



First records of *Stephanorhinus kirchbergensis* (Jäger, 1839) (Mammalia, Rhinocerotidae) from the Kuznetsk Basin (Kemerovo region, Kuzbass area, South-East of Western Siberia)

Emmanuel M.E. BILLIA

E.M.E. Billia, past Senior Visiting Research Fellow, Dept. of Palaeontology and Historical Geology, Tomsk State University (Russia);
Dipartimento di Scienze della Terra, Università di Roma La Sapienza, p.le A. Moro 5, 00187 Roma; e.billia@libero.it

KEY-WORDS: *Stephanorhinus kirchbergensis*, Quaternary, Kuznetsk Basin, Inya river, Mokhovo, Meret' river Valley, Siberia.

ABSTRACT - Two localities in the Kuznetsk Basin (Kemerovo region, Kuzbass area, South-East of Western Siberia) - a unique region for the study of the Quaternary theriofauna in Siberia - have yielded an extremely rich collection of Pleistocene mammalian skeletal remains - among which three isolated upper molars (one of which showing a singular genetic abnormality) belonging to *Stephanorhinus kirchbergensis* (Jäger, 1839), better known in Russia as "nosorog Merka" (Merck's rhinoceros).

In the Siberian area remains of *S. kirchbergensis* were found only in three other localities of this wide territory. These are the cases of the only two records from the Kemerovo region among the very few records from Russia.

At present, on the basis of the fossil evidence, *S. kirchbergensis* - unlike *Coelodonta antiquitatis* (Blum.), which abounds in Eurasia, just as well as other Plio-Pleistocene rhinoceroses - despite of being widely spread throughout the Eurasian continent, seems to be decidedly rare on Russian territory as well as in the European area being only reported from few localities. Finally, *S. kirchbergensis* appears to be a rhinoceros still little investigated, and consequently, not well known yet.

RIASSUNTO - [Primi ritrovamenti di *Stephanorhinus kirchbergensis* (Jäger, 1839) (Mammalia, Rhinocerotidae) nel bacino di Kuznetsk (regione di Kemerovo, areale del Kuzbass, Sud-Est della Siberia occidentale)] - Da due località situate nel bacino di Kuznetsk (regione di Kemerovo, areale del Kuzbass, sud-est della Siberia occidentale) - una regione unica per lo studio della fauna quaternaria in Siberia, costituita da una depressione intramontana che si estende latitudinalmente per oltre 350 chilometri e longitudinalmente per circa 150, delimitata dai monti del Kuznetsk Alatau, dalla Gornaya Shoriya e dalla catena montuosa Salair - provengono tre molari superiori isolati (uno dei quali evidenziante una non comune anomalia genetica) attribuiti a *Stephanorhinus kirchbergensis* (Jäger, 1839), meglio noto in Russia come "nosorog Merka" (rinoceronte di Merck).

Nel 1964, sulla riva destra del fiume Inya, a ridosso di una ferrovia industriale situata tra le città di Kemerovo e Leninsk-Kuznetskiy, è stato rinvenuto un terzo molare superiore isolato per il quale non sussistono dati stratigrafici.

In epoca più recente, a Mokhovo - località situata nella Valle del fiume Meret' e poco distante da Leninsk-Kuznetskiy - sono stati recuperati un secondo e un terzo molare superiori; quest'ultimo presenta, distalmente, un cono supplementare che interrompe ex abrupto l'ectometalofo, caratteristica questa attestante una singolare anomalia genetica che può considerarsi unica nel suo genere. Altri fattori anomali sono costituiti tanto dalla presenza del crochet distale, quanto dalla fossetta mesio-distale. I reperti odontologici, inclusi in quest'area nella "Tatarskaja Fauna", provengono dalla formazione Berezov (Berezovskaya svita, nella stratigrafia locale = Shirtinsky gorizont, in quella siberico-occidentale = Odinzovsky gorizont, in quella europeo-orientale; OIS 6; 0,18-0,16 Ma), una delle nove costituenti la fitta sequenza (oltre 150 metri) di depositi quaternari - accumulatisi in sezioni composite con sequenze biostratigrafiche complete - che hanno restituito, nel loro complesso, abbondanti resti fossili di mammalofaune di grande taglia (57 tra specie e sottospecie; 22 generi, 10 famiglie, 4 ordini) che coprono l'intero arco pleistocenico.

Con particolare riguardo all'area siberiana, resti di *S. kirchbergensis* sono stati rinvenuti solo in altre tre località di questo vasto territorio. Qui vengono rappresentati gli unici due rinvenimenti nella regione di Kemerovo, due fra i pochissimi in tutta la Federazione Russa.

Allo stato attuale, stando alle evidenze fossili, *S. kirchbergensis* - diversamente rispetto a *Coelodonta antiquitatis* (Blum.), che abbonda in Eurasia, come del resto anche altri rinoceronti plio-pleistocenici - nonostante la sua ampia dispersione sul continente eurasiatico, sembrerebbe essere decisamente raro tanto sul territorio russo, quanto su quello europeo, essendo riportato soltanto in un numero relativamente molto limitato di località.

Viene messo in luce anche come questa specie sia stata nel tempo così poco investigata e, di conseguenza, sia ancor oggi molto poco nota.

INTRODUCTION

The Kuznetsk Basin (Kemerovo region, Kuzbass area, South-East of Western Siberia), a unique region for the study of the Quaternary theriofauna in Siberia, is constituted by a wide intramontane depression whose surface extends latitudinally for more than 350 km and longitudinally for about 150 km; the area is surrounded by the Kuznetsk Alatau Mountains, the Gornaya Shoriya, and the Salair Ridge (Fig. 1).

In 1964, a single isolated rhinoceros tooth has been discovered in an outcrop along the right bank of the

Inya river near the industrial railway station Promyshlennaya Stanzya (about 54° 50' N - 85° 30' E), 58 km south-west of Kemerovo and 45 km north-west of Leninsk-Kuznetskiy (Fig. 1 (1)). Unfortunately, no stratigraphic data are available.

East of Promyshlennaya Stanzya, a thick sequence of Quaternary deposits, accumulated above the Palaeozoic bedrock throughout the Late Cenozoic, form deposits which represent several alternating stages of subaerial, deluvial-proluvial and lacustrine-alluvial sedimentation. The thick deposits - up to 150 meters - exposed in open-cast coal mines, in composite sections

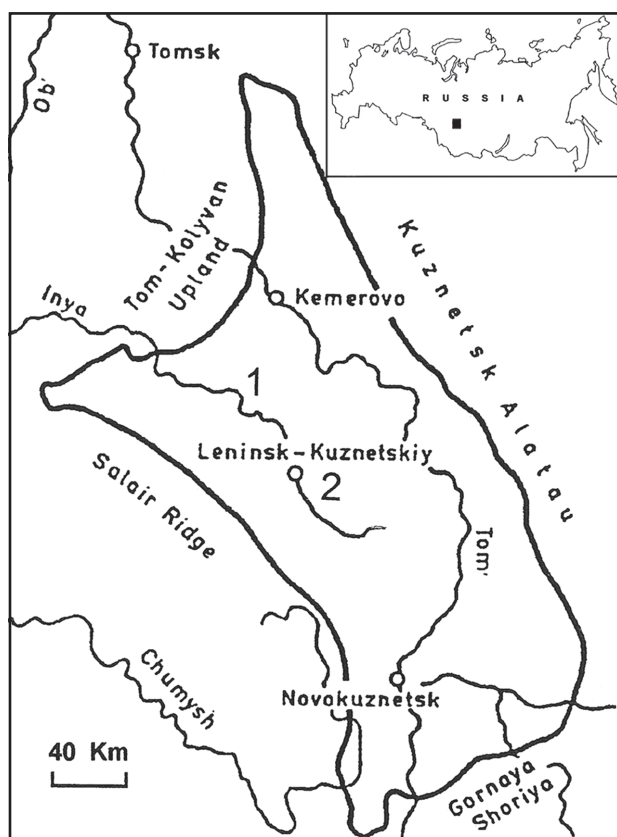


Fig. 1 - Index maps of the Kuznetsk basin (in the border) with the localizations of the points of the finds: (1) along the Inya river near the railway industrial station Promyshlennaya Stanzya and (2) Mokhovo.

with complete biostratigraphic sequences, make this area one of the most important in the non-glaciated zone of Russia. Previously described by Foronova (2001), it allowed to establish nine units which have brought to light, in recent years, an extremely rich collection of fossil remains belonging to 57 species and subspecies (22 genera, 10 families, 4 orders) of large mammals which cover all the Pleistocene. Each sedimentary unit has very rich and peculiar biostratigraphic features which provided the basis for a biostratigraphic classification of the deposit, also used as a regional stratigraphic scheme for the Altay-Sayan area (Vdovin et al., 1973; Zudin et al., 1982), and for the comparison with other parts of Western Siberia and the International Quaternary Correlation System (IQCS).

Excavations in the lower part of one (thickness about 5.5 m) of the nine lithostratigraphic units, the Berezov Formation (Berezovskaya svita, in the local stratigraphy = Shirtinsky gorizont, in the Western-Siberian stratigraphy = Odinzovsky gorizont, in the Eastern-European stratigraphy = Holstein, in the Western-European stratigraphy; OIS 6; 0.18-0.16 My) at Mokhovo (about 54° 30' N - 86° 10' E), in the Meret' river Valley, about 20 km east of Leninsk-Kuznetskiy (Fig. 1 (2)), have yielded a great number of fossil skeletal remains ascribed to *Panthera spelaea* (Goldf., 1810), *Cervus elaphus* L., 1758, *Megaloceros giganteus*

(Blum., 1803), *Bison priscus* Boj., 1827, *Rangifer tarandus* L., 1758, *Equus* sp., *Ursus* cf. *arctos* L., 1758, *Mammuthus* cf. *intermedius* Jourdan, 1861 (a transitional form with morphological characters between *M. chosaricus* Dubrovo, 1966 and primitive forms of *M. primigenius* (Blum., 1799)). Among them, two isolated rhinoceros teeth have also been unearthed. All these taxa are included in the so-called "Tatarskaya Fauna" ("Tatarian Fauna"). On the basis of the faunal composition the formation of the unit may be placed between the Shirta interglacial and the second half of the Saalian glacial (Foronova, 2001).

MATERIAL

The isolated tooth from the Inya river is a third upper molar (M^3) (KKM-PU 82); it is preserved in the collections of the Kemerovo Regional Ethnographic Museum.

The two isolated teeth recovered at Mokhovo consist of a third upper molar (M^3) (OIGGM SO RAN 9226) and of a second upper molar (M^2) (OIGGM SO RAN 9242) (collections of the Institute of Geology-Geophysics-Mineralogy of the Russian Academy of Science [Siberian Branch] in Novosibirsk).

The most salient characters of the three specimens are described here below.

Third upper molar KKM-PU 82 from the Inya river - Well-preserved, large-sized, and remarkably brachyodont third upper molar (Fig. 2a). The protocone appears really remarkably bulbous (max diameter of the bulbosity at the base of the protocone = 37.5 mm); *crochet* is present, *anticrochet* and *crista* are absent. Two small styli are present in the valley (base of the protocone); lingual *cingulum* present, roots still present. Some traces of cement are present on the buccal side of the crown.

Third upper molar OIGGM SO RAN 9226 from Mokhovo - Well-preserved, large-sized, and remarkably brachyodont third upper molar (Figs. 2b-d) slightly damaged in its mesial and distal portions. The ectometaloph *ex abrupto* distally interrupts to leave space for a supplementary *conus* completely separate from the ectometaloph; a *crochet* develops at the entrance of the valley and a mesio-distal *fossetta* is also present. Protocone and metacone are remarkably bulbous (max diameter of the bulbosity at the base of the protocone = 32 mm; at the base of the metacone = 25 mm). The enamel is quite smooth and semi-bright; the buccal side of the crown is covered by a very thin cement film whereas that of the lingual side shows only some traces of it. Also the enamel of both the mesio-distal valley and *fossetta* is covered by cement, but it is thicker than those on the buccal side.

A fragmentary *stylus* is present at the entrance of the valley. *Cingula* are present only at the base of the protocone (central and lingual side) and at the base of the metacone (labio-distal portion). The lower portion of the buccal crown shows some small *styli*; one of the latter is also present at the base of the mesostyle.

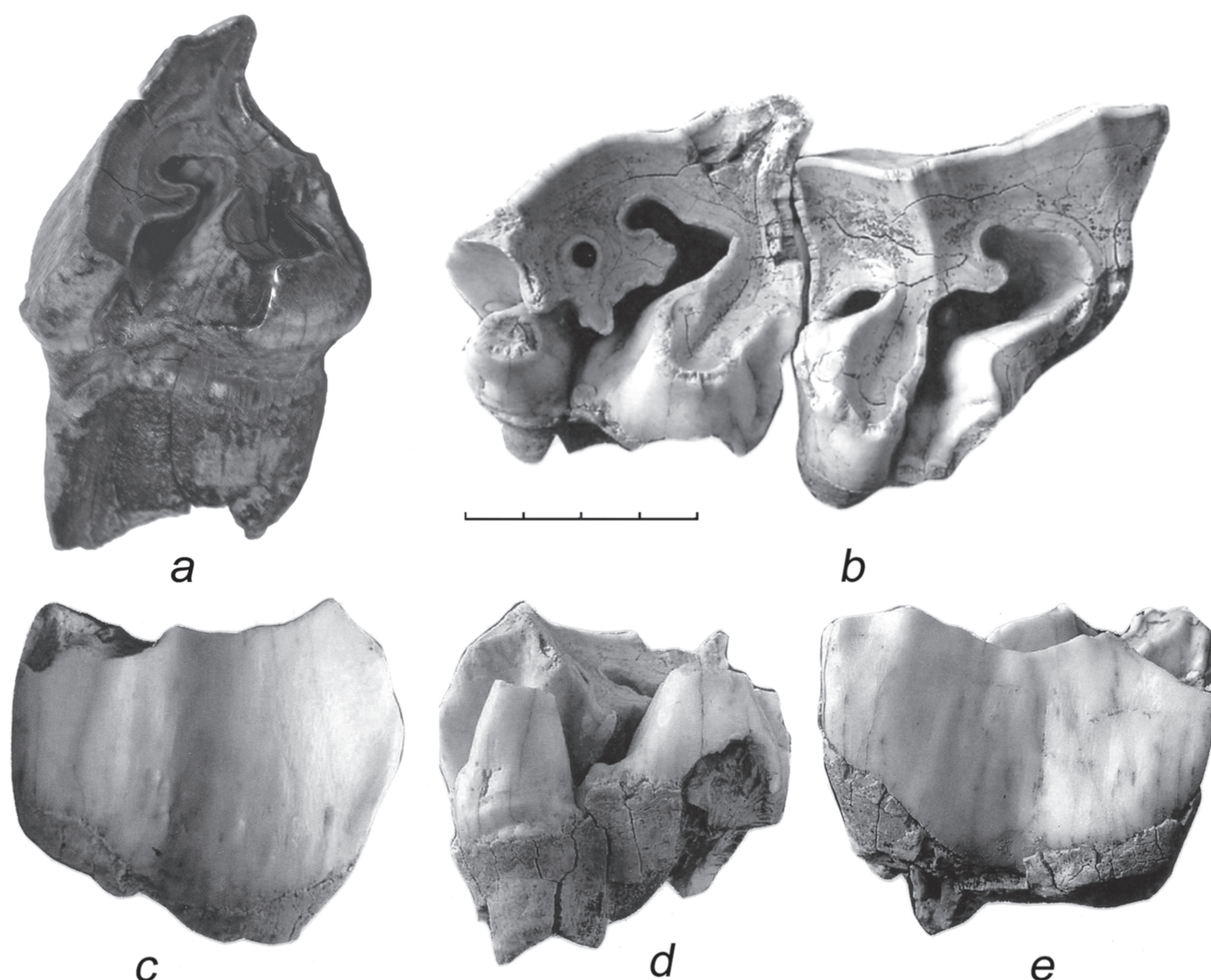


Fig. 2 - *Stephanorhinus kirchbergensis* (Jäger, 1839). Inya river near Promyshlennaya Stanzya (Kuznetsk Basin, Kemerovo region, Kuzbass area, South-East of Western Siberia); a) third upper molar [KKM-PU 82]; occlusal-distal view (about 3/4 nat. size). Berezov Formation (Shirtinsky gorizont = Middle Late Pleistocene); Mokhovo (Meret' river Valley, Kuznetsk Basin, Kemerovo region, Kuzbass area, South-East of Western Siberia); third [OIGGM SO RAN 9226] and second [OIGGM SO RAN 9242] upper molars, b) occlusal-lingual view (see, on the M³, the supplementary distal *conus* testifying a genetic abnormality); third upper molar, c) buccal view and d) distal view; second upper molar, e) buccal view (about 3/4 nat. size) (scale bar = 1 cm).

Second upper molar OIGGM SO RAN 9242 from Mokhovo - Large-sized and remarkably brachyodont second upper molar, damaged in its mesial-lingual portion (Figs. 2b, e). Even if damaged, the protocone allows to have an inkling of a remarkable bulbosity. The buccal side of the crown is covered by an extremely

thin cement film for 4/5 of its height. The enamel of both the valley and distal *fossetta* is also partly covered by a cement film, but thicker in comparison to that of the buccal side of the crown; otherwise, where the cement is absent (in both the central and distal valleys), the enamel is smooth and bright. One *stylus* is present in the central valley, while two sub-horizontal fragmentary *styli* are present at the entrance of the same valley. *Crochet* is present, *anticrochet* and *crista* are absent. *Cingula* are also absent.

Some measurements of the three upper molars are given in Tab. 1.

SPECIMEN	COLLECTION	BL	LL	DW
third upper molar	KKM-PU 82	71.2	69.4	62.5
third upper molar	OIGGM 9226	72.6	73.1	67.3
second upper molar	OIGGM 9242	66.2	=	69.8

Tab. 1 - Dimensions (in mm) of the third upper molar (KKM-PU 82) from the Inya river near Promyshlennaya Stanzya (Kuznetsk Basin, Kemerovo region), of the third and of the second upper molars (OIGGM 9226 and 9242) from Mokhovo (Meret' river Valley, Kuznetsk Basin, Kemerovo region). BL = buccal length; LL = lingual length; DW = distal width.

RESULTS

The large size, the remarkable brachyodonty and the bulbous protocone of the third upper molar from the Inya river, and the large size, the bulbous protocones,

the remarkable brachyodonty, the undulation of the ectoloph, the aspect of the enamel of both the third and the second upper molars from Mokhovo are morphological traits suggestive of *Stephanorhinus kirchbergensis* (Jäger, 1839) (sin. *Rhinoceros mercki* Kaup, 1841), the Pleistocene tandem-horned Eurasian interglacial rhinoceros, better known in Russia - and in the former Soviet Union - as “nosorog Merka” (literally, Merck’s rhinoceros). On the teeth of this species, the usually absent coronal cement is never thick when present.

An absolutely unique peculiarity is represented, on the third upper molar from Mokhovo, by the supplementary *conus* (see Figs. 2b, d) which *ex abrupto* distally interrupts the ectometaloph (on the third upper molar of all rhinoceroses - *Coelodonta antiquitatis* (Blum., 1799) excluded - ectoloph and metaloph form an unique ensemble, the ectometaloph) testifying a genetic anomaly which may be considered as unique in its kind. In addition, the distal *crochet* which develops at the entrance of the valley and the mesio-distal *fossetta* may be considered as anomalous factors. The two odontological remains undoubtedly belong to the same individual.

DISCUSSION

Unlike *C. antiquitatis*, which is widespread throughout Russia, *S. kirchbergensis*, like other Plio-Pleistocene rhinoceroses, seems to be rare in Russia (Billia, 2005, 2006a), just as well as in Europe.

In the Russian Federation, remains of *S. kirchbergensis* - often included in the so-called “Khazarskaya”, “Tiraspolskaya”, and “Tatarskaya” Faunas - are recorded, at least, from nine other localities. Four of them are located in the Russian-European area: along the Bol’shoy Uzen’ river near Kurilovka (Saratov region) (Belyaeva, 1935; Gromova, 1935) and along the right bank of the Volga, between the villages of Cherny Yar and Nizhnee Zaymishche (Astrakhan’ region) (Gromova, 1932, 1935), both referable to the Likhvinsky gorizont levels (Eastern-European stratigraphy = Tobol’sky gorizont, in the Siberian stratigraphy = Holstein, in the Western-European stratigraphy; OIS 10); at Samara (Samara region) (Strizheva, 1991) and at Podosinik (Volgograd region) (unpublished material), both without stratigraphic data. In the four cases, no accompanying faunal complexes are mentioned.

S. kirchbergensis remains have also been discovered in other four localities in the Russian-Siberian area: along the Ob’ near Krasny Yar (Tomsk region) (Alekseeva, 1980) (here, no stratigraphic data are available); along the right bank of the Ob’ at Krasny Yar, in front of the Sargulin island (Tomsk region) (Billia & Shpansky, 2005), in the Tobol’sky gorizont level (Siberian stratigraphy = Likhvinsky gorizont in the Eastern-European stratigraphy = OIS 10), together with *Mammuthus* ex gr. *trogontherii-chosaricus*, *Bison priscus* Boj., *Equus* ex gr. *mosbachensis-germanicus* remains; along the left bank of the Vilyuy river, close to its confluence with the Chebydy river, between the

villages of Verkhne-Vilyuysk and Vilyuysk (Yakutya region [Sakha Republic]), probably in the Shaytansky gorizont levels (Western-Siberian stratigraphy = Oksky gorizont, in the Eastern-European stratigraphy = Elster, in the Western-European stratigraphy; OIS 13), two upper teeth - together with a fragmentary molar of *Parelephas wüsti* (M. Pavlova, 1914) (= *Archidiskodon trogontherii* Pohlig, 1885) - have been discovered, in 1951, by Dubrovo (1957); according to the same author (pers. com.), the remains may be referred to the “Tiraspolian Faunal Complex” (“Tiraspol’sky Faunistichesky Kompleks”). Because of its extraordinary latitude (close to 64° N), this represents the farthest find of all the finds regarding *S. kirchbergensis*.

Finally, in the Museum of the Zoological Institute of the Russian Academy of Science in St. Petersburg is stored a skull from an unknown locality in the Irkutsk region (Chersky, 1874; Brandt, 1877; Billia, 2006b).

Some other localities in which remains ascribed to *S. kirchbergensis* were found are also mentioned (Belyaeva, 1935, 1939, 1940; Gromova, 1932, 1935; Salov, 1957); unfortunately at present the material is not traceable (Billia, 2006a).

Among the territories previously included in the former Soviet Union, *S. kirchbergensis* is certainly reported from Koshkurgan (Karatau Mountain, Chimkent region, South-Eastern Kazakhstan) (Khisarova, 1963). Other remains possible belonging to the same species were allegedly found in other localities of Kazakhstan (Kozhamkulova, 1981; Kozhamkulova & Kostenko, 1984; Tleuberdina et al., 1990), of Tajikistan (Sharapov, 1980; Dmitreva & Nesmeyanov, 1982), of Azerbaijan (Vereshchagin, 1959; Alev, 1969), of Ukraine (Gromova, 1935; Gromov, 1948), and at Kolkotova Balka (near Tiraspol’, Transnistria, Moldova) (David & Vereshchagin, 1967; Chepalyga, 1971; David, 1966, 1980, 1983).

In any case, the rarity of this species - despite of being widely spread throughout the Eurasian continent - has been reported even more on Russian territory as well as in the European area. Despite such numerous records, *S. kirchbergensis* is a rhinoceros still little investigated, and consequently, not yet well known.

ACKNOWLEDGEMENTS

My long stay in Russia has financially been supported by NATO. I am very grateful to all my Russian Friends and Colleagues for having very kindly and generously devoted their time in supporting my research in all possible ways, and for providing continuous valuable comments and suggestions.

Particularly, I am very much indebted to Marina V. Nasonova (curator of the Kemerovo Regional Ethnographic Museum) and to Irina V. Foronova (Institute of Geology-Geophysics-Mineralogy, Russian Academy of Science [Siberian Branch], Novosibirsk) for kindly allowing access to the rhinoceros collections.

REFERENCES

- Alekseeva E.V. (1980). Mlekopitayushchie Pleystozena Yugo-Vostoka Zapadnoy Sibiri (Khishchnye, Khotobnye,

- Kopytnye) [Pleistocene Mammals from South-East of Western Siberia]. AN SSSR, Dalnevostochny Nauchny Zentr Biologii (Pochv. Institut), Izd-vo Nauka, 187 pp., Moskva [in Russian].
- Alev S.D. (1969). Fauna Paleoliticheskogo Mestonakhozhdeniya v Aziche [The Fauna of the Palaeolithic Site of Azich]. Izd-vo AN AzSSR (otd. Paleobiologiya), 148 pp., Baku [in Russian].
- Belyaeva E.I. (1935). Nekotorye dannye o chetvertichnykh mlekopitayushchikh iz Nizhnevolzhskogo kraya po materialam muzeya g. Pugach. Zemlya [Some data on the Quaternary mammals from the area of the Lower Volga based on the material housed in the Pugachev Regional Municipal Museum]. *Trudy Komissii po Izucheniyu Chetvertichnogo Perioda*, 4: 303-308 [in Russian, German summary].
- Belyaeva E.I. (1939). Ob ostatkakh iskopaemogo nosoroga iz okrestnostey g. Rybinska [On fossil rhinoceros remains from the environs of Rybinsk]. In Belyaeva E.I. (ed.) *Voprosy Stratigrafii Chetvertichnykh Otlozhenii i ee Paleontologicheskoe Obosnovanie. Byulletin' Komissii po Izucheniyu Chetvertichnogo Perioda*, 5: 69-90 [in Russian].
- Belyaeva E.I. (1940). Novye nakhodki ostatkov nosoroga Merka na territorii SSSR [New finds of Merck's rhinoceros remains on the Soviet Union territory]. *Priroda (Paleozoologiya)*, 8: 82 [in Russian].
- Billia, E.M.E. (2005). Odontological distinguishing characters of *Stephanorhinus kirchbergensis* (Jäger, 1839) (Mammalia, Rhinocerotidae). Proceedings of 3rd International Symposium Evolution of Life on the Earth, Tomsk November 1-4 2005, *Evolution of Life on the Earth*, 3: 321-325.
- Billia E.M.E. (2006a). Revision of the fossil odontological material attributed to *Stephanorhinus kirchbergensis* (Jäger, 1839) (Mammalia, Rhinocerotidae) preserved in the museum collections of the Russian Federation. *Abstract of Proceedings of INQUA International Symposium Stratigraphy, Palaeontology, and Palaeoenvironment of Pliocene-Pleistocene of Transbaikalia and Interregional Correlations*, August 28-September 3, 2006, Ulan-Ude: 22.
- Billia E.M.E. (2006b). The skull of *Stephanorhinus kirchbergensis* (Jäger, 1839) (nosorog Merka) (Mammalia, Rhinocerotidae) from the Irkutsk province (South-West of Eastern Siberia). *Russian Journal of Theriology (Teriologicheskyy Zhurnal)*, 5 (1): 35-41.
- Billia E.M.E. & Shpansky A.V. (2005). *Stephanorhinus kirchbergensis* (Jäger, 1839) (Mammalia, Rhinocerotidae) from the Middle Pleistocene levels of the Ob' river at Krasny Yar (Tomsk region, Western Siberia). *DEINSEA*, 11: 75-82.
- Brandt J.F. (1877). Versuch einer Monographie der Tichorhinen Nashörner nebst Bemerkungen über *Rhinoceros leptorhinus* Cuvier u.s.w. *Mémoires de l'Académie Impériale des Sciences St.-Pétersbourg* (s. 7), 24 (4): 1-135.
- Chepalyga A.L. (1971). Opisaniye paleontologicheskogo materiala iz tiraspolskogo gravya. In Pleystozen Tiraspol'ya [Description of palaeontological material from the tiraspolian gravel. In Pleistocene of Tiraspol']. AN MolSSR (Otdel Paleontologii i Stratigrafii): 131-134 [in Russian].
- Chersky I.D. (1874). Opisaniye cherepa nosoroga, razlichnago ot *Rhinoceros tichorhinus* [Description of a rhinoceros skull different from *Rhinoceros tichorhinus*]. *Zapiski Imperatorskoy Akademii Nauk*, 25: 65-75 [in Russian].
- David A.I. (1966). Iskopaemye Nosorogi Antropogena Moldavii [Fossil Rhinoceroses from the Anthropogene of Moldavia]. *Izd-vo AN MolSSR (ser. Biol. i Him. Nauk)*, 10: 1-68 [in Russian].
- David A.I. (1980). Teriofauna Pleystozena Moldavii [Pleistocene Large Mammals from Moldavia]. AN MoldSSR (Otdel Paleontologii i Biostratigrafii), Izd-vo Shtiinza, 138 pp., Kishinev [in Russian].
- David A.I. (1983). Kolkotova Balka: Unikalny Pamyatnik Prirody Moldavii [Kolkotova Balka: An Unique Nature Monument in Moldavia]. AN MolSSR (Institut Zoologii i Fiziologii), Izd-vo Shtiinza, 98 pp., Kishinev [in Russian].
- David A.I. & Vereshchagin N.K. (1967). Sostoyaniye izuchennosti i dalneyshie zadachi issledovaniya iskopaemykh faun mlekopitayushchikh Moldavii. In Mesto i Znachenie Iskopaemykh Mlekopitayushchikh Moldavii v Kaynozoe SSSR. AN MolSSR (Otd. Paleontologii i Stratigrafii), 1-30, Izd-vo RIO AN MolSSR, Kishinev [in Russian].
- Dmitreva E.L. & Nesmeyanov S.A. (1982). Mlekopitayushchye i Stratigrafiya Kontinentalnykh tretichnykh otlozhenii Yugo-Vostoka Sredney Asii [Mammals and Stratigraphy of Continental Tertiary Sediments of South-Eastern Middle Asia]. *Trudy Paleontologicheskogo Instituta Akademii Nauk SSSR*, 193: 1-138 [in Russian].
- Dubrovo I.A. (1957). Ob ostatkakh *Parelephas wüsti* (M. Pavl.) i *Rhinoceros mercki* Jaeger iz Yakutii [On remains of *Parelephas wüsti* (M. Pavl.) and *Rhinoceros mercki* Jaeger from Yakutia]. *Byulletin' Komissii po Izucheniyu Chetvertichnogo Perioda*, 21: 97-104 [in Russian].
- Foronova I.V. (2001). Chetvertichnye Mlekopitayushchie Yugo-Vostoka Zapadnoy Sibiri. Kuznetskaya Kotlovina [Quaternary Mammals of South-East of Western Siberia. Kuznetsk Basin: Phylogeny, Biostratigraphy, and Palaeoecology]. Rossiyskaya Akademiya Nauk (Sibirskoe Otdel), Ob. Inst. Geol. Geof. i Miner., Izd-vo SO RAN, 243 pp., Novosibirsk [in Russian].
- Gromov V.I. (1948). Paleontologicheskoe i Arkheologicheskoe Obosnovaniye Stratigrafii Kontinentalnykh Otlozheniy Chetvertichnogo Perioda na Territorii SSSR [Palaeontological and Archaeological Background for the Stratigraphy of the Continental Quaternary deposits on USSR territory]. *Trudy Instituta Geologicheskoy Nauk, AN SSSR (ser. Geologiya)*, 64 (17): 1-524 [in Russian].
- Gromova V.I. (1932). Novye materialy po chetvertichnoy faune Povolzh'ya i istorii mlekopitayushchikh Vostochnoy Evropy voobshche [New materials of Quaternary Fauna and history of Mammalia from Eastern Europe]. *Trudy Komissii po Izucheniyu Chetvertichnogo Perioda*, 2: 69-184 [in Russian].
- Gromova V.I. (1935). Ob ostatkakh nosoroga Merka (*Rhinoceros mercki* Jaeg.) s Nizhney Volgi [Ueber die Reste des Merckschen Nashorn (*Rhinoceros mercki* Jaeg.) von der unteren Wolga] [On remains of Merck's rhinoceros, *Rhinoceros mercki* Jaeg., from Southern Volga]. *Trudy Paleontologicheskogo Instituta Akademii Nauk SSSR*, 4: 91-131 [in Russian, German abstract].
- Khisarova G.D. (1963). Iskopaemye kosti mlekopitayushchikh iz Koshkurganskogo grifona, Yuzhny Kazakhstan. In Materialy po Istorii Fauny i Flory Kazakhstana [Mammal osteological fossil remains from the Koshkurgan locality, Southern Kazakhstan. In Material on the History of the Fauna and Flora of Kazakhstan]. AN KazSSR (Institut Zoologii), Izd-vo Nauka KazSSR: 42-75 [in Russian].
- Kozhamkulova B.S. (1981). Pozdnekaynozoyiskie Kopytnye Kazakhstana [Late Cenozoic Ungulates of Kazakhstan]. AN KazSSR (Institut Zoologii), Izd-vo Nauka KazSSR: 52-63 [in Russian].
- Kozhamkulova B.S. & Kostenko N.N. (1984). Vymershie Zhivotnye Kazakhstana (Paleogeografiya Poznego Kaynozoya) [Extinct Animals of Kazakhstan (The Paleogeography of the Late Cenozoic)]. AN KazSSR (Institut Zoologii), Izd-vo Nauka KazSSR, 103 pp., Alma-Ata [in Russian].
- Salov I.N. (1957). Nakhodki iskopaemoy chetvertichnoy fauny v Smolenskoy oblasti. In Materialy po Izucheniyu Smolenskoy Oblasti [Finds of fossil Quaternary fauna in the Smolensk region. In Material for the Study of the Smolensk Region]. *Smolenskiy Oblastnoy Kraevedcheskiy Muzei*, 2: 311-333 [in Russian].
- Sharapov Sh. (1980). K istorii issledovaniya mestonakhozhdenii Lakuti i Kuruksay. In Graniza Neogena i Chetvertichnoy Sistemy. Sbornik dokladov [History of the researchers on the sites of Lakuti and Kuruksay. In Neogene Boundary and Quaternary System. Proceedings]. *Mezhdunarodny Soyuz po Izucheniyu Chetvertichnogo Perioda*: 237-238 [in Russian].
- Strizheva I.M. (1991). Kostnye ostatki krupnykh

- mlekopitayushchikh v rayone Samarskoy Luki [Osteological remains of large mammals from the Samara Luka district]. *Samarskaya Luka*, 2: 197-205 [in Russian].
- Tleuberdina P.A., Kozhamkulova B.S. & Kondratenko G.S. (1990). Katalog Kaynozoysskikh Mlekopitayushchikh Kazakhstana [Catalog on Cenozoic Mammals of Kazakhstan]. AN Kaz.SSR (Institut Zoologii), Izd-vo Nauka KazSSR, 135 pp., Alma-Ata [in Russian].
- Vereshchagin N.K. (1959). Mlekopitayushchie Kavkaza. Istoriya Formirovaniya Fauny [Mammals of Caucasus. History of the Faunal Formation]. AN AzerSSR, Iz-vo AN SSSR, 703 pp., Moskva/Leningrad [in Russian].
- Vdovin V.V., Zudin A.N. & Lavrentev A.I. (1973). On the stratigraphy of Anthropogene of the Kuznetsk Basin according to palaeomagnetic data. *Geology and Geophysics*, 1: 136-140.
- Zudin A.N., Nikolaev S.V. & Galkina L.I. (1982). [Foundation of the stratigraphical scheme of the Neogene and Quaternary deposits in the Kuznetsk Basin. *In* Problems of Pleistocene Stratigraphy and Palaeogeography of Siberia]. Izd-vo Nauka (SB RAS), pp. 143-149, Novosibirsk [in Russian].

Manuscript received 05 June 2006

Revised manuscript accepted 27 August 2007