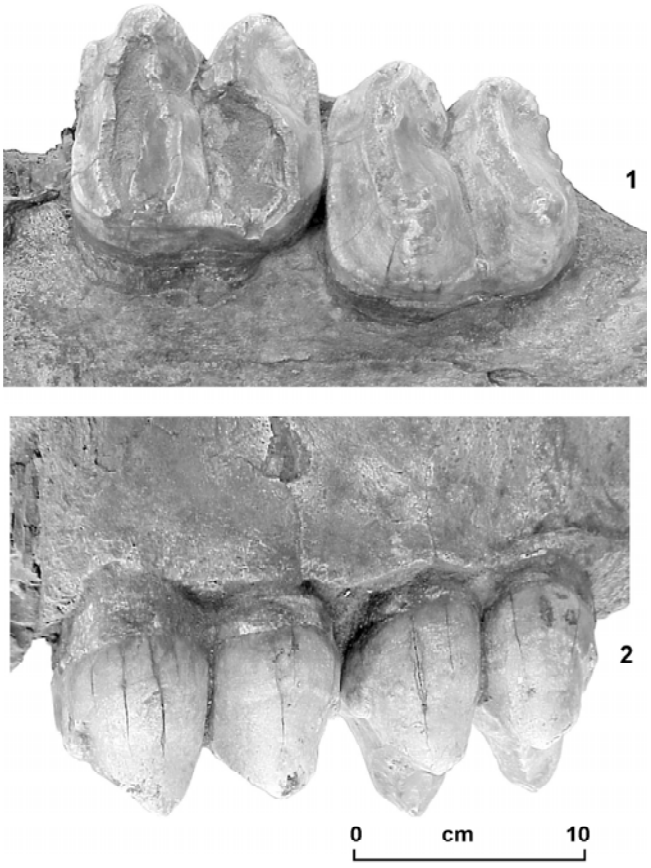

PLATE 1

Deinotherium giganteum from Obuhovka sand pit (the Lower Don Region, Russia), AMZ, No. KP-26579. Left upper teeth M^1 and M^2: 1. occlusial view; 2. labial view.

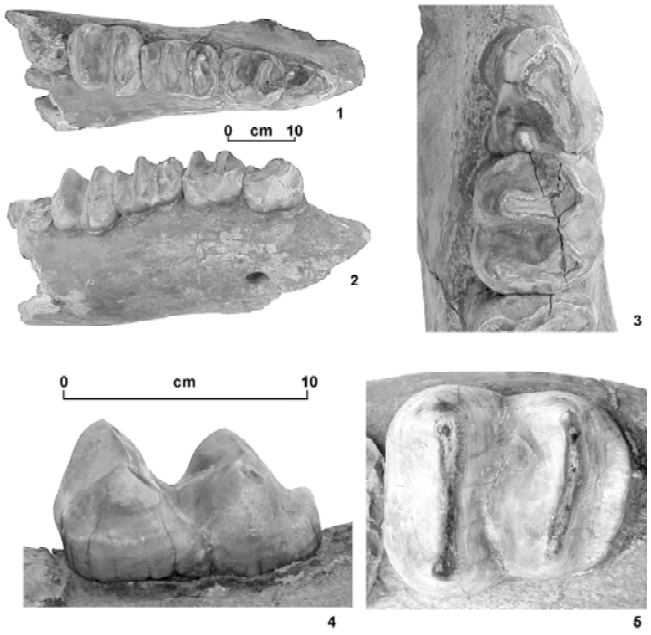

PLATE 2

Deinotherium giganteum from Obuhovka sand pit (the Lower Don Region, Russia), AMZ, No. KP-26579. Right mandible with P_1-M_2: 1. occlusial view; 2. labial view. P_3-P_4: 3. occlusial view. Left M_3: 4. labial view; occlusial view.

up backward a little. A wide anterior cingulum proceeds to lingual side of the crown. There is the roughness between lophs. On the posterior loph the roughness joins with the cingulum of the back side of the crown. The talon is pronounced weakly.

Lower jaw:

Symphysis and processus coronoideus are broken (Plate 2). The right mandible is more informative – it has teeth P_2-M_2 and roots of M_3. The left mandible has roots of P_3, P_4, M_2 and teeth M_1 and M_3. The height of right horizontal ramus mandibulae between P_4 and M_1 is 240.0, between M_1 and M_2 – 190.0 mm. Minimal width of the jaw is under M_1 – 142.0 mm. It becomes thicker to M_2, and under M_3 its width reached 207.0 mm.

The anterior foramen mentale on the right branch of the jaw is damaged. The posterior one is situated on the level of P_3-P_4 boundary and has dimensions 22.0 x 31.4 mm. On the left branch of lower jaw the anterior foramen mentale is situated under P_3 and the posterior one – between P_3-P_4. The exposed canal is very big. The processus coronoideus begins on the level of anterior lophid of M_3. The length of premolars is 167.8 mm, and the length of the row of molars – 305.0 mm. The ratio of premolar row's length to molar one is 35.7%. On the external upper part of the left branch of the jaw the rugosity is well presented. It stretches from symphysis part to the level of P_3-P_4. The degree of teeth obliterating in the tooth row is different. It decreases from P_3 to M_3, but premolars are erased less than two first lophids of M_1. Tops of M_3 lophids have narrow fascia of naked dentine only.

P_3 dex: The tooth is triangular in occlusial surface, which is tilted labially. Two anterior conids – proto- and metaconids are erased. Ptotoconid is connected with the hypoconid by a worn ectolophid that is low in the middle. The entoconid is separated from hypoconid by a deep depression. The cingulum presents on the anterior labial part of the crown. It is less pronounced than the posterior one which is presented on labial and caudal walls. The largest labial height of the crown is 60.0 mm and the lingual one – 46.2 mm. Roots are less bared on the outside than inside. Enamel thickness is changing from 5.0 to 6.2 mm.

P_4 dex: The tooth is bilophodont subquadrate and is narrower anteriorly than posteriory. The anterior lophid (protolophid) is larger than the posterior one (hypolophid) and is more erased. Lateral conids have anteriorly extending cristids. The anterior protocristid connects with the anterior cingulum. Low hypoconid's cristid joins the protoconid with hypoconid and carries out the function of an ectolophid. The posterior cingulum is well developed and on the back side unites with the hypoconid. Anterior roots are more bared inside (37.0 mm) than outside (15.0 mm). The enamel thickness is 5.0 mm on the posterior lophid.

M_1 dex: The tooth with three transverse lophids and o n l y last one is weakly touched by an abrasion. Protocristids are weakly developed. Cingula feebly marked on the front a n d back sides of the crown in places of contact with adjacent

teeth. It is better marked on the outside. The tooth is oriented in such way that its anterior part is situated higher and labial conids are lower than lingual ones. Left M_1 has a similar structure but differs from the right one by higher inner wall of the crown (39.0 mm on the first lophid against to 21.2 mm in the M_1 dex). The third lophid is narrower than two others.

M_2 dex: The tooth has two transverse lophids which crests are splaying backward. It is wider than previous tooth. The anterior lophid is more erased. The metalophid has two developed protocristids that extend medially and the labial one ends on the anterior cingulum. A cingulum well presented on anterior and posterior walls. The ratio of posterior cingulum's width to the width of hypolophid is 75.5%. The maximal lingual height of the crown is on the posterior lophid – 54.2 mm.

M_3 sin: The tooth narrows posteriorly slightly. Transverse lophids are inclined backwards, but not so much as in M_2. The anterior cingulum is weak and outlines the lingual part of the anterior lophid. Posterior cingulum is well marked and forms a small talonid; its length is 10.0 mm and width – 61.2 mm. Enamel thickness – 2.2 mm.

COMPARISON AND CONCLUSIONS

There are some similarities and differences of *Deinotherium* from Obuchovka sand pit with *D. giganteum* from Western Europe. On the cast of *D. giganteum* cranium from Eppelsheim (collection of Azov historical-archeological and paleontological museum) the anterior edge of the choana is situated more caudally — on the level of the posterior lophid of M^3. On the Obuhovka sample M^2 and M^3 are situated at an angle to each other in contrast to Eppelsheim's cranium, where molars are situated aligned. Upper teeth of *Deinotherium* from the Sea of Azov Region differ from the same from Eppelsheim by wider lophs (T a b . 1). Lengths of upper molars from Obuhovka are larger than the same of *D. giganteum* from Western Europe and are smaller than teeth of *Deinotherium gigantissimum* STEFANESCU (BELOKRYS, 1960). The length of M^2 from the skeleton from Kadrianka (Moldova) is 103.0 mm and is similar with AMZ, No. KP-26579. This Moldavian sample was determined as *D. gigantissimum* (DAVID & SHUSHPANOV, 1972).

The length of the toothrow P_3-M_3 of describing finding is similar with *D. giganteum* (Tab. 2). P_4-M_3 length is equal with the same of *D. giganteum* "*race major*" from Bulgaria (BAKALOV, 1950) and is 420.0 mm.

Teeth measurements of *Deinotherium* from Eastern Europe exceed that from Western Europe (Tab. 3). *D. giganteum* from Eastern Europe have similar or slightly smaller lower teeth in comparison with forms which were described as *D. gigantissimum*. Unfortunately, the limit of variability of *D. gigantissimum* parameters is discovered insufficiently; they are basing on few samples.

B.A. TARABUKIN (1974) who studied remains of *Deinotherium*'s skeletons from museums of Moldova alleged that in the Meotian age *D. levius* and *D. giganteum* existed simultaneously. Later, in the Pontian stage, these two species lived together with *D. gigantissimum*. *D. giganteum* was the ancestor taxon for *D. gigantissimum* according to his opinion. This author established not only b o d y size increasing but morphology changes of teeth, lower jaw

TABLE 1

Measurements of upper teeth of *Deinotherium* from Obuhovka sand pit (Rostov Region, south of Russia) and some other localities of Western Europe. Abreviations: L - length, W- weight, $W_{1/2}$ – weight of the first/second loph.

Upper teeth	M^2			M^3			M^2-M^3
Locality	*L*	*W_1*	*W_2*	*L*	*W_1*	*W_2*	*L*
Deinotherium giganteum							
Eppelsheim, cast, mm	104.0	90.4	87.0	102.8	91.2	83.6	210.0
Obuhovka sand pit, mm	104.0	114.6	113.4	104.8	114.0	103.0	206.0
Western Europe (BELOKRYS, 1960), mm	81.0-92.0	-	-	78.0-94.0	-	-	-
Deinotherium gigantissimum							
Western Europe (BELOKRYS, 1960), mm	108.0-116.0	-	-	107.0-115.0			

TABLE 2

The comparison of the length of lower P_3-M_3 from some European localities.

Length of P_3-M_3	Locality	Author	Measurement, mm
Deinotherium giganteum	Obuhovka, Russia	original; sin	470.0
	Krivoy Rog, Ukraine	BELOKRYS, 1960	470.0
	Eppelsheim, Switzerland	STEFANESCU, 1899	453.0
Deinotherium levius	Gusiatin, Ukraine	SVISTUN, 1974	409.0
Deinotherium gigantissimum	Manşazi, Rumania	STEFANESCU, 1899	540.0

TABLE 3

Comparisons of lower teeth of *Deinotherium* from some European localities.
Abreviations: L- length, W- weight, $W_{1/2/3/0}$ – weight of the first/second/third lophids/maximal;
AMZ – collection of Azov historical-archeological and paleontological museum,
ROMK – Rostov regional local museum.

Lower tooth, mm		*Deinotherium giganteum*											*Deinotherium gigantissimum*
		Western Europe				Eastern Europe							Europe
		Dinotherium-sande, Germany, MN 9		Montredon, France, MN 10		Obuhovka sand pit, Yanov formation		Popov khutor, Yanov formation	Rostov-on-Don, Upper Miocene	Bulgaria	Tanovka, Stavropol region	Krivoy Rog	Kul'm	by Gräf, 1957
		Huttunen, Göhlich, 2002				AMZ, KP-26579		Bogatchev 1941	ROMK-1535, original	Bakalov, Nikolov, 1962	Belokrys, 1960			
		n	min - max	n	min - max	dex	sin							min - max
P_3	L	17	55-63-72	8	58-65-74	79.8	-	-	-	80.0	-	-	-	83.0-90.0
	W_0	17	48-50-56	8	49-52-58	66.0	-	-	-	68.0	-	-	-	68.0-73.0
P_4	L	17	52-68-76	7	68-74-79	82.0	-	-	-	92.0	87.0	-	-	90.0-98.0
	$W_{1,0}$	17	52-68-76	8	49-57-59	73.8	-	-	-	88.0	90.0	-	-	72.0-78.0
	W_2	17	46-55-64	6	56-60-64	76.0	-	-	-	86.0	-	-	-	-
M_1	L	12	81-86-91	2	90; 94	103.0	103.4	-	(108.0)	110.0	-	-	-	107.0-111.0
	$W_{1,0}$	12	62-65	3	58-63-69	(72)	75.4	-	83.5	85.0	-	-	-	70.0-77.0
	W_2	12	56-60-65	6	60-64-69	75.2	73.6	-	-	82.0	-	-	-	-
	W_3	12	50-54-62	5	58-60-64	70.0	70.0	-	68.5	75.0	-	-	-	-
M_2	L	17	64-78-104	3	78-80-81	103.0	-	108.0	-	104.0	-	102.0; -	-	108.0-120.0
	$W_{1,0}$	16	54-68-87	3	69-72-75	97.2	-	105.0	-	103.0	-	-; 86.0	-	97.0-120.0
	W_2	16	49-68-75	3	63-65-68	94.0	-	-	-	95.5	-	105.0; 107.0	-	-
M_3	L	19	67-83-104	3	84-88-90	-	109.0	-	-	110.0	-	93.0; 100.0	105.0	118.0-120.0
	$W_{1,0}$	19	50-68-87	3	73-78-82	-	98.8	-	-	110.0	-	-	87.0	90.0-101.0
	W_2	19	49-62-75	3	72-75-79	-	88.2	-	-	93.0	-	-	-	-

and skull's distinctions in deinotherium lineage evolution (TARABUKIN, 1974). There is the statement about the coexisting of two *Deinotherium* species in Rumania and Moldova in N.N. MOROSAN (1935). But there are no real paleontological confirmations for such conclusions.

L.S. BELOKRYS (1960) considered that *Deinotherium*'s teeth have a wide morphological variability except size variation. So he concluded that there are no serious evidences of species independence of *D. gigantissimum*. It corroborates by the finding of giant forms with mixed morphological features of *D. levius* and *D. giganteum*, which had similar dimensions with *D. gigantissimum* in Upper Sarmatian as in Lower and Middle Sarmatian deposits. Thus *gigantissimum*-like forms are *D. giganteum* (BELOKRYS, 1960). According to this author, morphology and measures fluctuation of teeth and jaws may be considered as the result of individual, sexual, age and population intraspecific changes. We agree with this opinion and relate the sample from Obuhovka sand pit to *D. giganteum*.

ACKNOWLEDGEMENTS

We are very thankful for E.S. Tsoukala from Aristotle University of Thessalonici Faculty of Sciences for the sending of papers about *Deinotherium*. The restoration of the *Deinotherium* skeleton was realized by supporting of Federal special program "The culture of Russia" No. 868-1015/25.

REFERENCES

BAJGUSHEVA, V.S. (2003). *Deinotherium giganteum* KAUP skeleton in hipparion fauna of the Sea of Azov Region. *In:* V.N. ORLOV (*Eds*.) Teriofauna of the Russia and neighborhood territories. [in Russian]. *Moscow*, 26-27.

BAJGUSHEVA, V.S. & M. Yu. TISHKOV (1998). About the find of *Deinotherium giganteum* KAUP skeleton near Novocherkassk town of Rostov Region. *In:* V. Ya KIYASHKO. (*Eds*.) Historical and archeological researches in Azov and on the Lower Don in 1995-1997, 15. [in Russian]. *Azov*, 305-311.

BAKALOV, P. (1950). Einige neue *Dinotherium* funden in Bulgarien. [in Russian]. *Ann. Univ. Sofia*, 46, 99-106.

BAKALOV, P. & I. NIKOLOV (1962). Tertiary mammals. The Fossils of Bulgaria, 10. [in Bulgarian]. *Bulgarian Acad. of Sc. Press*, Sofia, 1-162.

BELOKRYS, L.S. (1960). To the systematic and phylogeny of deinotheriums. *Paleontological Journal*, 4, 95-103.

BOGATCHEV, V.V. (1941). New finds of *Deinotherium* in the Don Region. Priroda, 2. [in Russian]. *Moscow*, 95-97.

DAVID, A.I. & K. SHUSHPANOV (1972). Mammal remains from Neogene deposits of Moldova. *In:* K.N NEGADAEV-NIKONOV & A.I. DAVID (*Eds*.) Vertebrates of Neogene and Pleistocene of Moldova. [in Russian]. *Shtiinca, Chisinau*, 3-18.

HUTTUNEK, K. & U.B. GÖHLICH (2002). A partial skeleton of *Prodeinotherium bavaricum* (Proboscidea, Mammalia) from the Middle Miocene of Unterzolling (Upper Freshwater Molasse, Germany). *Geobios*, 35, 489-514.

KOROTKEVICH, E.L. (1988). The history of the forming of hipparion faunas in Eastern Europe. [in Russian]. *Naukova*

dumka, Kiev, 1-160.

KRAHMAL'NAYA, T.V. (1996). The hipparion fauna of the ancient Meotian of the Northern Black Sea Region. [in Russian]. *Naukova dumka*, Kiev, 1-226.

MOROSAN, N.N. (1935). Dinotheridés de Bessarabie: Contribution à l'etude de dention et de la disrtribution paléogeographique des Dinotheridés de Roumanie. *Extrait des Ann. Scient. l'Univ. Jassy*, 22 (1-4), 256-279.

PEVZNER, M.A., SEMENENKO, V.N. & E.A. VANGENGEIM (2003). Position of the Pontian of the Eastern Paratethys in the magnetochronological scale. *Stratigraphy and Geological Cor - relation*, 11 (5), 482-491.

RODZIANKO, G.N. (1986). The south part of central regions of Eastern European platform. *In:* MURATOV, M.V. & L.A. NEVESSKAYA *(Eds.)* Stratigraphy of the USSR. Neogene, 1. [in Russian]. Moscow, 268-287.

STEFANESCU, G. (1899). *Dinotherium gigantissimum*. Le squelette de Mânzat. *An. Mus. Geol. Pal. Bucharest*, 1896, 110-145.

SVISTUN, V.I. (1974). Deinotheriums of Ukraine. [in Russian]. *Naukova dumka*, Kiev, 1-71.

TARABUKIN, B.A. New data about the systematic, phylogeny and ecology of suborder Deinotherioidea OSBORN (1921). 1974. *In:* DAVID, A.I., LOZAN, M.N. & B.A. TROPHIMOV *(Eds.)* Mammals of Late Cenozoic of Southwest of the USSR. [in Russian]. Shtiinca, Chisinau, 77-90.

ZHIZHCHENKO, B.P., KOLESNIKOV, V.A. & A.G. EBERZIN (1940). *Neogene of the USSR*, 7. [in Russian]. Moscow, Leningrad, 1-667.