THE FIRST RECORD OF THE CHALICOTHERE *Ancylotherium pentelicum* IN ROMANIA

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Abstract. An isolated leg bone of the chalicothere *Ancylotherium pentelicum* was found in the locality Pogana, in Moldavia (Eastern Romania). The ungual phalanx was unearthed from Maeotian sands. It is the first chalicothere species ever reported in Romania documenting the presence of the Schizotheriinae. The fossil, as well as the sedimentary environment of the hosting rocks, is indicative for a late Miocene fluvial system that drained river streams from the Ukrainian High to the Black Sea Depression. Based on other similar finds from southeastern Europe and Turkey and on local geology, the locality Pogana could belong to MN 11-MN 12 units (Turolian). This find fills a gap in the knowledge about the circum-Pontic distribution of the late Miocene chalicotheres.

Keywords: Perissodactyls, chalicothere, late Miocene, Moldavia, Romania.

Rezumat. Prima semnalare a chalicotherului *Ancylotherium pentelicum* în România. Un os izolat de membru anterior al chalicotherului *Ancylotherium pentelicum* a fost descoperit în localitatea Pogana din Moldova (România estică). Falanga ungulă a fost extrasă din nisipuri meoțiene. Este prima specie de chalicother semnalată în România care dovedește prezența subfamiliei Schizotheriinae. Fosila, precum și mediul sedimentar al rocilor gazdă sunt indicative pentru un sistem fluviatil miocen terminal care a drenat râuri dinspre Masivul Ucrainean spre Depresiunea Mării Negre. Pe baza unor descoperiri similare din sud-estul Europei și din Turcia, precum și pe baza geologiei locale, localitatea Pogana ar putea reveni unităților MN 11 - MN 12 (Turolian). Această descoperire completează o lacună în cunoașterea distribuției chalicotherilor mioceni superiori din arealul circum-Pontic.

Cuvinte cheie: Perissodactyle, chalicother, Miocene terminal, Moldova, România.

INTRODUCTION

Chalicotheres are extinct, uneven-hoof-toed mammals that occurred in Eocene and went extinct in Pleistocene (COOMBS, 1989). In Europe they flourished in late Miocene, mainly in the eastern and southeastern regions of Europe (KOUFOS & KOSTOPOULOS, 2016). After the late Miocene they vanished from these regions, probably due to climate changes. If in Bulgaria, Greece or Turkey chalicotheres are rather often noticed (GERAADS et al., 2001; 2006; SARAÇ et al., 2002; SARAÇ & SEN, 2005; SPASSOV, 2002; GIAOURTSAKIS & KOUFOS, 2009; KOUFOS & KOSTOPOULOS, 2016), their documentation in Romania is extremely scarce. PAUCĂ (1938) described a "distal extremity of a median right metacarpal" mentioning that this fragmentary fossil could hardly be taken into consideration for a species and even for a genus assignation. Unfortunately, he neither illustrated the fossil, nor indicated the collection where the bone is hosted. It was collected in the area located north to the village Armășești (northeastern Oltenia, Vâlcea District), reworked into the actual alluvia of Cernișoara River. As it was found *ex situ* he theorized the stratigraphy of the deposits the bone originated from. Based on the known local geology, Paucă presumed either a Sarmatian, or Maeotian age of the originating rocks and assigned the fossil to the genus *Chalicotherium*. The geological map 1:200 000 *folio* 33 Tg. Jiu shows that the Sarmatian deposits should be excluded from this presumption, as the valley stream do not cross rocks of this age. Therefore, in our opinion, only a provenance from the Maeotian deposits could be taken into consideration.

Decades afterwards, this discovery was mentioned by MACAROVICI (1978) in a list of the Cenozoic mammals of Romania. But in this list, confusions occurred. Besides the find from Armășești, it also mentioned the chalicothere locality Mistelbach as being situated in Transylvania. Obviously, this locality is located in Austria and the find of a chalicothere there (FUCHS, 1881) has nothing in common with Romania. In the same list he mentioned the presence of "molaires bunosélenodontes attribuées à *Chalicotherium*" (p. 83), in the Sarmatian deposits of Oltenia, based on a paleontological textbook (BARBU, 1968). But Barbu just mentioned Paucă's find, without any reference to cheek teeth. This overview topic is useful for underlining that the find from Oltenia is in fact the single one in Romania. The subsequent mentions just resumed Paucă's find, eventually adding useless data that rather induced confusion instead of clarifying things. It is worth mentioning that the fossil from Oltenia seemingly is either lost, or mislead and we were not able to find it in a collection from Romania. Despite this apparent scarcity, some chalicothere remains were recovered decades ago in Transylvania from the clay of the Iris Formation (early Sarmatian *s.str.*), at Cluj-Napoca (unpublished material, VAC *personal observation*) in the former "Iris open pit" (local geology in MÉSZÁROS et al., 1991). They refer to a fragmentary skeleton of a young (possibly, juvenile) individual (ribs, fragments of forelimb and hind limb and spine; strangely, the cranium was not recovered although the taphonomy of the other bones – nearly in anatomical connection - is indicative for an environment devoid of dynamic waters). This material hosted at Babeș-Bolyai University of Cluj-Napoca will be studied in detail elsewhere.

This contribution is focused on the find of a chalicothere phalanx in the Maeotian sands exposed at Pogana (Moldavia, Vaslui District), on the left bank of the Tutova Valley, on Covurlui Hills (Fig. 1). Considering the extreme scarcity of chalicothere remains in Romania, it completes the geographic distribution of these perissodactyls not only in Romania, but also in the circum-Pontic region.

Figure 1. Satellite view of Tutova Valley, at Pogana; the outcrop is marked by a white rectangle (after bing.com/maps/aerial, modified).

GEOLOGICAL SETTING

The sedimentary deposits exposed in the Pogana area (Fig. 2) belong, from a structural viewpoint, to the Scythian Platform (RĂILEANU et al., 2012), more exactly to the westernmost area of this platform in Romania, the so-called "Bârlad Platform" (*sensu* IONESI, 1994). The sedimentary rocks covering the platform sole are divided into three megasequences. The one the fossils originated from is the third sedimentary megasequence ("megacycle" in IONESI, 1994), which started to accumulate in middle Miocene (late Badenian) and ended in Quaternary (IONESI, 1994). In the Pogana area, only a restricted stratigraphic succession can be observed in exposures, as long as only late Sarmatian and Maeotian rocks are cropping out. Like in the whole Central Moldavia, in this area too, the Saramatian/Maeotian boundary is marked by the basal portion of the andesitic tuff strata called "Nuțasca-Ruseni Tuff" (SEVASTOS, 1922) or "Nuțasca-Ruseni horizon" (JEANRENAUD, 1961). In spite of its classical largely accepted value as stratigraphic boundary marker, there is no radiometric dating of this tuff. It is considered a marker only because Sevastos mentioned just above these strata a vertebrate fauna considered by him as Maeotian. Another reason is practical, as long as it is easy to follow in the field, making easier the geological mapping in the central part of Moldavia. As this whole area exposes strata dipping as a monocline devoid of faults, interpolations and extrapolations of this tuff level were frequently done on the geological maps, based exclusively on the geometry of strata. On the Tutovei Hills, the tuff is mixed with sand and marl, with variable thickness reaching 10-20 m, by far thinner compared to the type found in the locality of Ruseni. But this stratigraphic marker could have also disadvantages. In some areas, one may think that the andesitic tuff could be reworked in different erosion events and its presence in such sections could be deceptive and inducing confusions on the real geological ages. There, the genuine volcanic input is mixed with clastic sediments, as it was reported from several sections located on the easternmost sides of the Scythian and Moldavian platforms.

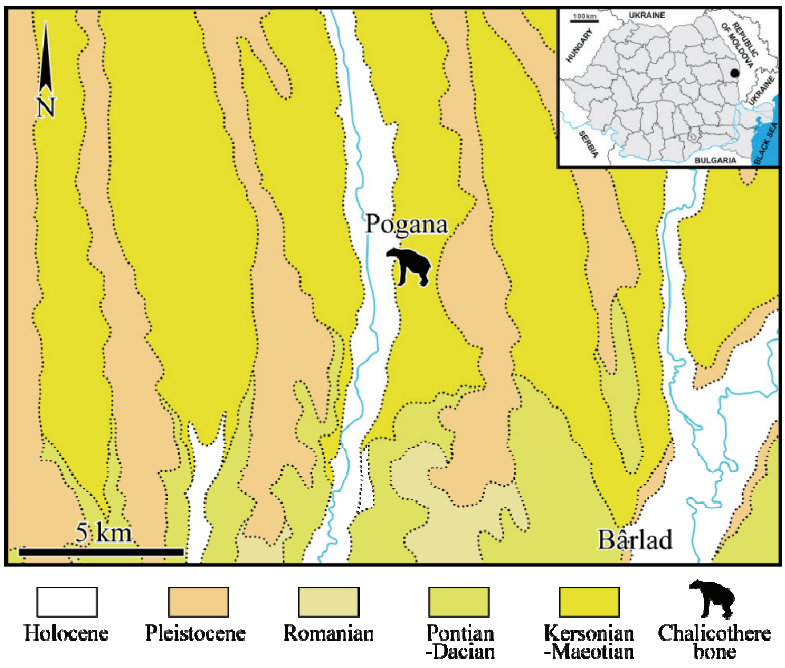

Figure 2. Geological map of the studied area (redrawn and modified, after SAULEA et al., 1967).

Under the tuff, the Kersonian deposits in Pogana are deltaic, with sand dominance and interbeddings of silt and clay (JEANRENAUD, 1961; 1965). Above the andesitic tuff, there is an obvious dominance of cross-bedded sands, sometimes bearing sandstone concretions and lens-like clay interbeddings. JEANRENAUD (1961; 1971a; b) divided the Maeotian strata into a lower portion that includes the andesitic tuff strata and an underlying one with cross-bedded sands in dominance and rarer clay interleavings. Both are considered by IONESI et al. (2005) as lithostratigraphic members. On the other hand, in a chart, MARINESCU et al. (1998) tried to coin the so-called "Murgeni Formation", without defining this unit. Both lower and upper limits of this "formation" are considered by these authors as marked by erosion events. They named "Nuțasca Strata" the andesitic tuff, considering its areal distribution as restricted only to a limited sector, probably in the western sides of the platform. In these circumstances, as none of these definitions does not agree with the stratigraphic rules, we consider the Maeotian deposits from the Scythian Platform to belong to an unnamed formation, including a basal Nuțasca-Ruseni Member and an unnamed upper member with "sands and clays" (IONESI et al., 2005). The Maeotian sand is covered by latest Miocene (Pontian), Pliocene and Quaternary deposits, mainly in fluvial-lacustrine environments.

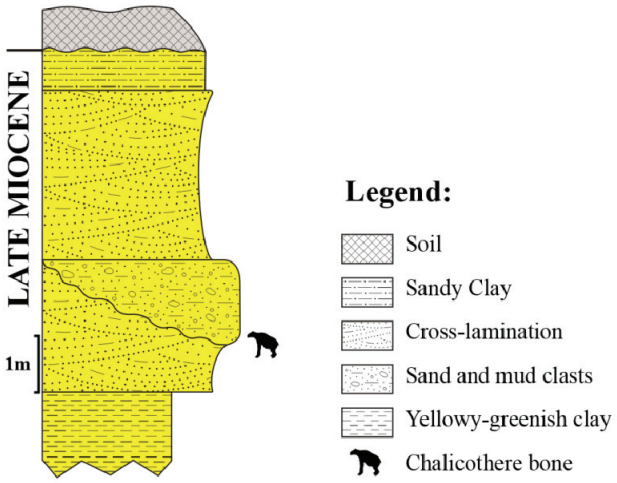

Figure 3. Lithological column of the Pogana outcrop (after CODREA et al., 2011).

Vertebrate remains are originating mainly from the basal section of the Pogana open pit succession. All of them refer to large sized vertebrates. There, several isolated teeth and bones were collected in the last couple of decades. The chalicothere bone does not break this depositional rule: it was dragged by the water streams for a distance before its burial. The vertebrates already collected from Pogana refer to rhinoceros (assigned to *Chilotherium* sp. in CODREA et al. 2011), a mastodon basin (possibly, *Tetralophodon longirostris*) and few remains of the tri-toed horse *Hipparion* sp. This assemblage is by far vague to define a clear age, but it can be useful at least to sketch a paleoenvironment of the area.

MATERIAL AND METHODS

A single large ungual phalanx of the manus is available for study, herein labeled as PCh1 (meaning: P – from the locality Pogana; Ch – from Chalicotherioidea; 1 – the number of the fossil). After this study, it will be stored in the paleontological collection of the "Vasile Pârvan" Museum from Bârlad (Moldova, Romania; hereafter, abbreviated VPM). After its collection from the outcrop, the bone was cleaned of the matrix sand with basic laboratory tools, and then the detached fragments were glued at VPM. Photographs were captured with D7000 Nikon camera equipped with a 105 mm Sigma lens, using a professional tripod. All measurements are in millimeters, taken with a professional caliper. The anatomical terminology follows BUTLER (1965) and COOMBS (1979).

SYSTEMATIC PALEONTOLOGY

Order **Perissodactyla** OWEN, 1848
Suborder **Ancylopoda** COPE, 1889
Superfamily **Chalichoterioidea** GILL, 1872
Family **Chalicotheriidae** GILL, 1872
Subfamily **Schizotheriinae** HOLLAND & PETERSON, 1914
Genus ***Ancylotherium*** GAUDRY, 1862
Ancylotherium (Ancylotherium) pentelicum **(**GAUDRY & LARTET, 1856)
Plate I – a-e

An unarticulated large ungual phalanx evidences the presence of chalicotheres in the faunal assemblage of Pogana. Its size and morphology allows considering it as the one of the digit II of the manus. The termination of the proximal portion of the dorsal process is damaged, due to hydrotaphonomy. It is also damaged on the subungual process area, which is hardly distinct on one side and completely broke on the opposite one. In such circumstances, the median pit for the flexor ligament (BUTLER, 1965) cannot be observed. In lateral views, the long dorsal process outline of the preserved portion is obliquely trended and straight. The articulation with duplex, composed by two facets separated by a prominent ridge-like keel is elongate and strongly concave, extending on over the half surface of the preserved portion of the lower side of the dorsal process. The morphology of the subungual process is different in Schizotheriinae vs. Chalicotheriinae, in the first case the lower margins of the articulation facets with duplex being lowered, almost at the level of the vollar boss. This feature can be observed in ROUSSIAKIS & THEODOROU (2001: Figs. 30, 6-7), in *A. (A.) pentelicum* from Pikermi (Greece) and on a photograph on a material from Pikermi stored in the National Museum of Natural History in Paris (abbreviated, MNHN). It is the same in SARAÇ et al. (2002; Fig. 4, 4) from Pinaryaka, Turkey (Turolian). In *Anisodon grande*, these margins are considerably higher (ZAPFE, 1979). In *Chalicotherium* cf. *goldfussi* KAUP, 1833 from Hadjidimovo-1 this feature follows the same rule, the specimen HD-650 being smaller compared to *A. pentelicum* (GERAADS et al., 2001; Table 3). The dorsal margins of facets are indistinct, erased by the hydrotaphonomy. The lateral sides forming the beds for the claw insertion are crossed by deep, irregular distributed grooves. They are separated by the cleft extending backward until the tearing up the dorsal lateral outline.

The measurements (after ROUSSIAKIS & THEODOROU, 2001) from Table 1 are in accordance with the values of the specimens from the Turolian localities of Pikermi, Samos, Pinaryaka and Novo-Ukrainka (Budyonnovka).

Table 1. Comparative measurements (mm) of the phalanx III of the digit II in the forelimb of *A. (A.) pentelicum.*

	L_{max}	DT_{pr}	DAP_{pr}	DT_{max}	L_{vol}
PCh1 Pogana	>153.0	>38.5	86.0	>51.0	87.7
PG 95/531[1] Pikermi	>160.9	47.4	(90.0)	54.9	(102.0)
PG 95/532[1] Pikermi	(102.5)	(38.0)	59.7	43.0	(68.3)
Pikermi [2,1]	(158.1)	(41.7)	87.8	58.8	101.6
Pikermi [2,3]	170.0	-	70.0	56.0	-
Samos [2,1,3]	(224.0)	-	74.0	57.0	-
Samos [2,1,3]	170.0	-	75.0	54.0	-
Pinaryaka[3]	178.0	-	87.0	56.0	110.0
Novo-Ukrainka (Budyonnovka)[4]	166.0	-	-	53.0	-

[1] ROUSSIAKIS & THEODOROU (2001); Middle Turolian.
[2, 1] SCHAUB (1943) and ROUSSIAKIS & THEODOROU (2001); Middle Turolian.
[2,1,3] SCHAUB (1943), ROUSSIAKIS & THEODOROU (2001), SARAÇ et al. (2002); Turolian.
[3] SARAÇ et al. (2002); Turolian.
[4] PIDOPLICHKO (1959); Maeotian.

DISCUSSIONS

A lot of studies concerning chalicotheres were based before anything else, on teeth. Some species were firstly described based only on few teeth (e.g. "*Chalicotherium goldfussi"*, in KAUP, 1833). Therefore, it is rather hard to make sometimes direct comparisons in the postcranial bones of various chalicotheres as long as not for all taxa neither the distal phalanges are known (e.g. for *Kalimantsia* from Bulgaria; GERAADS et al., 2001), nor their exact anatomical position, i.e. to which specified digit a phalanx belongs. Basically, for a lot of chalicotheres the anatomy remains poor known because of the scarcity and fragmentary status of fossils. Some authors tried to find discrimination features in the morphology on the distal phalanges, as ABEL (1920). Later, COOMBS (1989) considered that the ungual phalanges in Chalicotheriinae are strongerly laterally compressed compared with the ones of Schizotheriinae, as a derived state.

The stratigraphic distribution of this chalicothere species is not very controversial but some shades must be outlined. This representative of Schizotheriinae is spread in the upper Miocene formations of Europe. HEISSIG (1999), referenced to a "gap in the schizotheriinae record from MN 8 to MN 11" (p. 190), mentioning for *A. (A.) pentelicum* a stratigraphic range between MN 12 and MN 13. But COOMBS (2009) mentioned that the genus *Ancylotherium* occurred in Europe since Vallesian (MN 9 and MN 10 units), considering the species *A. (A) pentelicum* as Turolian (MN 11-MN 13), recorded in various localities. More recently, KOUFOS & KOSTOPOULOS (2016) specified for this species a distribution range in Europe between the mammal units MN 10-MN 13, mentioning however, that the Vallesian materials from Spain are "scarce and fragmentary and the determinations quite doubtful" (p. 83). On their chart, they illustrate a long continuous record of this species in Thermopigi and Esendere, and shorter ones in Tito Veles or Gorna Susitsa. As not enough arguments are available, we consider for instance the chalicothere from Pogana as Upper Miocene, but the assignation of a clear MN unit in this locality needs additional evidence. Even in this context, based on the local geology one may estimate its geological age as MN 11-MN 12 (Turolian).

The geographic distribution of the species illustrated by GERAADS et al. (2006) and GIAOURTSAKIS & KOUFOS (2009) reflects the uneven status of knowledge in Eastern Mediterranean (i.e. "Greco-Iranian", "Balkano-Iranian"

or ”subparatethyan” in SARAÇ et al., 2002; SARAÇ & SEN, 2005) vs. the circum-Pontic regions. But, one may think that this could be result of the collecting bias and rarity of these mammals in the Miocene vertebrate assemblages of this region. If in Turkey, Greece and southwestern Bulgaria there are several localities where this chalicothere was recorded, nothing is known in Romania and Republic of Moldova. In Ukraine, the locality Novo-Ukrainka (?MN 11) yielded such fossils (PIDOPLICHKO, 1959; KOROTKEVICH, 1988, KOROTKEVICH & SULIMSKI, 1990; see discussions about this locality in GERAADS et al., 2006). The species is known from the Grebienniki subdivision of the Berislav faunistic complex […] corresponding to the zone MN 11” (KOROTKEVICH & SULIMSKI, 1990).

Therefore, the discovery from Romania completes the geographic distribution of this species. The upper Miocene geography allows thinking about a dispersal of this chalicothere from the Balkans towards the northern Black Sea region, probably following trails along the riparian areas of the Dacian basin. Since the middle Sarmatian, sectors of this basin in Moldavia became emerged. In the Galitzian Gulf, the waters gradually retreated from north-west towards south-east (as reflected by the lithological-paleogeographic maps of Paratethys in POPOV et al., 2004). Since late middle Miocene and even in a more extended way in late Miocene, we may accept that land bridges occurred between Balkans and Carpathians, allowing the passages of vertebrates from south to north. Since the late Sarmatian in Moldova, but even more in the Maeotian on the emerged areas, fluvial systems occurred with rivers flowing from the Ukrainian High towards the Black Sea Depression. We consider that the Maeotian deposits from Pogana are of such fluvial origin. For instance, as we already mentioned in the previous section, there are not too many vertebrate remains collected from this locality. Until now, there were no articulated bones, the majority being heavy marked by hidrotaphonomy, due to longer or shorter transport by the water streams.

Due to the scarcity of fossils from this locality, it is difficult to reconstruct in a detailed manner the paleoenvironment for this chalicothere species. But this is an environmental marker itself, starting from previous discoveries. HEISSIG (1999) pointed out that *Ancylotherium* lived in a dry environment, but not devoid of trees or brushwood, as GERAADS et al. (2006) claimed too. Data about the Maeotian vegetation in Moldavia are not very rich, but some studies added details to previous knowledge. ȚABĂRĂ & SAVA (2011), based on a macroflora from Mânzați rich in broad leaf taxa, estimated a Mean Annual Temperature (MAT) with an average around 12^{o}C. Their environment refers to a hilly region, with 100-200 m altitudes. Later, ȚABĂRĂ & CHIRILĂ (2012) estimated for the Maeotian from the Dacian basin a mean annual temperature (MAT) around 16^{o}C. The rainfall (MAP) was diverse, with a couple of increasing tendencies. The basal one was ca. 1100 mm/yr, followed by a decrease to less than 1000 mm/yr, then again an increase to ca. 1150 mm and finally, near the Maeotian/Pontian boundary, a severely decrease at 900 mm. These data are nearly the same in Bulgaria (IVANOV et al., 2002).

Based on these data, we consider that the Maeotian chalicothere from Pogana lived in a hilly area on low altitudes, nearby a river bordered by woods were broad leaf trees were dominant. Probably at a distance, more open areas were present. Compared to the present situation, the climate was by far, warmer.

CONCLUDING REMARKS

The chalicothere *A. (A.) pentelicum* from Pogana is the first Schizotheriinae representative reported in Romania, being the first to the east of the Carpathians, in Moldova. This large perissodactyl lived in late Miocene (Maeotian) in an environment where the woodland was alternating with the open spaces, savannah-like. All the vertebrate remains from Pogana were found in fluvial deposits, most of them being dragged on longer or shorter distances by the water streams. The climate was warm, cca. 16^{o}C MAT. The seasonal regime (pluvial vs. dry seasons) is not excluded. For instance, as the list of fossils is not very rich in taxa, it is hard to estimate an exact geological age for this locality, but based on the other discoveries of this chalicothere elsewhere in southeastern Europe or in Turkey one may presume that the time span referring to MN 11-MN 12 could be documented at Pogana. It brings a new detail about the late Miocene mammal communities from Romania, also important for Republic of Moldova, supporting a logical pattern of dispersal from Greco-Iranian province to northern Black Sea areas.

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REFERENCES

ABEL O. 1920. Studien über die Lebensweise von *Chalicotherium*. *Acta Zoologica.* Wiley Press. London. **1***:* 21-60.

BARBU V. 1968. *Paleontologie* (Ediția a II-a). Edit. Didactică și Pedagogică. București. 500 pp.

BUTLER P. M. 1965. Fossil mammals of Africa. No. 18. East African Miocene and Pleistocene chalicotheres. *Bulletin of the British Museum Natural History Geology*. London. **10**: 165-237.

CODARCEA AL., RĂILEANU GR., BERCIA I., MARINESCU FL., MUTIHAC V., PAVELESCU M., STANCU J. 1967. *Harta geologică 1:200000, folio 33 (L-34-XXX), Tg. Jiu*. Comitetul de Stat al geologiei. Institutul Geologic. București.

CODREA A. V., URSACHI L., BEJAN D., FĂRCAȘ C. 2011. Early Late Miocene *Chilotherium* (Perissodactyla, Mammalia) from Pogana (Scythian Platform). *North-Western Journal of Zoology*. Herpetological Club of Oradea. **7**(2): 184-188.

COOMBS M. C. 1979. *Tylocephalonyx*, a new genus of North American dome-skulled chalicotheres (Mammalia, Perissodactyla). *Bulletin American Museum of Natural History*. New York. **164**: 64 pp.

COOMBS M. C. 1989. Interrelationships and diversity in the chalicotheriidae. In: Prothero DR & Schoch RM (Eds). *The evolution of perissodactyls*. Clarendon Press. New York: 438-457.

COOMBS M. C. 2009. The chalicothere *Metaschizotherium bavaricum* (Perissodactyla, Chalicotheriidae, Schizotheriinae) from the Miocene (MN5) Lagerstätte of Sandelzhausen (Germany): description, comparison, and paleoecological significance. *Paläontologische Zeitschrift*. Springer. Berlin. **83**: 85-129.

FUCHS Th. 1881. *Chalicotherium* sp. von Siebenhirten bei Mistelbach. *Verhandlungen der k.k. geologischen Reichsanstalt*. Wien. **5**: 77-78.

GERAADS D., SPASSOV N., KOVACHEV D. 2001. New Chalicotheriidae (Mammalia) from Bulgaria. *Journal of Vertebrate Paleontology*. Taylor & Francis for the Society of Vertebrate Paleontology. Bethesda. **21**:596–606.

GERAADS D., SPASSOV N., KOVACHEV D., 2006. The Bulgarian Chalicotheriidae (Mammalia): an update. *Revue de Paléobiologie*. Museum of Natural History of the City of Geneva Publisher. Geneva. **25**(2): 429-437.

GIAOURTSAKIS I. X. & KOUFOS G. D. 2009. The Late Miocene Mammal Faunas of the Mytilinii Basin, Samos Island, Greece: New Collection. 10. Chalicotheriidae. *Beitrage Paläontolgie*. Wien. **31**: 189-205.

HEISSIG K. 1999. 17. Family Chalicotheriidae. In: Rössner G. E & Heissig K. (Eds.) *The Miocene. Land Mammals of Europe*. Verlag Dr. Fr. Pfeil. München: 189-192.

IONESI L. 1994. *Geologia unităților de platformă și a Orogenului Nord-Dobrogean*. Edit. Tehnică. București. 280 pp.

IONESI L., IONESI, B., LUNGU A., ROȘCA V., IONESI V. 2005. *Sarmațianul mediu și superior de pe Platforma Moldovenească*. Edit. Academiei Române. București: 558 pp.

IVANOV D., ASHRAF A. R., MOSBRUGGER V., PALAMAREV E. 2002. Palynological evidence for Miocene climate change in the Forecarpathian Basin (Central Paratethys, NW Bulgaria). *Palaeogeography, Palaeoclimatology, Palaeoecology*. Elsevier. Amsterdam. **178**: 19-37.

JEANRENAUD P. 1961. Contribuții la geologia Podișului Central Moldovenesc. *Analele Ştiinţifice ale Universităţii „Al. I. Cuza" Iaşi, Geologie-Geografie*. Iași. **7**(2) : 417-432.

JEANRENAUD P. 1965. Cercetări geologice între valea Crasna și Prut. *Analele Ştiinţifice ale Universităţii „Al. I. Cuza" Iaşi, Geologie-Geografie*. Iași. **9**: 31-44.

JEANREAUD P. 1971a. *Geologia Moldovei Centrale dintre Siret și Prut*. Ph. D. Thesis, Universitaty „Al. I. Cuza" Iaşi. 386 pp.

JEANRENAUD P. 1971b. Harta geologică a Moldovei centrale dintre Siret și Prut. *Analele ştiinţifice ale Univeităţii „Al. I. Cuza" Iaşi, Geologie*. Iași. **17**: 65-78.

KAUP J.-J. 1833. Description d'ossements fossiles de mammifères inconnus jusqu'à présent qui se trouvent au Muséum grand-ducal de Darmstadt. *Second cahier*. Darmstadt: 1-31.

KOROTKEVICH O. 1988. Genesis of the *Hipparion*-fauna of Eastern Europe [in Russian]. *Naukova Dumka*. Kiyv. 160 pp.

KOROTKEVICH O. & SULIMSKI A. 1990. A new chalicotherian finding from the Miocene karst in Poland (Mammalia, Badenian). *Acta Palaeontologica Polonica.* Warszawa. **35** (1-2): 91-96.

KOUFOS G. D. & KOSTOPOULOS D. S. 2016. Palaeontology of the upper Miocene vertebrate localities of Nikiti (Chalkidiki Peninsula, Macedonia, Greece). Chalicotheriidae. *Geobios*. Elsevier. Amsterdam. **49**: 75-83.

MACAROVICI N. 1978. Sur la faune des mammifères fossiles néozoiques de la Roumanie. *Revue Roumaine de Géologie, Géophysique et Géographie, Géologie*. București. **22**: 71-98.

MARINESCU Fl., MĂRUNȚEANU M., PAPAIANOPOL I., POPESCU GH. 1998. Tables with the correlation of the Neogene deposits in Romania. *Romanian Journal of Stratigraphy*. București. **78**: 181-186.

MÉSZÁROS N., PETRESCU I., MÂRZA I. 1991. Contributions to the Study of the Miocene Formations Bearing Volcanic Tuff from the Colina "Iris" Quarry (Cluj-Napoca). In: Márza I. (Ed.) *The Volcanic Tuffs from the Transylvanian Basin*. Cluj-Napoca: 55-61.

PAUCĂ M. 1938. Sur la presence du genre *Chalicotherium* en Roumanie. *Comptes rendus des séances de l'Académie des Sciences de Roumanie*. Bucharest. **2**(5): 540-54.

PIDOPLICHKO G. I. 1959. New finds of mammals in the Neogene of the Ukraine [in Ukrainean]. *Dopovidi Akademiî Nauk Ukrainsîkoi RSR*. Kyiv. **5**: 531-534.

POPOV S. V., RÖGL F., ROZANOV A.Y., STEININGER F.F., SHCHERBA I.G., KOVÁČ M. 2004. Lithological–Paleogeographic maps of Paratethys. 10 Maps Late Eocene to Pliocene. *Courrier Forschungsinstitut Senckenberg*. Frankfurt aim Main. **250**: 1-46.

RĂILEANU V., TATARU D., GRECU B., BALA A. 2012. Crustal models in Romania. II. Moldavian Platform and adjacent areas. *Romanian Journal of Physics*. Edit. Academiei Române. București. **57**: 1438-1454.

ROUSSIAKIS S. J. & THEODOROU G. E. 2001. *Ancylotherium pentelicum* (Gaudry & Lartet, 1856) (Perissodactyla, Mammalia) from the classic locality of Pikermi (Attica, Greece), stored in the Palaeontological and Geological Museum of Athens. *Geobios*. Elsevier. Amsterdam. **34**(5): 563-584.

SARAÇ G., KAYA T., GERAADS D. 2002. *Ancylotherium pentelicum* (Perissodactyla, Mammalia) from the Upper Miocene of central and western Turkey / *Ancylotherium pentelicum* (Perissodactyla, Mammalia), du Miocène supérieur de Turquie centrale et occidentale. *Geobios*. Elsevier. Amsterdam. **35**: 241-251.

SARAÇ G. & SEN S., 2005. Chalicotheriidae (Mammalia, Perissodactyla) from the late Miocene of Akkaşdağ, Turkey. *Geobios*. Elsevier. Amsterdam. **27**(4): 591-600.

SAULEA E., GHENEA C., GHENEA A. 1967. *Harta geologică 1:200000 folio 22 (L-35-XVI, L-35-XVII) Bârlad*. Comitetul de Stat al geologiei din România. Institutul Geologic. București.

SCHAUB S. 1943. Die Vorderextremität von *Ancylotherium pentelicum* GAUDRY& LARTET. *Schweizerische Paläontologische Abhandlungen*. Birkhäuser. Basel. **64**: 1-36.

SEVASTOS R. 1922. Limita Sarmatianului, Meoțianului și Ponțianului dintre Siret și Prut. *Anuarul Institutului Geologic al României*. București. **9**: 373-399.

SPASSOV N. 2002. The Turolian Megafauna of West Bulgaria and the character of the Late Miocene "Pikermian biome". *Bollettino della Società Paleontologica ltaliana*. Modena. **41**(1): 69-81.

ȚABĂRĂ D. & SAVA G. M. 2011. Paleobotanical remains from the Late Sarmatian and Maeotian age of the northern Scythian Platform. *Analele Stiintifice ale Universitatii „Al. I. Cuza" din Iași, Seria Geologie*. Iași. **57**(2): 19-34.

ȚABĂRĂ D & CHIRILĂ G. 2012. Palaeoclimatic estimation from Miocene of Romania, based on palynological data. *Carpathian Journal of earth and Environmental Sciences*. Baia Mare. **7**(2): 195-208.

ZAPFE H. 1979. *Chalicotherium grande* (Blainv.) aus der miozänen Spaltenfüllung von Neudorf an der March (Devinská Nová Ves), Tschechoslowakei. *Neue Denkschriften des Naturhistorischen Museums in Wien*. Wien. **2**: 1-282.

***. https://www.bing.com/maps/aerial?toWww=1&redig=63D7B81CCFBC4E9A9E6438C04802EA33 (accessed: February 8, 2019).

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Plate I: ***Ancylotherium (Ancylotherium) pentelicum*** phalanx III, digit II of manus. a – lateral view; b – plantar view; c – dorsal view ; d – proximal view ; e – distal view.