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***Elephas falconeri* (Busk, 1867) and *Leithia melitensis* (Adams, 1863) from a karst fissure of the Hyblean Plateau (South-eastern Sicily)⁽¹⁾**

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ABSTRACT – A new karst fissure deposit containing vertebrate fossil remains has been recently found during building works at Contrada Annunziata, in the Ragusa carbonatic platform. The excavations have brought to light a cavity, filled with red residual soil sediments containing several skeletal parts of the pigmy elephant *Elephas falconeri* (Busk, 1867) and giant dormouse *Leithia melitensis* (Adams, 1863), associated with some limbs bones of birds and scarce carapace fragments of tortoise. Some *E. falconeri* remains have been found in anatomical connection. *L. melitensis* remains were particularly accumulated into two points. Taphonomic features suggest that the fissure acted as a morphological trap, where remains accumulated after animal death. Micromammal remains could reach the cave as disgorged piles by birds of prey. The new faunal assemblage of Contrada Annunziata belongs to the *Elephas falconeri* Faunal Complex, early Middle Pleistocene in age, characterized by a poorly diversified faunas with marked endemic features, such as the large mammals dwarfism (*E. falconeri*) and the small mammals giantism (*L. melitensis*). The new finding of Contrada Annunziata represents a new contribution to the knowledge of the Quaternary vertebrate populations of Sicily.

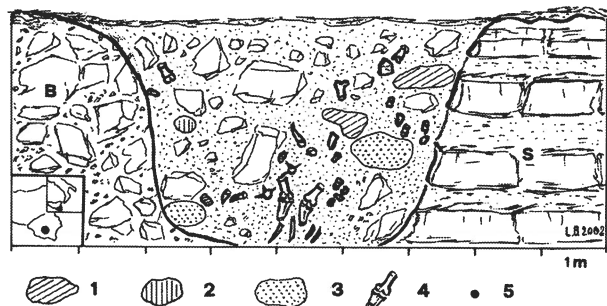
RIASSUNTO – [Nuovi resti di *Elephas falconeri* (Busk, 1867) e *Leithia melitensis* (Adams, 1863) da un deposito di fessura del Plateau Ibleo (Sicilia sud-orientale)] – Nel Plateau Ibleo, durante recenti lavori di sbancamento in contrada Annunziata di Ragusa, è stato rinvenuto un deposito di fessura contenente resti scheletrici di vertebrati pleistocenici. La cavità era riempita da un deposito di suolo rossastro contenente diversi elementi scheletrici dell'elefante nano *Elephas falconeri* e del ghiro gigante *Leithia melitensis*, associati ad alcune ossa degli arti di uccelli ed a scarsi resti di carapace di testuggine. Alcuni resti di elefante erano in connessione anatomica. I resti di ghiro erano particolarmente concentrati in due punti del deposito. Da una preliminare analisi tafonomica risulta che la fessura ha funzionato come una trappola morfologica alla quale i resti scheletrici sono pervenuti dalla superficie per dilavamento di porzioni di carcasse, mentre gli accumuli di micromammiferi rappresentano boli di rapaci. La nuova associazione faunistica di contrada Annunziata appartiene al Complesso Faunistico a *Elephas falconeri*, diffuso in Sicilia nella prima metà del Pleistocene Medio e caratterizzato da faune scarsamente diversificate e con spiccati caratteri endemici. Il ritrovamento di Contrada Annunziata porta un nuovo contributo alla conoscenza delle faune quaternarie della Sicilia e conferma l'importanza del controllo del territorio per la salvaguardia del patrimonio paleontologico dell'isola.

INTRODUCTION

In 1999 a new karst fissure deposit containing remains of Pleistocene vertebrate has been brought to light during building works on the Ragusa carbonatic platform, at Contrada Annunziata (Ragusa, South-eastern Sicily) (Text-fig. 1). The cavity, exposed for about m 4 x 3, was filled with red residual soil sediments containing calcareous fragments. The fossil remains mainly belong to the pigmy elephant *Elephas falconeri* and to the giant dormouse *Leithia melitensis*. Some limbs bones of birds and scarce carapace fragments of tortoise have been also found. At Contrada Annunziata scarce vertebrate fossil remains have been previously recovered from another karst fissure deposit (Bonfiglio & Insacco, 1992).

The Ragusa carbonatic platform, which is in the central part of the Hyblean Plateau, emerged since Tortonian-Messinian times and it is affected by block-faulting along normal faults (Di Geronimo *et al.*, 1980; Carbone *et al.*, 1982). During the Pleistocene many cavities, probably originated along fault planes, represented accumulation areas for debris and continental vertebrate remains. In time several deposits containing fossil remains of quaternary mammals have been brought to light by quarry and building works in the neighbouring of Ragusa (Contrada Annunziata, Contrada Pianetti, Contrada Cimillà, Contrada Tabuna); they provided new important data on the bio-chronology of the Pleistocene vertebrate faunas of Sicily (Bonfiglio *et al.*, 2000, with bibliography).

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Text-fig. 1 - Location and schematic outline of the karst fissure deposit of Contrada Annunziata (Ragusa, South-eastern Sicily). S: substrate; B: sterile breccia; 1) accumulations of birds remains; 2) remains of an individual of *Leithia melitensis*; 3) accumulations of *Leithia melitensis* remains associated with birds remains; 4) humeri of *Elephas falconeri* in anatomical connection with the ulnae; 5) location of the city of Ragusa on the Ragusa carbonatic platform.

ANATOMICAL DESCRIPTION

ELEPHAS FALCONERI (Busk, 1867) Pl. 1, figs 1-5

Fiftyseven remains of *E. falconeri*, represented by teeth, vertebrae, ribs and limbs bones, have been collected.

One complete deciduous left M^2 (Pl. 1, fig. 1) belonging to a young individual is composed of five laminae and two talons, with abundant intralaminar cement. Only the anterior talon and the first two laminae are worn; the enamel layer is rather thin and folded. One indeterminable little fragment of molar belongs to an adult; the enamel is rather thick and not much folded. Four badly preserved little tusk fragments have also been recovered. The dimensions, the number of laminae and the laminar frequency of the left M^2 are within the range of values attributed to *Elephas falconeri* (Ambrosetti, 1968; Vaufrey, 1929).

The bodies of one axis, three thoracics and one lumbar vertebrae are preserved; two neural spines fragments have also been recovered. The axis has a massive and transversely elongated body. The thoracic vertebrae are represented by one fourth/fifth, one indeterminable and one juvenile vertebrae. The fourth/fifth vertebra (Pl. 1, fig. 2) has a slightly transversely wider body, with a very marked ventral crest; the caudal surface is concave. The indeterminable vertebra (Pl. 1, fig. 3) is massive with a little pronounced ventral crest.

Twenty-five fragments of ribs, with different length and thickness, are preserved. Only one rib preserves the articular surface; the head is oval and the tubercle is small and rounded.

The fore-limb is represented by two incomplete humeri (one right medio-distal fragment and one left incomplete bone), two fragments of radius-ulna (one right proximal fragment and one left proximal fragment of ulna), three carpal bones (one right lunar, one left trapezoid, one left uncinatum), two metacarpal bones (one left II metacarpus, one left IV metacarpus) and three phalanges. The two humeri have been found in anatomical connection with the respective radius-ulna (Pl. 1, fig. 4) and probably belong to the same individual because of the simmetry and the dimensions. The right radius-ulna is completely fused along the diaphysis; this is typical of very old individuals. The very marked epicondyloid crest, which is in a very low position, and the strongly laterally inclined distal articulation are typical morphological features of the humerus of *E. falconeri* (Ambrosetti, 1968).

The hind-limb is represented by two juvenile fragments of femur (one proximal fragment of a left diaphysis and one fragment of head), one proximal fragment of a left tibia, one right astragalus, two metatarsal bones (one right IV metatarsus and one left V metatarsus) and one phalanx. The diaphysis of the tibia has a triangular section, with a very robust tuberosity on the cranial side. The proximal articulation is particularly wide and robust with respect to the diaphysis; this is a typical feature of *E. falconeri* (Ambrosetti, 1968). The proximal articulation of the astragalus (Pl. 1, fig. 5a) is quadrangular with a shorter lateral side; it has a convex surface. The distal articulation (Pl. 1, fig. 5b) shows two articular facets. The facet for the calcaneum has a narrow and flattened medial portion; the facet for the navicular is sub-triangular. The Dietrich angle, which is the supplementary to the angle formed by the facet for the navicular with the facet for the tibia (proximal articulation), is equal to 160° . This high value indicates strong digitigrady, and it is correlated to the reduction of size in the elephants (Trevisan, 1948).

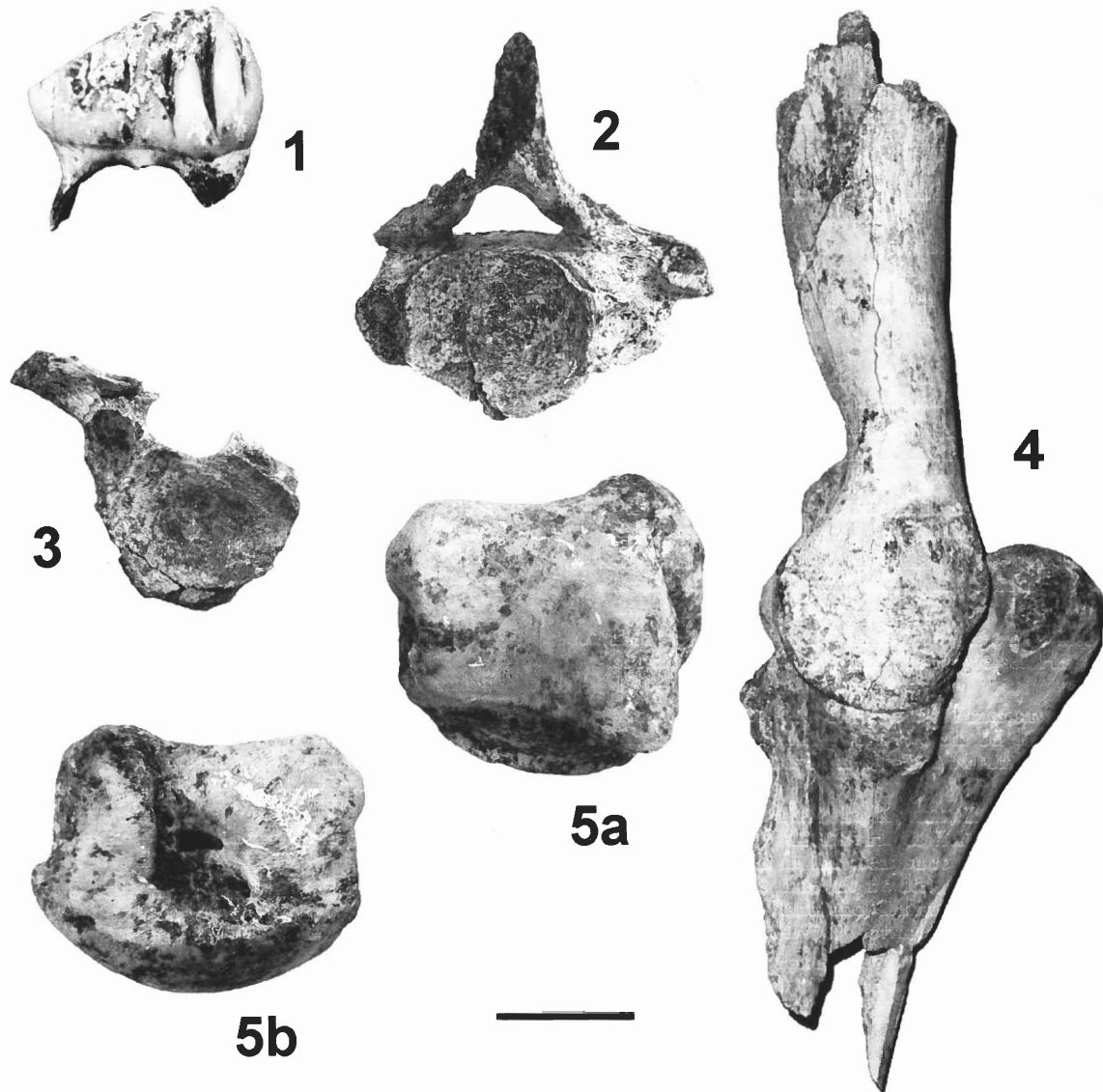
LEITHIA MELITENSIS (Adams, 1863)

Text-fig. 2a-d

Leithia melitensis is represented by 181 very fragmentary remains, which were particularly accumulated into two points.

The cranial skeleton is represented by: 19 skull fragments, 6 maxillar bones and 13 mandibles, having complete or partially complete dentition, 2 molars and 13 incisors. Both upper and lower molars and premolars have a quadrangular or trapezoidal outline (Text-fig. 2a, b). On the occlusal surface they have transversal ridges, which are considered typical of this species (Petronio, 1970). Lower molars and premolars are characterised by the presence of one or more furrows on the crown, due to the incomplete fusion of the ridges on the lateral sides. Upper incisors are stronger and more curved than the lower ones. The dimensions and the morphology of dentition is within the range of variability for *L. melitensis* from the Spinagallo Cave (Petronio, 1970).

Post-cranial elements are very abundant and prevalently fragmentary. They are represented by: 2 atlantes, 26 dorsal vertebrae, 24 ribs, 5 scapulae, 8 humeri, 2 radii, 3 ulnae, 8 coxal bones, 9 femuri, 14 tibiae, 1 calcaneum,

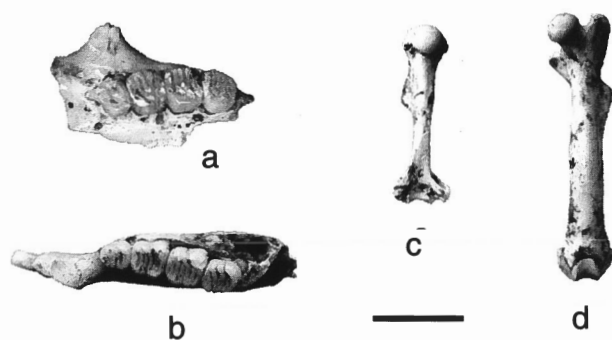


EXPLANATION OF PLATE 1

Figs. 1-5 - *Elephas falconeri* (Busk, 1867) from Contrada Annunziata (Ragusa, South-eastern Sicily): 1) Left M2, lateral view; 2) Fourth/fifth thoracic vertebra, caudal view; 3) Indeterminable thoracic vertebra, caudal view; 4) Right humerus in anatomical connection with the radius-ulna, lateral view; 5) Right astragalus (5a, proximal view; 5b, distal view). Scale bar = 2.5 cm (5 cm in figs. 2,3,4).

10 metapodial bones and 16 phalanges. The scapula has a long and narrow neck and a wide spine, lightly leaning caudally. The glenoid cavity is oval and shallow. The humerus (Text-fig. 2c) has a more or less cylindrical smooth diaphysis. The proximal epiphysis has a voluminous and spherical head on the caudal side. The distal epiphysis is flattened in cranial-caudal direction. The radius, represented only by proximal fragments, has a strongly curved proximal diaphysis. The proximal epiphysis is oval and cranio-caudally flattened. The ulna has a transversally flattened olecranon.

The caudal edge of the bone is narrow and becomes wide toward the proximal extremity; the cranial side is divided by a sharp olecranon beak, under which coronoid process and a semicircular trochlear notch are present. The coxal bones have a wide furrow on the acetabulum, which is circular and very concave. The proximal epiphysis of the femur (Text-fig. 2d) has a voluminous great trochanter; the head is cranially directed. The distal epiphysis has two prominent condyles, the medial more prominent. The femoral trochlea is straight. The diaphysis of the tibia has a triangular section



Text-fig. 2 - *Leithia melitensis* (Adams, 1863) from Contrada Annunziata (Ragusa, South-eastern Sicily): a) Left maxilla, occlusal view; b) Right mandible, occlusal view; c) Right humerus, caudal view; d) Left femur, cranial view. Scale bar = 1 cm (figs. a,b), 2 cm (figs. c,d).

and it is very flattened in the distal portion, where it is fused with the fibula. The tibial crest is long, thin and straight. The distal epiphysis, flattened in a cranial-caudal direction, has two deep notches separated by a marked crest. The medial malleolus is voluminous and rounded; the lateral one is flattened. The calcaneum is flattened in dorsal-plantar direction and it has a wide distal extremity. The proximal articular surface is flattened and laterally concave. The distal articulation is rounded with a furrow on dorsal side.

The morphological features and the dimensions of post-cranial remains are the same of *L. melitensis* from the Spinagallo Cave (Petronio, 1970).

THE FAUNAL ASSEMBLAGE OF CONTRADA ANNUNZIATA IN THE FRAMEWORK OF QUATERNARY POPULATIONS OF SICILY

In Sicily five different quaternary Faunal Complexes have been identified. In each F. C. the characteristic *taxa* are associated with *taxa* that are common to more complexes (Bonfiglio *et al.*, 2000, 2001). In different times the faunas entered the island from Europe and/or Africa, and the number of species has been reduced with respect to the coeval continental faunas (Tab. 1). Sicily, like other islands, has been inhabited by endemic faunas, which underwent important evolutionary changes during their existence on the island.

The findings on the Hyblean Plateau provided important data to the knowledge of Sicily populations and to the biocronology of Quaternary vertebrates. On the eastern and western edges of the Hyblean Plateau vertebrate fossil remains have been found in continental sediments correlated with marine deposits (Bonfiglio, 1991, 1992; Bonfiglio & Burgio, 1992; Bonfiglio & Insacco, 1992; Chilardi & Gilotti, 1996; Bonfiglio *et al.*, 1996, 1997). In the central part of the Hyblean Plateau, which emerged since the Miocene, vertebrate fossil remains have been found in cavities and karst fissures not correlated with marine sediments or coastal lines. The different cavities contain faunal assemblages belonging to the "*E. falconeri*" F. C., at Contrada Annunziata (Bonfiglio & Insacco, 1992), to the "*E. mnaidriensis*" F. C., at Contrada Cimillà and Contrada Tabuna (Bonfiglio *et al.*, 1993, 2001; Fabiani, 1927; 1928), and to the "Pianetti-Grotta S. Teodoro" F. C., at Contrada Pianetti (Bonfiglio *et al.*, 1997, 2001).

The new faunal assemblage from Contrada Annunziata belongs to the "*E. falconeri*" Faunal Complex.

Faunal Complexes	Age	Degree of endemism of taxa	Biodiversity
"Castello" F. C.	Late Glacial (Leighton, 1996)	Not endemic taxa.	Low. Continental fauna.
"Pianetti-Grotta S. Teodoro" F. C.	Late Upper Pleistocene (Bonfiglio <i>et al.</i> , 2001)	Low. Endemic taxa of " <i>E. mnaidriensis</i> " F.C. associated with not endemic taxa.	Medium. Oligotypical, but balanced fauna.
" <i>Elephas mnaidriensis</i> " F. C.	Late Middle Pleistocene-Upper Pleistocene (Bada <i>et al.</i> , 1991; Bonfiglio <i>et al.</i> , 2000; Rhodes, 1996)	Medium. Not very small sized taxa associated with not endemic taxa.	Medium. Balanced fauna with large carnivores.
" <i>Elephas falconeri</i> " F. C.	Early Middle Pleistocene (Bonfiglio <i>et al.</i> , 2000)	High. Pigmy elephant and giant dormouse are present.	Low. Oligotypical fauna.
"Monte Pellegrino" F. C.	Pliocene- Early Lower Pleistocene (Thaler, 1972); Early Lower Pleistocene (Burgio & Fiore, 1997)	High.	Low. Archaic fauna.

Tab. 1 - Synoptical table of the Quaternary Faunal Complexes of Sicily.

DISCUSSIONS AND CONCLUSIONS

The new finding of Contrada Annunziata provides a new contribution to the knowledge of paleontological and taphonomical characters of the fissure filling deposits of the Ragusa platform.

The distribution of the *Leithia melitensis* remains suggest that the micromammal skeletal elements probably reached the cavity as disgorged piles by the birds of prey which frequented it. The anatomical connections of the skeletal elements of *Elephas falconeri* suggest that they reached the cavity after the animal death, when the soft tissues were not yet destroyed. Taphonomic features indicate that the cavity acted as a morphological trap.

The measurements of all the elephant remains are within the variability of *Elephas falconeri* (Ambrosetti, 1968). *E. falconeri* is the characteristic species of the Faunal Complex diffused in Sicily in the early middle Pleistocene. It is characterised by a very reduced size, a strong sexual dimorphism and marked allometries (Ambrosetti, 1968; Caloi *et al.*, 1996). This species is contained in oligotypic and not balanced assemblages and it has been frequently found associated with *Leithia* remains.

The giant dormouse remains of Sicily have been attributed to two species, *L. melitensis*, larger, and *L. cartei*, smaller in size, having the same morphological features. *Leithia*, for a long time considered a characteristic taxon of the "*E. falconeri*" F. C., has been recently found in faunal associations belonging to the more recent "*E. mnai-driensis*" F. C. (Bonfiglio *et al.*, 1997, 2000; Kotsakis, 1996). According to Zammit Maempel & De Bruijn (1982) the so long existence of *Leithia* in the Siculo-Maltese archipelago could suggest evolutionary differences between the findings coming from different localities with different ages. Since a revision lacks, the new dormouse remains from Contrada Annunziata have been attributed to *L. melitensis*, because of the morphology and the dimensions.

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