Fossil Old World monkeys (Primates, Cercopithecidae) from the Pliocene of Dorkovo, Bulgaria

Eric DELSON
Department of Anthropology, Lehman College and the Graduate School,
City University of New York, NYCEP (The New York Consortium in Evolutionary Primatology)
and
Department of Vertebrate Paleontology, American Museum of Natural History,
Central Park West at 77th street, New York, NY 10024 (USA)
delson@amnh.org

Herbert THOMAS
UMR-CNRS 5143 Paléodiversité, département Histoire de la Terre,
Muséum national d'Histoire naturelle et Collège de France, case postale 38,
8 rue Buffon, F-75231 Paris cedex 05 (France)
hthomas@mnhn.fr

Nikolaï SPASSOV
National Museum of Natural History, Bulgarian Academy of Sciences,
1 Tzar Osvoboditel, 1000 Sofia (Bulgaria)
nspassov@nmnh.bas.bg

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ABSTRACT
Two colobine species occur at the early Pliocene (MN 14) locality of Dorkovo: *Dolichopithecus ruscinensis* Depéret, 1889 and *Mesopithecus monspessulanus* (Gervais, 1849). Such an association is known from at least three other Ruscinian or earliest Villafranchian sites, and at two other localities a cercopithecine taxon joins the two colobines. The large colobine from the Kuchurgan localities of Ukraine has previously been considered either a distinct genus or a separate species of *Dolichopithecus*, but it is here synomymized with *D. ruscinensis*; an isolated Kuchurgan molar previously published as a macaque is here tentatively re-identified as a colobine, perhaps *M. monspessulanus*. No temporal patterning has been observed either for associations among these Pliocene genera or of size change within the two Dorkovo taxa.

KEY WORDS
Mammalia,
Primates,
Colobinae,
Dolichopithecus ruscinensis,
Mesopithecus monspessulanus,
Pliocene,
Ruscinian,
Bulgaria.

RÉSUMÉ
Les cynomorphes fossiles (Primates, Cercopithecidae) du Pliocène de Dorkovo, Bulgarie.
Deux colobinés sont présents dans le gisement pliocène (MN 14) de Dorkovo : *Dolichopithecus ruscinensis* Depéret, 1889 et *Mesopithecus monspessulanus* (Gervais, 1849). La coexistence de ces deux primates caractérise au moins trois autres gisements d'âge ruscinien ou villafranchien basal. Dans deux autres gisements, ces colobinés sont associés à un cercopithéciné. Le grand colobiné des localités de Kuchurgan en Ukraine considéré auparavant comme un genre distinct ou comme une espèce différente de *Dolichopithecus* est interprété ici comme un synonyme de *D. ruscinensis.* Une molaire isolée de Kuchurgan identifiée précédemment à celle d'un macaque est attribuée à un probable colobiné, peut-être *M. monspessulanus.* Aucune répartition chronologique particulière n'a pu être observée quant à l'association de ces genres pliocènes ni quant aux changements de taille chez les deux taxons de Dorkovo.

MOTS CLÉS
Mammalia,
Primates,
Colobinae,
Dolichopithecus ruscinensis,
Mesopithecus monspessulanus,
Pliocène,
Ruscinien,
Bulgarie.

INTRODUCTION

Discovered in 1982 during geological prospecting, the Pliocene locality of Dorkovo (S-W Bulgaria) is situated in the western Rhodope Mountains in the Neogene deposits of the Chepino depression, about 15 km north of the town of Rakitovo and about 120 km E-SE of Sofia. The site of Dorkovo, 500 m WNW of the village of the same name, is exceptionally rich in fossil mammals, but 90% of the remains belong to a single proboscidean species, *Anancus arvernensis* (Croizet & Jobert, 1828). The fossil level is an immense concentration of skeletons in a layer more than 1 m thick covering an area of several hundred square meters. Only about 10% of the fossiliferous zone was excavated by a Franco-Bulgarian team in a systematic way using a 1-m grid, during three field seasons (1985-1987). Extraction of the bones was difficult because they were tightly interlocked and due to a high concentration of radon gas. Preliminary results of the first field season have been published (Thomas *et al.* 1986).

The vertebrate fauna comprises some 30 species, but until now, only the birds (Boev 1998), *Anancus* (Metz-Muller 1995, 2000) and hipparions (Alberdi & Alcala 1999) have been described. In addition to the cercopithecid monkeys discussed in the present paper, the large mammals noted or described from the locality are as follows: *Ursus* ex gr. *ruscinensis* Depéret, 1890; Mustelidae Fischer de Waldheim, 1817 indet.; Hyaenidae Gray, 1821 indet. (size of *Chasmaporthetes* Hay, 1921); *Anancus arvernensis* (Croizet & Jobert, 1828); *Mammut borsoni* (Hays, 1834); Cervidae Goldfuss, 1820 indet.; Suidae Gray, 1821 indet.; Bovidae Gray, 1821 indet.; *Stephanorhinus megarhinus* (de Christol, 1834); and *Hipparion crassum* Depéret, 1890 (Thomas *et al.* 1986; Metz-Muller 1995, 2000; Alberdi & Alcala 1999; Spassov 2003).

This faunal association is typical of the Ruscinian, especially of the MN 14 unit. The abundance of *Prosomys insuliferus* (Kowalski, 1958; Arvicolidae Gray, 1821) confirms this age, which is further supported by magnetostratigraphic data indicating reverse polarity correlated with the Gilbert chron (Thomas *et al.* 1986).

Characteristic features of the Dorkovo fauna include: the relative scarcity of hipparions and *Mammut borsoni*; the dominance of cervids among the artiodactyls; the extreme abundance of *Anancus arvernensis* representing at least 100 individuals; and the presence of the *Dolichopithecus-Mesopithecus* association. This association indicates a prevalence of open woodland habitats in the Dorkovo region *c.* 4.5 Ma (Thomas *et al.* 1986; Spassov in press).

ABBREVIATIONS

DKV Dorkovo collection (in NMNH);
MNHN Muséum national d'Histoire naturelle, Paris;
NMNH National Museum of Natural History, Sofia.

MATERIALS AND METHODS

The specimens which form the focus of this paper comprise 10 primate teeth from Dorkovo: NMNH DKV 78, 79, 82 and 479-485. Two smaller teeth (DKV 480 and 481) are identified as *Mesopithecus monspessulanus*, while the eight larger specimens are identified as *Dolichopithecus ruscinensis*.
Comparative metrical data are provided for the equivalent teeth only from the major samples known for each species (see Delson 1973 for a discussion of most material). The large sample of *Dolichopithecus ruscinensis* from Perpignan is housed mainly in Paris and Perpignan. The samples of *Mesopithecus monspessulanus* from Montpellier and Fornace RDB (Villafranca d'Asti) are housed in Paris, Lyon, Montpellier and Basel.
Specimens were measured by the senior author according to the definitions in Delson (1973), using Helios dial or Fowler digital calipers fitted with needle points; measurements were recorded in tenths of mm.

SYSTEMATICS

Order PRIMATES Linnaeus, 1758
Hyporder ANTHROPOIDEA Mivart, 1864
Infraorder CATARRHINI
E. Geoffroy Saint-Hilaire, 1812
Parvorder EUCATARRHINI Delson, 1977
Superfamily CERCOPITHECOIDEA Gray, 1821
Family CERCOPITHECIDAE Gray, 1821
Subfamily COLOBINAE Blyth, 1875
Genus *Dolichopithecus* Depéret, 1889

Dolichopithecus ruscinensis Depéret, 1889

MATERIAL EXAMINED. — NMNH DKV 78, right m3 in fragment of mandible (Fig. 1E); DKV 79, left male c1 (Fig. 1B); DKV 82, partial left m1? (Fig. 1D); DKV 479, heavily worn female right c1 or possibly left C1 (or even right i2); DKV 482, left male C1 crown (Fig. 1A); DKV 483, right M3? (Fig. 1C); DKV 484, left male p3, nearly unworn (Fig. 1F); DKV 485, heavily worn right female c1 or possibly left i2.

DESCRIPTION

These specimens are essentially identical in morphology and size to fossils of this species from the type locality, Perpignan (France; MN 15a), which has yielded the largest collection to date. *D. ruscinensis* is known from 16 localities, of which half have produced only one specimen. In addition to Perpignan and Dorkovo, only Baraolt-Capeni and Malusteni (Romania; see Delson 1973 and Szalay & Delson 1979 unless otherwise noted) and the Kuchurgan sites (Ukraine; Maschenko 1991, see below) have produced more than three or four isolated teeth, while a well preserved mandible is known from Megalo Emvolon (Greece; Koufos *et al.* 1991). Other nearby localities include Beresti (Romania), Ciuperceni-2 (Romania; Terzea 1979) and Ptolemais (Greece; Doukas & De Bruijn 2002), each yielding only one or two teeth. Delson (1973) reported no significant differences in size or morphology of this species across localities. The biochronologic range of this taxon extends from the Early Pliocene (MN 14) of Montpellier (France) and Beresti (age following Radulescu & Samson 2001) to the earlier Late Pliocene of Balaruc-2 (France; MN 16? if the age assignment in Fejfar *et al*. 1997 is accepted; Radulescu *et al*. 2003 suggested that Baraolt-Capeni is better placed in MN 15b). The reported Late Miocene occurrence of *D. ruscinensis* at Pestlörinc (near Budapest, Hungary; see Delson 1974) was based on an incorrect age estimate for that site, which is actually of MN 15 age (Delson 1994).
The dentition of colobines has been described in detail by Szalay & Delson (1979: 321-323, 383, 384), and these specimens do not provide any novel features. The m3 (DKV 78) presents clear colobine features, including the high cristodont lophids, deep median lingual (talonid) notch between the lophids, and short trigonid basin (mesial fovea). The hypoconulid is long,

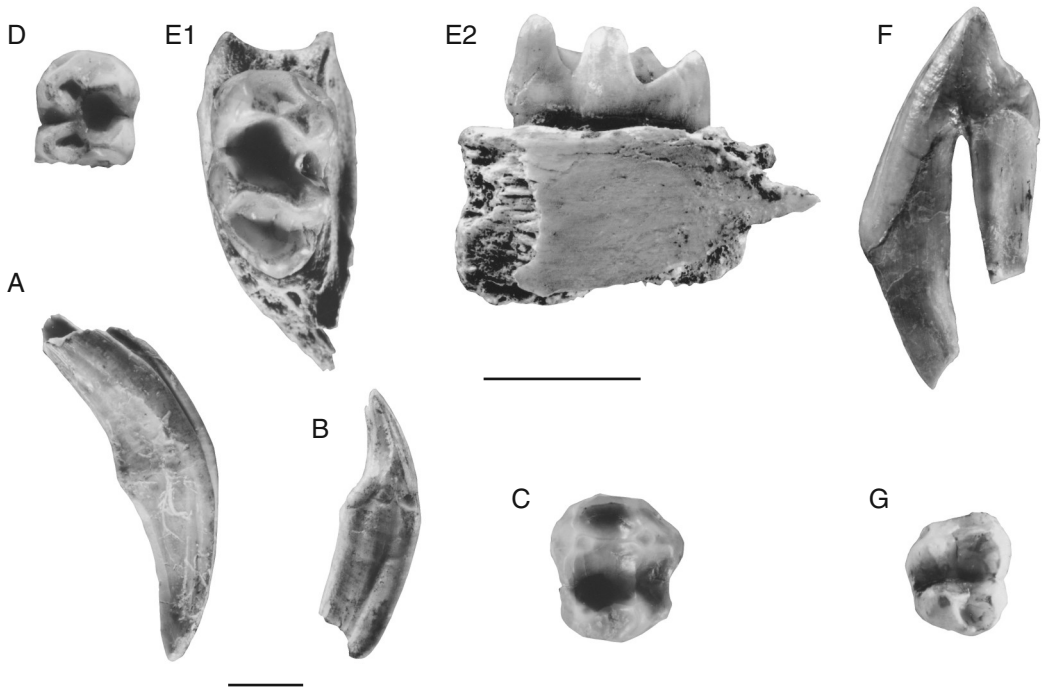

FIG. 1. — **A**-**F**, lower and upper teeth of *Dolichopithecus ruscinensis* Depéret, 1889; **A**, left male C1 (DKV 482), lingual view; **B**, left male c1 (DKV 79), lingual view; **C**, right M3? (DKV 483), occlusal view; **D**, left m1? (DKV 82), occlusal view; **E**, right m3 in fragment of corpus (DKV 78), **E1** occlusal view, **E2** lingual view; **F**, left male p3 (DKV 484), buccal view; **G**, upper molar of *Mesopithecus monspessulanus* (Gervais, 1849), left M3? (DKV 480), occlusal view. Scale bars: A, B, 1 cm; C-G, 2 cm.

displaced buccally and situated nearly in line with the buccal cusps; there is no *tuberculum sextum*. The fragmentary lower molar (DKV 82) is broken distal to the hypolophid, and it is not possible to determine definitively to which molar it belongs; its size suggests an m1, and it may be noted that its DW is smaller than any of 18 known from Perpignan, while its MW is equal to the smallest thereof. The upper molar (DKV 483) is identified as an M3 due to its reduced distal loph and lack of a distal contact facet. The male p3 (DKV 484) has the typical strongly sloping mesial honing flange of cercopithecids corresponding to a large and projecting C1 (as in DKV 482), which in turn complements the tall and slender c1 (DKV 79). It is not possible to distinguish canine teeth by subfamily, but the lack of any cercopithecine molars suggests that they are best identified as *D. ruscinensis*. Two other worn anterior teeth, as noted above, cannot be definitively identified. DKV 479 presents a worn crown and a complete root; so little crown morphology remains that it might represent either a female canine (upper or lower) or possibly a lower i2. DKV 485 is a more incisiform tooth: if it is a lower right canine, the external face is smooth with a slight cingular base, while internal face rises in inverted "V" below the cingulum; the distolingual face presents a complex wear surface, and the root is gracile. Its morphology, however, appears different from that of the equivalent tooth in female mandible MNHN PER 004. The colobine morphology of these teeth excludes their allocation to known European Pliocene cercopithecines (see below), and their size (Table 1) separate them from *Mesopithecus*. Neither Delson (1973) nor any other author has found any temporal pattern of size change in *Dolichopithecus* across its time range.

TABLE 1. — Measurements (in mm) of lower and upper teeth of *Dolichopithecus ruscinensis* Depéret, 1889 from Dorkovo compared to those from the sample from Perpignan. Abbreviations: **N**, number of specimens; **Min.**, minimum value; **Max.**, maximum value; for canines and lower third premolars: ♂, male individuals only; ♀, female individuals only; for canines: **L**, mesiodistal length (note that length is smaller than width for lowers as thus defined); **W**, labiolingual width (taken perpendicular to length); **H**, mesiobuccal height of crown; **RH**, height of root below cervix for lowers; for lower premolars: **W**, maximum buccolingual width; **FL**, length of mesiobuccal flange (taken from cusp apex to mesiobuccal end); for molars: **MW**, maximum mesial buccolingual width, taken across paraloph or protolophid cusps at cervix; **DW**, maximum distal buccolingual width, taken across metaloph or hypolophid cusps at cervix; **L**, maximum mesiodistal length, taken near cervix; **RW**, relative molar width = 100 × DW/MW; **RL**, relative molar length = 100 × MW/L.

		Dorkovo (DKV No.)						Perpignan			
		479 ♀	485 ♀	79 ♂	484 ♂	82	78	N ♀/♂	Mean ♀/♂	Min. ♀/♂	Max. ♀/♂
c1	L	5.3	4.5	7.3				12/11	4.6/7.4	3.5/6.3	5.3/8.4
	W	7.2	6.4	11.5				12/11	6.9/10.8	6.2/9.1	7.8/12.1
	H	7.3	9.8	19.3				11/9	8.5/19.2	6.7/13.3	10.9/24.1
	RH	14.5	11.3	20+				6/5	12.9/23.8	11.9/22.5	14.7/24.7
p3	W				5.5			-/5	-/7.1	-/6.2	-/9.0
	FL				18.0			-/5	-/15.2	-/14.5	-/16.0
m1?	MW					7.0		18	6.8	6.0	7.7
	DW					6.8		18	7.1	6.2	8.0
	RW					102.9		18	96.6	89.6	103.1
m3	MW						8.7	15	8.3	7.6	9.3
	DW						8.4	18	8.0	7.2	8.8
	L						13.5	18	13.1	11.8	14.7
	RW						103.0	15	104.9	90.5	112.7
	RL						64.4	15	63.9	58.5	72.4
		482 ♂	483								
C1	L	9.3						8/6	6.0/9.1	5.6/8.1	6.5/10.7
	W	14.0						8/6	7.9/12.6	7.0/11.4	8.7/13.9
	H	30.0						7/5	9.4/22.9	8.2/17.3	10.2/29.0
M3?	MW		9.1					10	9.1	8.6	9.7
	DW		7.3					10	8.1	6.9	9.3
	L		9.5					10	9.7	8.4	10.6
	RW		119.7					10	113.0	104.3	124.6
	RL		95.8					10	93.9	89.3	102.4

DISCUSSION

Gremyatski (1958) described several colobine mandible fragments from the Kuchurgan sites (Voinichevo river, including Novopetrovka and other find-spots; probably MN 15 after Fejfar *et al.* 1997), which he named *Adelopithecus hypsilophus* Gremyatski, 1958. Szalay & Delson (1979) tentatively synonymized the two genera, but they had not seen the full publication, and the specimens had not yet been located in Moscow. Alexejeva (1964) had also described a subadult mandible from Novopetrovka, and in 1982 Delson examined several isolated teeth and casts from there in the Kiev collection. Maschenko (1991) assessed the systematic position of *Adelopithecus* and synonymized it with *Dolichopithecus*, but he continued to recognize the Kuchurgan material as the separate species *D. hipsulophus* (an incorrect spelling-*lapsus calami*). Maschenko (1991) reported (also in a letter to Delson) that the mandible which Gremyatski had used as holotype was lost but that two others remained, which he compared with casts of Perpignan specimens. He did not mention Alexejeva's specimen. Maschenko argued that several features (especially the tall, narrow and mesiodistally short symphysis

TABLE 2. — Measurements (in mm) of the p4 of *Mesopithecus monspessulanus* (Gervais, 1849) from Dorkovo (DKV 481) compared to those for the combined sample from Montpellier and Fornace RDB (Villafranca d'Asti). Abbreviations: **N**, number of specimens; **Min.**, minimum value; **Max.**, maximum value; **W**, maximum buccolingual width; **L**, length; **FL**, length of mesiobuccal flange (taken from cusp apex to mesiobuccal end); **RW**, relative width = 100 × W/L.

	Dorkovo DKV 481	Montpellier and Fornace/Villafranca d'Asti			
	p4	N	Mean	Min.	Max.
W	4.9	6	4.3	4.0	4.4
L	6.1	6	5.4	4.8	6.1
FL	5.4	3	5.0	4.8	5.3
RW	80.3	6	80.3	70.5	89.6

TABLE 3. — Measurements (in mm) of the M3(?) of *Mesopithecus monspessulanus* (Gervais, 1849) from Dorkovo (DKV 480) compared to those for all other known upper molars attributed to the species. Abbreviations: **MW**, maximum mesial buccolingual width, taken across paraloph cusps at cervix; **DW**, maximum distal buccolingual width, taken across metaloph cusps at cervix; **L**, maximum mesiodistal length, taken near cervix; **RW**, relative molar width = 100 × DW/MW; **RL**, relative molar length = 100 × MW/L.

	DKV 480	Wölfersheim	Ivanovce	Red Crag
	M3?	M1?	M2?	M3?
MW	7.3	5.2	6.0	7.0
DW	6.1	5.1	5.8	6.5
L	7.9	5.6	6.4	7.6
RW	119.7	102.0	103.0	108.0
RL	92.4	93.0	94.0	92.0

and narrow p3 talonid) of the Kuchurgan specimens significantly distinguished them from those of Perpignan and other sites, but in fact these appear to fall within the expected range of variation. *D. hypsilophus* Gremyatski, 1958 is here formally synonymized with *D. ruscinensis* Depéret, 1889.

Genus *Mesopithecus* Wagner, 1839

Mesopithecus monspessulanus (Gervais, 1849)

MATERIAL EXAMINED. — DKV 480, unworn left M3? (Fig. 1G); DKV 481, left p4.

DESCRIPTION

The p4 is comparable to several from Montpellier and Fornace RDB (Villafranca d'Asti; again, see Delson 1973 and Szalay & Delson 1979 for details). The upper dentition of this taxon is represented by only five other teeth: three upper molars, one incisor and one canine. The Dorkovo upper molar lacks a distal contact facet and is metrically most similar to the presumed M3 from the Red Crag (see Tables 2 and 3).

DISCUSSION

Research in progress is evaluating the distinction between *M. monspessulanus* and *M. pentelicus* Wagner, 1839, and the species allocation of several late Miocene samples. Tentatively, it appears that specimens from MN 13 sites at Baltavar, Polgardi and Varpalota (Hungary), Monticino Quarry and Casino (Italy) and Maramena (Greece) are best included in *M. pentelicus*, while long-lost material from Gravitelli cannot be accurately determined (see also Rook 1999). The Dytiko sites in Greece, especially Dytiko-2 (Bonis *et al.* 1990, 1997; Koufos *et al.* 2004; Delson pers. obs.) appear to yield remains of both species; if that interpretation is correct, these would be the oldest known representatives of *M. monspessulanus*. The co-occurrence of the two species requires additional documentation. Up to now, they have been considered as chronospecies, but if they are indeed found together it suggests that the two are biospecies: *M. pentelicus* may have given rise to *M. monspessulanus* and briefly coexisted with its daughter species before becoming extinct. The latter taxon continues through MN 14 and 15, with the youngest individuals perhaps derived from MN 16 localities such as Hajnacka (Slovak Republic), and the Red Crag (England).

CONCLUSIONS

In their original report on the Dorkovo fauna, Thomas *et al.* (1986) mentioned the co-occur-

rence of *Dolichopithecus* and *Mesopithecus* as a rare phenomenon in the Ruscinian, and Spassov (2003) noted that this association is characteristic for the Ruscinian of the southern half of Europe. In fact, four species of cercopithecid are known in MN 14-16, and their joint presence is not uncommon. In addition to the two colobines mentioned, macaques (broadly referable to *Macaca* cf. *sylvanus* subspp.) appeared in Europe in the latest Miocene (Köhler *et al*. 2000) and persisted into the Late Pleistocene, while *Paradolichopithecus arvernensis* is now known from the Late Pliocene of Senèze (France), Graunceanu (Romania), and Vatera-F (Lesvos, Greece), with fragmentary remains of smaller-sized individuals occurring at earlier Pliocene localities. The most common association is that at Dorkovo: *Mesopithecus* and *Dolichopithecus* co-occur also at Perpignan, Baraolt-Capeni, and Wölfersheim (Germany); they are joined by *Macaca* at Montpellier and by cf. *Paradolichopithecus* at Malusteni. *Macaca* and *Dolichopithecus* co-occur at Cova Bonica (Spain) and Balaruc-2, while *Macaca* and *Mesopithecus* are found at Fornace RDB (Italy). Tesakov & Maschenko (1992) described an isolated tooth from Grebeniki-2 (a Kuchurgan locality) which they identified as a macaque, but which appears colobine (perhaps *M. monspessulanus*) from their drawing; in either case, a second taxon accompanies *Dolichopithecus* in the Kuchurgan region. Among younger localities, the only co-occurrence is of *Paradolichopithecus* and cf. *Macaca* at Senèze. There does not appear to be any temporal pattern in these associations.

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REFERENCES

ALBERDI A. & ALCALA L. 1999. — A study of the new samples of the Pliocene *Hipparion* (Equidae, Mammalia) from Spain and Bulgaria. *Transactions of the Royal Society of Edinburgh, Earth Sciences* 89: 167-186.

ALEXEJEVA L. I. 1964. — [New finds of remains of monkey bones from the family Cercopithecoidea from the southern European part of the USSR]. *Voprosy Antropologii* 16: 129-134 (in Russian).

BOEV Z. 1998. — Fossil birds of Dorkovo: an Early Pliocene site in the Rhodope Mts. (Southern Bulgaria). *Geologica Balcanica* 28: 53-60.

BONIS L. DE, BOUVRAIN G., GERAADS D. & KOUFOS G. 1990. — New remains of *Mesopithecus* (Primates, Cercopithecoidea) from the Late Miocene of Macedonia (Greece), with the description of a new species. *Journal of Vertebrate Paleontology* 10: 473-483.

BONIS L. DE, BOUVRAIN G., GERAADS D. & KOUFOS G. 1997. — New material of *Mesopithecus* (Mammalia, Cercopithecidae) from the Late Miocene of Macedonia, Greece. *Neues Jahrbuch für Geologie und Paläontologie, Monatshefte* 5: 255-265.

DELSON E. 1973. — *Fossil Colobine Monkeys of the Circum-Mediterranean Region and the Evolutionary History of the Cercopithecidae (Primates, Mammalia).* Unpublished Ph. D. dissertation, Columbia University, New York, USA, 856 p.

DELSON E. 1974. — Preliminary review of cercopithecid distribution in the circum-Mediterranean region. *Mémoires du Bureau de Recherches géologiques et minières* 78: 131-135.

DELSON E. 1994. — Evolutionary history of the colobine monkeys in palaeoenvironmental perspective, *in* DAVIES G. & OATES J. F. (eds), *Colobine Monkeys: their Ecology, Behaviour and Evolution*. Cambridge University Press, Cambridge: 11-43.

DOUKAS C. S. & DE BRUIJN H. 2002. — A new occurrence of *Dolichopithecus* (Mammalia, Primates) in N. Greece. *Annales géologiques des Pays helléniques* 39: 295-297.

FEJFAR O., HEINRICH W.-D., PEVZNER M. A. & VANGENGEIM E. A. 1997. — Late Cenozoic sequences of mammalian sites in Eurasia: an updated correlation. *Palaeogeography Palaeoclimatology Palaeoecology* 133: 259-288.

GREMYATSKI M. A. 1958. — [Fossil monkeys from the territory of the U.S.S.R. (in connection with some questions of phylogeny of the higher primates)]. *Trudy VI Vsesoyuznovo Sezda Anatomov, Gistologov, Embryologov* [= *Papers presented to VIth All-Union Congress of Anatomy, Histology, and Embryology*]. Kiev, vol. 2: 576-579 (in Russian).

KÖHLER M., MOYÀ-SOLÀ S. & ALBA D. M. 2000. — *Macaca* (Primates, Cercopithecidae) from the Late Miocene of Spain. *Journal of Human Evolution* 38: 447-452.

KOUFOS G. D., SYRIDES G. E. & KOLIADIMOU K. K. 1991. — A Pliocene primate from Macedonia (Greece). *Journal of Human Evolution* 21: 283-294.

KOUFOS G., BONIS L. DE, KOSTOPOULOS D., VIROT L. & VLACHOU T. 2004. — *Mesopithecus* (Primates, Cercopithecidae) from the Turolian locality of Vathylakkos 2 (Macedonia, Greece). *Paläontologische Zeitschrift* 78 (1): 213-228.

MASCHENKO E. N. 1991. — [Tooth system and taxonomic status of early Pliocene cercopithecid monkey *Dolichopithecus hipsulophus* (Primates, Cercopithecoidea)]. [*Moscow Bulletin of Tests of Nature*] 66: 61-74 (in Russian).

METZ-MULLER F. 1995. — Mise en évidence d'une variation intra-spécifique des caractères dentaires chez *Anancus arvernensis* (Proboscidea, Mammalia) du gisement de Dorkovo (Pliocène ancien de Bulgarie, biozone MN14). *Geobios* 28: 737-743.

METZ-MULLER F. 2000. — *La population d'*Anancus arvernensis *(Proboscidea, Mammalia) du Pliocène de Dorkovo (Bulgarie) ; étude des modalités évolutives d'*Anancus arvernensis *et phylogénie du genre* Anancus. Unpublished doctoral thesis, Muséum national d'Histoire naturelle, Paris, France, vol. 1 (texte), 306 p.

RADULESCU C. & SAMSON P. 2001. — Biochronology and evolution of the Early Pliocene to the Early Pleistocene mammalian faunas of Romania. *Bollettino della Società Paleontologica Italiana* 40: 285-291.

RADULESCU C., SAMSON P.-E., PETCULESCU A. & STIUCĂ E. 2003. — Pliocene large mammals of Romania. *Coloquios de Paleontología* 53 (2003): 1-10.

ROOK L. 1999. — Late Turolian *Mesopithecus* (Mammalia, Primates, Colobinae) from Italy. *Journal of Human Evolution* 36: 535-547.

SPASSOV N. 2003. — The Plio-Pleistocene vertebrate fauna in South-Eastern Europe and the megafaunal migratory waves from the east to Europe. *Revue de Paléobiologie* 22 (1): 197-229.

SPASSOV N. in press. — Brief review of the Pliocene ungulate fauna of Bulgaria, *in* CRÉGUT-BONNOURE E. (ed.), Les Ongulés holarctiques du Plio-Pléistocène. *Le Quaternaire* n° spécial 2.

SZALAY F. S. & DELSON E. 1979. — *Evolutionary History of the Primates*. Academic Press, New York, 580 p.

TERZEA E. 1979. — Découverte d'une faune de Mammifères pliocènes à Ciupercemi (dép. de Teleorman). Remarques sur deux espèces inconnues en Roumanie. *Travaux de l'Institut de Spéléologie « Emile Racovitza »* 18: 171-184.

TESAKOV A. N. & MASCHENKO E. N. 1992. — The first reliably identified macaque (Cercopithecidae, Primates) from the Pliocene of the Ukraine. *Paleontological Journal* 26: 55-61.

THOMAS H., SPASSOV N., KOJUMGIEVA E., POIDEVIN J.-L., POPOV V., SEN S., TASSY P. & VISSET D. 1986. — Résultats préliminaires de la première mission paléontologique franco-bulgare à Dorkovo (arrondissement de Pazardjik, Bulgarie). *Comptes Rendus de l'Académie des Sciences* II, 302: 1037-1042.

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