

Biochronology and evolution of the Early Pliocene to the Early Pleistocene mammalian faunas of Romania

Constantin RADULESCU Petre-Mohai SAMSON

"Emil Racovita" Speleological Institute
Romanian Academy, Bucharest

KEY WORDS – *Mammal faunas, Biochronology, Stratigraphy, Pliocene, Early Pleistocene, Romania.*

ABSTRACT – *The authors present the biostratigraphical sequences of the Dacic Basin and Brasov Depression, Romania, based on small and large mammals. Faunas of selected Pliocene and Early Pleistocene fossiliferous localities are discussed and a tentative correlation with the Faunal Units (F.U.) of Italy is undertaken. The fossil sites discussed here encompass a time period of about 3 million years (Myr), lasting from the Early Pliocene (lagomorphic faunal complex without arvicolids older than 4 Myr known from Beresti) to the Early Pleistocene (occurrence of *Prolagurus pannonicus* and *Allophaiomys* cf. *plioaenicus* at Fierbinti, a site dated to about 1 Myr).*

RIASSUNTO – [Biocronologia ed evoluzione delle faune a mammiferi dal Pliocene inferiore al Pleistocene inferiore in Romania] – *Gli autori presentano la successione biocronologica del bacino Dacico e della Depressione Brasov (Romania) basandosi sui dati delle associazioni a macro- e micromammiferi. Faune locali plioceniche e pleistoceniche inferiori, selezionate per la loro importanza, sono discusse e viene proposto un tentativo di correlazione con le Unità Faunistiche basate sulle faune italiane. Le località fossilifere trattate abbracciano un periodo di tempo di circa tre milioni di anni (Ma), dal Pliocene inferiore (Beresti, complesso faunistico a lagomorfi senza arvicolidi, più vecchio di 4 Ma) al Pleistocene inferiore (presenza di *Prolagurus pannonicus* e *Allophaiomys* cf. *plioaenicus* a Fierbinti, una località datata circa 1 Ma).*

INTRODUCTION

The mammalian assemblages considered by this paper occur in long sequences of stratified fluvio-lacustrine deposits in the Dacic Basin and the Brasov Depression of Romania. The Dacic Basin is a large sedimentary area connecting Central to Eastern Paratethys; it is situated between the Southern Carpathians in the north and the Balkans in the south. The Brasov Depression is an intermontane basin of the inner bend zone of the Eastern Carpathians and is composed of several smaller basins developed as gulfs along drained valleys. The two areas have yielded the most important mammal remains from Romania, representing a time interval of approximately 3 million years (Myr), lasting from more than 4 Myr [Beresti fauna in southern Moldova assigned to the Early Pliocene (Late Dacian)] to about 1 Myr (Fierbinti small mammals from the southeastern Dacic Basin) (Text-fig.1). Inferences drawn from studies of the mammals are supported by other sources of evidence such as molluscan faunas, lithologies, and palaeomagnetic determinations.

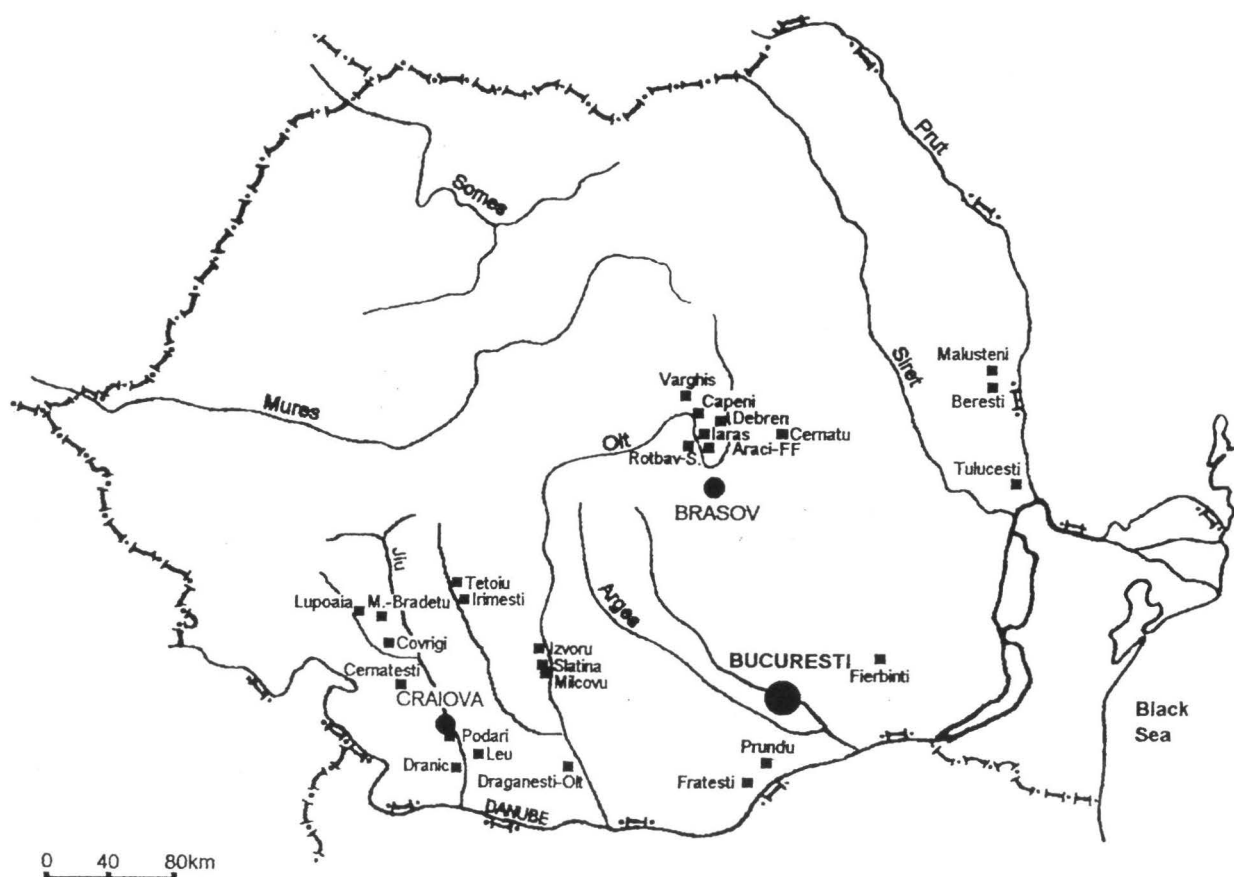
In addition to presenting the biochronology and evolution of selected Pliocene and Early Pleistocene mammalian assemblages from Romania, an attempt is made to correlate them with equivalent Mediterranean (Tethys) sites, especially the Faunal Units (F.U.) of Italy (Text-fig.2). We adopted a three-fold subdivision of the Pliocene according to the chronostratigraphy of the Mediterranean area. In this frame-

work, the Early Pliocene corresponds to the Zanclean and to most portions of the Gilbert palaeomagnetic Epoch. The Middle Pliocene covers the Piacenzian and the Gauss palaeomagnetic Epoch. The Late Pliocene is equivalent to the Gelasian and the first part of Matuyama palaeomagnetic Epoch, consisting of the early Matuyama subchron and the Olduvai event within which the Pliocene/Pleistocene boundary is delineated. The faunal events discussed in this paper apply only to the Dacic Basin and the Brasov Depression. It is worth mentioning, however, that similar faunal events have been documented in stratigraphic sequences from other regions of Eurasia. Several faunal events correlate well with periods of cooling and/or dryness and very probably have global significance. Local evolution of morphogenetic lineages, especially among the rodents, seems to have been a response to environmental constraints.

EARLY PLIOCENE

DACIC BASIN

The oldest Pliocene (Ruscinian) mammal associations are known from Beresti and Malusteni, two localities in the northeastern Dacic Basin (southeastern Moldova). Beresti has yielded a rich fauna dominated by lagomorphs (*Trischizolagus dumitrescuae*), especially ochotonids (*Ochotona ursui*, *Pliolagomys* cf. *gigas*). A characteristic species is what appears to be a small-sized primitive cricetid, *Moldavimus simiones-*



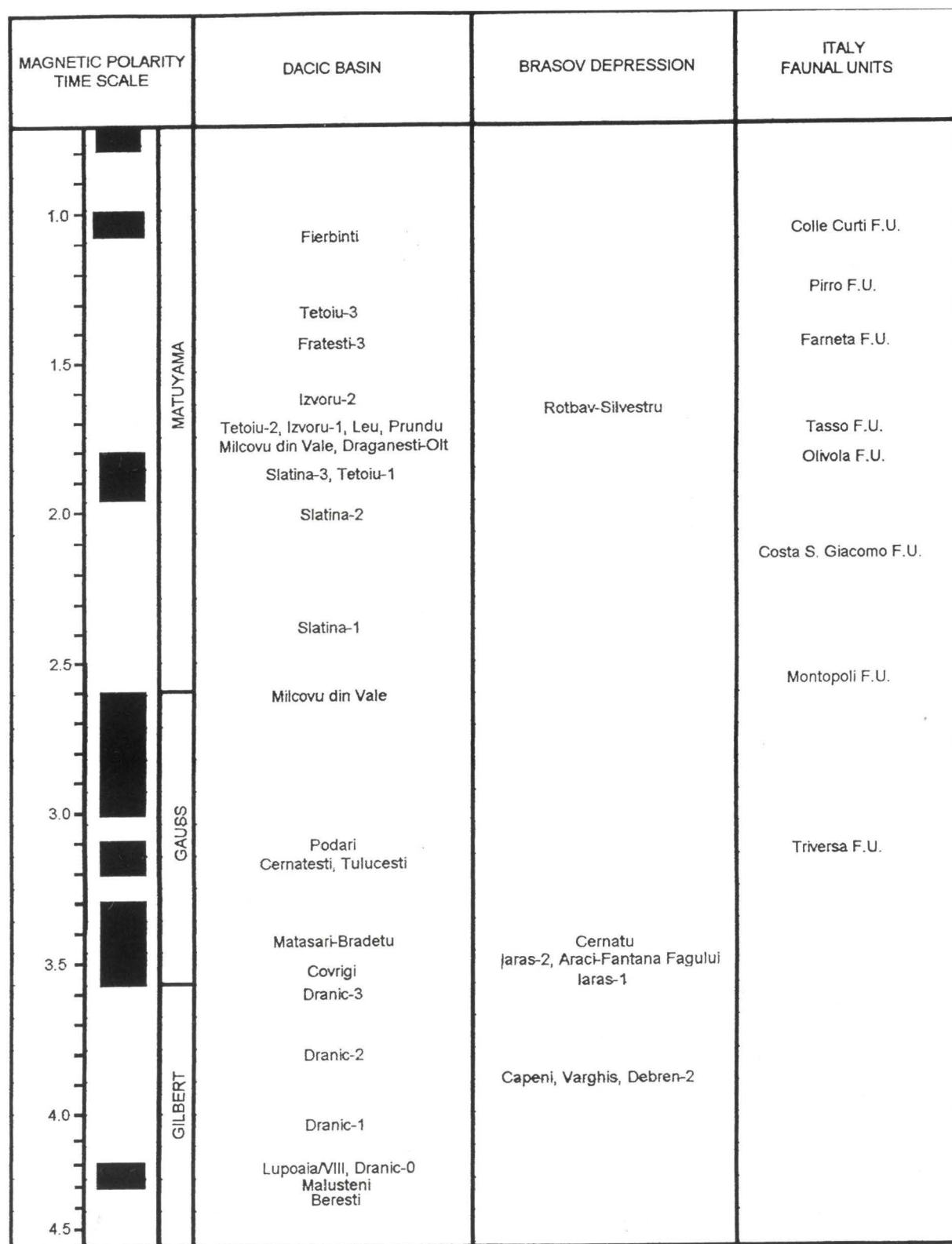
Text-fig. 1 - Map of Romania showing the location of Pliocene and Early Pleistocene sites mentioned in the text.

cui, most closely related to the vast extant *Cricetulus* group. The fauna includes, among other forms, castorids (*Castor praefiber*, *Zamolxifiber covurluensis*, *Romanocastor filipescui*), *Paracamelus bessarabiensis*, *Pliocervus* cf. *kutchurganicus*, "*Stephanorhinus*" cf. *leptorhinus*, *Hipparion malustenense*, "*Equus*" (*Hipparion*?) *simionescui* (Radulescu & Samson, 1995a). Mimomyian forms are absent. The Beresti fauna was assigned to a late Dacian age, a time interval separating the *Prosomys insuliferus* zone from the first appearance of the genus *Mimomys* (*M. moldavicus*). As a whole, the Beresti fauna suggests a predominantly continental climate, in contrast to the more humid environment that prevailed at the beginning of the Ruscianian.

A renewal in the fauna is indicated at Malusteni by the presence of particular species of rodents, such as *Mimomys moldavicus* and *Prospalax rumanus*, which are here considered as northern and eastern immigrants. The arrival of *Mimomys*, undoubtedly from Asia, probably coincided with climatic cooling at the global scale and with more humid conditions than at Beresti. Malusteni is also the type-locality for the large antelope, "*Parabos*" *athanasiui*, represented by a damaged skull (Simionescu, 1922, 1930). This antelope

seems to derive from an Anatolo-Aegean stock that is still poorly known. A closely related species is represented at Megalo Emvolon, Greece, by ?*Parabos macedoniae* (Gromolard, 1981). The Malusteni fauna also contains castorids, cervids, carnivores, primates, and other forms. It is worth recalling that Simionescu (1930) described a juvenile upper jaw assigned to *Equus* cf. *robustus* from this site. According to Samson (1976) this specimen belongs to *Plesippus* (*Allohippus*) cf. *euxinicus*. Some authors argue, however, that the horse from Malusteni is not contemporaneous with the bulk of the fauna from this site. Taking into account the aspect of the horse maxillary, which does not differ from the rest of the fossils from Malusteni, we are inclined to maintain a species of monodactyle horse in the association of this locality. Tentatively, *Plesippus* cf. *euxinicus* might belong to the first migratory wave of monodactyle horses coming from North America and could date to about 4 Myr. In the biostratigraphical scheme of the Dacic Basin, Malusteni is situated within the Cochiti event near the boundary of the Dacian/Romanian stages.

In the northwestern portion of the Dacic Basin (between the Jiu and Motru rivers), the first appearance of "*Mimomys*" *rhabonensis*, a large-sized primitive



Text-fig. 2 - Biochronology of selected Pliocene and Early Pleistocene mammalian sites of Romania and a tentative correlation with Faunal Units of Italy.

arvicolid, is recorded at Lupoia Coal Quarry (fossiliferous level at the base of coal layer VIII) (Radulescu *et al.*, 1989). Palaeomagnetic determinations place Lupoia/VIII within the Cochiti normal event, and that indicate that overlying coal layers IX to XI belong to the late Gilbert subchron. The Gilbert/Gauss boundary is placed above coal layer XI, whereas coal layers XI to XIV are assigned to the early Gauss subchron (Andreescu *et al.*, 1986).

One of most complete and interesting depositional sequences rich in micromamalian remains is found at Dranic in the Jiu valley (Radulescu *et al.*, 1993, 1997). The fossiliferous levels can be grouped into four main subdivisions from Dranic-0 to Dranic-3, encompassing a time period beginning within the Cochiti event (Dranic-0) and continuing to the Gilbert/Gauss boundary (Dranic-3). The lowest level (Dranic-0) has yielded a faunal association similar to that of Lupoia/VIII; both contain "*Mimomys*" *rhabonensis* in the same evolutionary stage. In addition, Dranic-0 yielded dental remains belonging to *Mimomys moldavicus*. The morphological analysis of the material collected from successive levels at Dranic shows that "*M.*" *rhabonensis* gave rise to *Dolomys nehringi* (Radulescu *et al.*, 1997), whereas *M. moldavicus* was the primitive stock from which *Propliomys hungaricus* evolved (Radulescu & Samson, 1996).

BRASOV DEPRESSION

The well-known faunas from Baraolt-Capeni and Varghis come from the third coal layer in the Baraolt Basin sequence and are situated paleomagnetically within the late Gilbert subchron. This layer contains many Ruscinian taxa ("*Stephanorhinus*" *leptorhinus*, *Parailurus anglicus*, *Protarctos boeckhi*, "*Parabos*" cf. *athanasiui*, *Dolichopithecus rusciniensis*, etc.) in association with *Metacervocerus pardinensis*, a cervid species characteristic of the Early Villafranchian. Also found at Capeni was a metatarsal bone of a primitive monodactyle horse attributable to the *Plesippus athanasiui* phyletic lineage (Samson, 1976; Forsten, 1999). A Ruscinian fauna (*Anancus arvernensis*, "*Stephanorhinus*" *leptorhinus*, *Muntiacus polonicus*, *Hypolagus brachygnathus*) is also known from Debren-2 in the Sfântu Gheorghe Basin. Some Ruscinian taxa persisted in the Brasov Depression until the beginning of the Gauss chron, as demonstrated by the presence of "*Stephanorhinus*" cf. *leptorhinus*, *Hipparion* cf. *malustense* and "*Parabos*" cf. *athanasiui* at Iaras-1 (Baraolt Basin) (Alimen *et al.*, 1968).

MIDDLE PLIOCENE

DACIC BASIN

The macromammalian community is distinguished during the early Gauss by the appearance of

invading species. The Covrigi fauna includes a new type of rhinoceros, *Stephanorhinus elatus* (= *jeanvireti*), probably representing an Asiatic immigrant, in association with *Mammuth borsoni*, *Anancus arvernensis*, *Metacervocerus pardinensis*, *Cervus perrieri* and *Equus* sp. As a whole, the Covrigi fauna seems to be an equivalent of the Triversa F.U. of Italy (Azzaroli *et al.*, 1988; Gliozzi *et al.*, 1997). Also remarkable is the first occurrence of a smaller rhinoceros attributable to *Stephanorhinus etruscus* at Matasari-Bradetu. The appearance of *S. etruscus* can be placed within the early Gauss, a later phase postdating the arrival of *S. elatus* (Radulescu & Samson, 1995b), on the basis of palaeomagnetic calibration. A further step in the formation of a new mammalian community is indicated by the occurrence of a very primitive elephant, *Mammuthus rumanus*, at Tulucesti and Cernatesti (Samson & Radulescu, 1973; Radulescu & Samson, 1995b).

In Italy, the Montopoli F.U., calibrated with the Gauss/Matuyama transition, has yielded a relatively primitive elephant identified as *M. gromovi* (Azzaroli 1977). In the Dacic Basin, *M. rumanus*, which is more archaic than the Montopoli elephant, can be placed on palaeomagnetic evidence within the middle Gauss subchron. According to Garutt (1992), *M. rumanus* is a descendant of *M. subplanifrons* from South and East Africa. However, *M. rumanus* also displays similarities to *M. africanavus* from North and East Africa. Thus *M. rumanus* appears to belong to the first wave of elephants that expanded into southeastern Europe from Africa via the Anatolian and Aegean regions.

A biochronologic equivalent of the Tulucesti/Cernatesti fauna is known from Podari (Jiu valley). At this level of comparison, the evolutionary processes leading from "*Mimomys*" *rhabonensis* to *Dolomys nehringi*, on the one hand, and from *M. moldavicus* to *Propliomys hungaricus* on the other, had already been completed (Radulescu & Samson, 1996; Radulescu *et al.*, 1997). Representatives of the genus *Mimomys* are absent. Palaeomagnetic data suggest that Cernatesti and Podari can be placed within the middle Gauss subchron. The late Middle Pliocene, corresponding to the end of the Gauss palaeomagnetic Epoch, is characterized by the first appearance at Milcovu din Vale (Olt valley) of a mimomyian species belonging to the *Mimomys stehlini/minor* group in association with *Dolomys milleri* and *Trogonthierium minus* (Radulescu & Samson, 1983).

BRASOV DEPRESSION

An Early Villafranchian fauna showing many similarities to Triversa F.U. was recorded at Iaras-2 from normally magnetized deposits and at Araci Fantana Fagului (Baraolt Basin). This fauna includes *Mammuth borsoni*, *A. arvernensis*, *Tapirus arvernensis*, *Stephanorhinus elatus*, *Cervus perrieri*, (Radulescu & Samson,

1985). A somewhat later fauna containing *S. elatus*, Canidae indet., *Arvernoceros ardei*, *Trogontherium minus* and *Mimomys* sp. was found at Cernatu in the Targu-Secuiesc Basin.

LATE PLIOCENE

DACIC BASIN

Mammalian associations similar to the Montopoli F.U. are unknown in Romania. Late Pliocene micro-mammals are recorded from the sequence of deposits with superposed fossiliferous levels that outcrop between Slatina and Milcovu din Vale in the Olt valley.

The small mammal association from Slatina-1, situated within the Early Matuyama subchron, contains *Dolomys milleri* (dominant form), *Mimomys minor* and *Desmana kormosi*. The Slatina-2 fauna and its equivalent from the nearby locality of Cherlestii-Mosteni are distinguished by the last appearance of the *Dolomys* lineage (*D. ferui*) and the presence of steppe elements such as *Borsodia* and *Allactaga*. Paleomagnetically, Slatina-2 antedates the Olduvai event, indicating a climatic shift to more continental conditions. The biochronologic level of Slatina-3, connected to the Olduvai event, is characterized by the presence of a medium-sized *Trogontherium* (*T. dacicum*), which seems to be endemic to the Dacic Basin.

Late Pliocene macrofaunas were recorded from the middle Oltet valley at Tetoiu and Irimesti (Radulescu & Samson, 1990). The lower fossiliferous horizon called Tetoiu-1 has yielded rich mammalian remains at La Pietris and Valea Graunceanului, indicating a shift from a more open environment (La Pietris) to a warm-temperate forested one (V. Graunceanului, personal communication). Although the two sites include a great number of common species, such as *Nyctereutes megamastoides*, it is worth remembering the appearance at V. Graunceanului of new exotic elements such as *Hystrix* sp., *Manis* cf. *hungarica*, *Mitilanotherium*, and *Paradolichopithecus*. The occurrence of a large-sized ostrich (*Pachystruthio* sp.), probably of African origin, is also characteristic of this fauna. Up to now, similar faunas are not recorded in Italy, but they are known from the Aegean and Anatolian regions (*Mitilanotherium*) and from France (*Paradolichopithecus*).

EARLY PLEISTOCENE

DACIC BASIN

In the Tetoiu-2 faunal horizon, the association from Fantana Alortitei is characterized by the first appearance of *Canis etruscus* and *Pachycrocuta brevirostris* (Radulescu & Samson, 1990). The neighbouring site of Fantana lui Mitilan yielded remains of *Megalovis latifrons*, *Leptobos* sp., possibly *Allocaenelaphus*, and a medium-sized equid with slender limbs

(*Plesippus stenonis mitilanensis*). *Trogontherium boisvilleti* replaces *T. dacicum* of the Tetoiu-1 fauna. An equivalent stratigraphic level at Valea Mijlociei yielded *Alces gallicus* and the same slender equid (Samson, 1976).

At Milcovu din Vale, a level of magnetically reversed sands situated above deposits of normal polarity assigned to the Olduvai event has yielded remains of *Mammuthus meridionalis* and *Paracamelus alutensis*. A rich small mammal association is known from equivalent deposits at Draganesti-Olt, preserving *Mimomys ostramosensis*, *M. coelodus alutae*, *Borsodia* cf. *lagurodontoides*, and *Allactaga* sp., among other taxa.

M. meridionalis and *Alces gallicus* were also described at Prundu in the southeastern Dacic Basin (Apostol, 1972). A recently discovered fauna at Leu south of Craiova (Aurelian Popescu, personal communication) also includes *M. meridionalis* and *Alces gallicus* in association with *Eucladoceros* sp. (= *E. dicranios*?), *Leptobos* cf. *furtivus* and *Pliotragus ardeus*; the latter species is well documented in the Tetoiu-1 faunas. Clearly, a new mammalian community had formed.

The faunal transition from Tetoiu-1 to Tetoiu-2 appears to indicate climatic deterioration in the form of increasingly continental conditions. This time interval may have its counterpart in the Olivola F.U. and the beginning of the Tasso F.U. of Italy. The earlier appearance of a primitive megalocerine deer (*Allocaenelaphus*) seems to be another characteristic of the faunal evolution in the Dacic Basin. *Allocaenelaphus* probably is present at Fantana lui Mitilan (Tetoiu-2) and undoubtedly at Izvoru-1 in the Olt valley. This latter site is overlain by the Izvoru-2 microfauna which lacks arhizodont arvicolids of the *Lagurus* (*Lagurodon*) and *Allophaiomys* types (Radulescu & Samson, 1986). The Izvoru-1 fauna seems, therefore, to precede the Farneta F.U., which is characterised by the first appearance in Italy of *Megaceroides obscurus* and of the *Allophaiomys* group (Gliozzi et al., 1997; Masini et al., 1998). On the other hand, the large mammals from Fratesti-3 (southeastern Dacic Basin) (Feru et al., 1983) include a recently discovered fine partial cervid skull retaining the left antler, similar in form to *Megaceroides obscurus* from Pietrafitta (Farneta F.U.) (Azzaroli & Mazza, 1992; Abbazzi, 1995).

The biochronology of Tetoiu-3 fauna is still provisional. The occurrence of *Alces* cf. *carnutorum*, *Bison*, *Soergelia*, *Plesippus* cf. *suessenbornensis*, and *Equus aluticus* suggest a broad equivalence with Pirro-Nord F.U., distinguished by the occurrence of a primitive *Bison* and ovibovine remains (Gliozzi et al., 1997).

Finally, *Prolagurus pannonicus* and *Allophaiomys* cf. *pliocenicus* described at Fierbinti (southeastern Dacic Basin) (Radulescu et al., 2000) probably should be placed between the Pirro-Nord and Colle Curti F.U.

BRASOV DEPRESSION

The Early Pleistocene mammals are still poorly known in this area. The Rotbav-Silvestru locality and other sites assigned to the same fossiliferous level have yielded remains of a form of *Mammuthus meridionalis* that retains some primitive dental features, along with *S. hundsheimensis*, *Plesippus* cf. *suessenbornensis*, *E. aluticus*, *Allocaenelaphus arambourgi* (type-locality), *Trogontherium boisvilletti*, etc. Taking into account the presence of *Allocaenelaphus* in association with *P.* cf. *suessenbornensis* and *E. aluticus*, the Rotbav-Silvestru fauna could be assigned an intermediate age between Izvoru-1 and Tetoiu-3 faunal horizon of the Dacic Basin.

CONCLUSIONS

The biochronologic scheme based on the mammalian faunas of the Dacic Basin is distinguished by several peculiarities:

- 1 - The occurrence of a monodactyle horse as early as the Malusteni faunal level, situated within the Cochiti event. Monodactyle horses are also known from other localities, ranging in age from the early to middle Gauss;
- 2 - The presence of some early Villafranchian species in faunas older than the Triversa F.U. (*Metacervocerus pardinensis* in the Brasov Depression dated to the middle late Gilbert);
- 3 - Immigration from Africa of a very primitive elephant (*Mammuthus rumanus*), dated to the Middle Gauss subchron (Tulucesti, Crnatesti);
- 4 - A Pliocene/Pleistocene transition characterised by a general renewal of the mammalian fauna (e.g., *Nyctereutes* is replaced by *Canis*), and the appearance of cold resistant species (*Alces gallicus*, *Megalovis*);
- 5 - The occurrence of a primitive large-sized cervid (*Allocaenelaphus*) in the biochronologic unit of Tetoiu-2 (probably older than Farneta faunal unit) whose antler morphology displays some similarities to an advanced *Eucladoceros*.

The above mentioned peculiarities are undoubtedly influenced by the geographic situation of Romania, some Asiatic or African immigrants reaching southeastern Europe earlier and later spreading to the central and western parts of the continent.

ACKNOWLEDGMENTS

We are grateful to our colleague Mr. Alexandru Petculescu, who kindly processed the text and figures of our paper.

REFERENCES

- ABBAZZI, L., 1995, *Megaceroides obscurus* from the Val di Chiana (Cava Liberatori, Tuscany, central Italy, Farneta F.U., early Pleistocene). Remarks on the early evolution and systematics of *Megaceroides*: Boll. Soc. Paleont. Ital., 34: 223-234.
- ALIMEN, H., RADULESCU, C. & SAMSON, P.-M., 1968, Précisions paléontologiques et indices climatiques relatifs aux couches pléistocènes de la Dépression de Brasov (Roumanie): Bull. Soc. géol. France (7), 10: 549-560.
- ANDREESCU, I., RADAN, S. & RADAN, M., 1986, Magnetostratigraphy of the Dacian-Romanian deposits of the Lupoaia quarry: D.S. Inst. Geol. Geofiz., 70-71 (4): 219-226.
- , RADULESCU, C., SAMSON, P.-M., TCHÉPALYGA, A. L. & TROUBIKHINE, V., 1981, Chronologie (Mollusques, Mammifères, Paléomagnétisme) des formations plio-pléistocènes de la zone de Slatina (Bassin dacique) Roumanie: Trav. Inst. Spéol. "Emile Racovitza", 20: 127-137.
- APOSTOL, L., 1972, Les mammifères pléistocènes de la zone de Prundu, district d'Ilfov: Trav. Mus. Hist. Nat. "Grigore Antipa", 12: 427-438.
- AZZAROLI, A., 1977, Evolutionary patterns of Villafranchian elephants in Central Italy: Atti Acad. Naz. Lincei Mem. Cl. Sci. Fis. Ser. 8, 14: 151-168.
- , DE GIULI, C., FICCARELLI, G. & TORRE, D., 1988, Late Pliocene to early Mid-Pleistocene Mammals in Eurasia: Faunal Succession and Dispersal events: Palaeogeogr. Palaeoclim. Palaeoecol., 66: 77-100.
- & MAZZA, P., 1992, On the possible origin of the giant deer genus *Megaceroides*: Rend. Fis. Acc. Lincei: s.9, 3 (1): 23-32.
- FERU, M., RADULESCU, C. & SAMSON, P.-M., 1983, Succession des mammifères plio-pléistocènes dans le Bassin Dacique (Roumanie): Ann. Inst. Géol. Géophys., 59: 161-167.
- FORSTEN, A., 1999, A review of *Equus stenonis* Cocchi (Perissodactyla, Equidae) and related forms: Quatern. Sci. Rev., 18: 1373-1408.
- GLIOZZI, A., ABBAZZI, L., ARGENTI, P., AZZAROLI, A., CALOI, L., CAPASSO BARBATO, L., DI STEFANO, G., ESU, D., FICCARELLI, G., GIROTTI, O., KOTSAKIS, T., MASINI, F., MAZZA, P., MEZZABOTTA, C., PALOMBO, M.R., PETRONIO, C., ROOK, L., SALA, B., SARDELLA, R., ZANALDA, E. & TORRE, D., 1997, Biochronology of selected mammals, molluscs and ostracods from the Middle Pliocene to the Late Pleistocene in Italy. The state of the art: Riv. Ital. Paleont. Strat., 103: 369-388.
- GROMOLARD, C., 1981, Les grands Bovidae (Mammalia, Artiodactyla) du Pliocène d'Europe occidentale: biostratigraphie, paléoneurologie, systématique, évolution, paléocologie. Thèse 3 cycle Univ. Cl. Bernard-Lyon I, 271 pp.
- MASINI, F., ABBAZZI, L., LIPPI, P., SALA, B. & TORRE, D., 1998, Review and new finds of *Microtus (Allophaiomys)* (Rodentia, Arvicolidae) from the Early Pleistocene of the Italian peninsula: Paludicola, 2 (1): 78-90.
- RADULESCU, C., ENCIU, P. & PETCULESCU, A., 2000, On the presence of *Prolagus* and *Allophaiomys* in the Dacic Basin: Trav. Inst. Spéol. "Emile Racovitza", 36: 119-133.
- & SAMSON, P.-M., 1985, Pliocene and Pleistocene mammalian biostratigraphy in southeastern Transylvania (Romania): Trav. Inst. Spéol. "Emile Racovitza", 24: 85-95.
- & —, 1986, Les mammifères du Pléistocène inférieur d'Izvoru (Département d'Olt, Olténie): Quartärpaläontologie, 6: 157-171.
- & —, 1990, The Plio-Pleistocene mammalian succession of the Oltet Valley, Dacic Basin, Romania: Quartärpaläontologie, 8: 225-232.
- & —, 1995a, The mammals of the Dacian in "Stratigraphic correlation Tethys-Paratethys Neogene", International Geological correlation programme: Chronostratigraphie und Neostatotypen, Bd. 9 Dacien: 506-518, Edit. Acad. Rom.
- & —, 1995b, Review of the Villafranchian s.s. Faunas of Romania: Il Quaternario, 8 (2): 377-382.
- & —, 1996, Pliocene and Early Pleistocene arvicolids (Rodentia, Mammalia) of the Dacic Basin, Romania: Acta zool. cracov., 39 (1): 401-406.

- , —, SEN S., STIUCA, E. & HOROI, V., 1997, Micromammifères pliocènes de Dranic (Romanien inférieur, Bassin Dacique, Roumanie), corrélations biostratigraphiques mammaliennes du Cénozoïque: Actes Congrès Biochrom '97, Mém. Trav. Inst. Montpellier, 21: 635 - 647.
- , — & STIUCA, E., 1989, Pliocene (Lower Romanian) micro-mammals in the Dacic Basin: Misc. Spéol. Rom., 1: 313-326.
- , —, —, ENCIU, P. & POPESCU, A., 1993, Sur la découverte de nouvelles associations de micromammifères dans le Pliocène d'Olténie. Implications paléobiogéographiques: Anal. Univ. Bucuresti, Geologie, 42: 69-78.
- SAMSON, P.-M., 1976, Les Equidés fossiles de Roumanie (Pliocène moyen – Pléistocène supérieur): Geologica Romana, 14: 165-352.
- & RADULESCU, C., 1973, Les faunes de Mammifères et la limite Pliocène-Pléistocène en Roumanie: Trav. Inst. Spéol. "Emile Racovitza", 12: 191-228.
- SIMIONESCU, I., 1922, Über eine pliocäne Wirbeltierfauna aus Rumänien: Centralblatt f. Min., 6: 185-186.
- , 1930, Vertebratele pliocene de la Malusteni (Covurlui): Acad. Rom., Publ. Fond. V. Admachi, 9, 49: 1-69.

(manuscript received October 13, 2000
accepted February 2, 2001)

Constantin RADULESCU

Petre-Mihai SAMSON

"Emil Racovita" Speleological Institute
Romanian Academy, Bucharest, Romania
Str. Frumoasa 11 - 78114 Bucuresti, Romania