Archeozoological, anatomical and biomechanical analysis of one subject of the genus *Equus asinus* L. from Palazzo Poggi (Lucca)

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Abstract. The study faces a new argument for the Archeozoology and the Veterinary Anatomy: the combination of these disciplines has permitted to carry out the macroscopic and osteological analysis of finds from Palazzo Poggi (Lucca) and to conduct an extensive research of pathological components in them. Then we have proceeded with the reconstruction of movement of the animal from a biomechanical perspective, starting from the myologic evidence on the archeozoological finds.

Keywords: *Perissodactyla*, Archeozoology, Veterinary anatomy, *Equus asinus* L.

INTRODUCTION

The analyzed osteological finds for this study comes from the excavations took place in 2009 in the archaeological site of Palazzo Poggi, old building in the historical center of Lucca (Italy), not far from its Renaissance walls.

This material was a good indicator to define a chronological arc: the High Medieval period (VI - IX century AD) characterized by episodes of famine. The archeological finds come from the Ambient T, specifically from U.S. 189 (Fig. 1).

Throughout the analysis of fauna found in Palazzo Poggi, specific aspects related to particular farming techniques for human food were revealed: osteological finds of swine, sheep, goat, cattle and deer but also of donkey, a specie normally not used in medieval time food, were found. This feature proves the conditions of famine present in Lucca between the VI and IX centuries AD. Lucca has weakened the continuing bloody barbarian invasions, when whole of Europe was in the grip of hunger and pandemics. The traces of slaughter found on a donkey subject testify that such an animal was shot down for food. In the Middle Age, the practice of killing equids for eating was rather rare because *Equidae* were used as animals of burden, and cases of slaughtered equids were restricted to individuals unable to work (Fumagalli, 1983; Montanari, 1983, 1997, 2008; Valenti, 1996). After exhausting the animals commonly used for food, those ones used only for work were slaughtered only if they were not affected by obvious symptoms of disease. We can assume that the scarcity of food led men to look for fallback solutions, as the consumption of equine meat died for pain caused by heavy work.

The aim of the present study is to combine the knowledge of archaeozoology and veterinary medicine to carry out an analysis of the osteological finds of a donkey subject (*Equus asinus L.*) and from the pathological evidence to reconstruct the activities of the animal during its life.

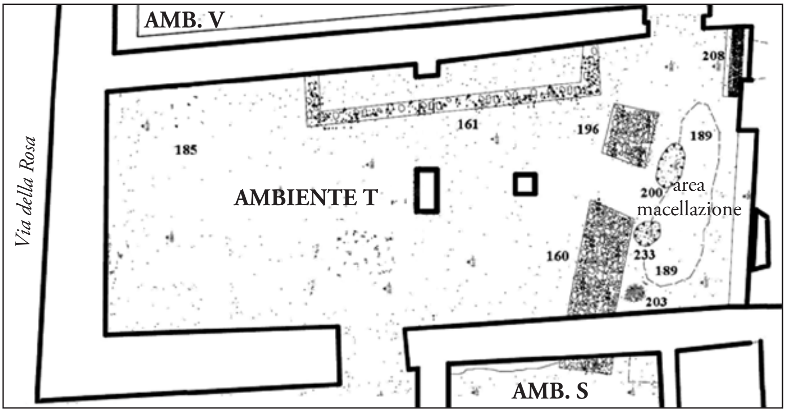


Fig. 1 – Planimetry of the archeological site.

MATERIALS AND METHODS

We performed the determination of skeletal elements, then the minimum number of individuals from the number of finds. The gross anatomy was also investigated by means of x-ray. The morphometric study allowed the estimate of the height at the withers. The recognition of sex and age were deducted from welding of the growth plates of the bones, and the eruption of dental wear. The identification of possible diseases was carried out by x-ray.

RESULTS

The finds belong to a single male specimen of *Equus asinus L.* , 5 years old (Silver, 1971; Wilson, Grigson, & Payne, 1982). The estimation of age and of sex were carried out analyzing the teeth of the left hemimandible (Barone, 1980, 1981; Getty, 1982).

The subject of *Equus asinus L.* analyzed shows evidence of skeletal anomalies related to pathologies: the areas affected by pathological disorders are the vertebral column (thoracic and lumbar vertebrae) and the forelimb (shoulder and phalanx). The physical stress and the excessive work reverberated through muscles, tendons, ligaments and skeletal system. The pathologies discovered allowed a reconstruction of the activities that this animal used to perform routinely.

The analysis of the left scapula and the metatarsal bone allowed to establish that the height of this subject ranged between 136.96 cm and 138.58 cm (Von den Driesch, 1976). The subject was characterized by some pathologies in the left scapula, in the thoracic and lumbar vertebrae and in the first left phalanx of anterior limb.

Slaughtering cuts made across the jaw and marks of scarification of the diaphysis of the metatarsal bone attest that the animal has been abated to be eaten.

Axial skeleton

Thoracic vertebrae: in cranial view (Fig. 2) it can be observed a ridge flattening ventral, and asymmetrical cranial articular processes, of which the right in particular is compressed. The right articular surface of the right rib is compressed. The cranial process looks deformed.

In right lateral view (Fig. 3) , there is an evident fusion of spinous processes due to the presence of the osteophytic bridge, probably related to an inflammatory cause. The spinous process reveals a bone regrowth on both sides, and its top is eroded. The transverse processes are deformed. In caudal view, it's possible to observe the asymmetry of the articular surfaces for the ribs, and especially the right one has suffered a compression.

Lumbar vertebrae: in cranial view the anomalous growth of bone is observed on the transverse processes. The mammillary process is crushed and deformed, and the top of the spinous process is eroded. The partially welded right intertransverse joint caused the asymmetry of the sides and its extension to the right (Fig. 5). In ventral view (Fig. 6) there is a bone growth on the right, and on caudal view (Fig. 7) is noted that the margins of the articular surface of the transverse process for the sacrum are deeper.

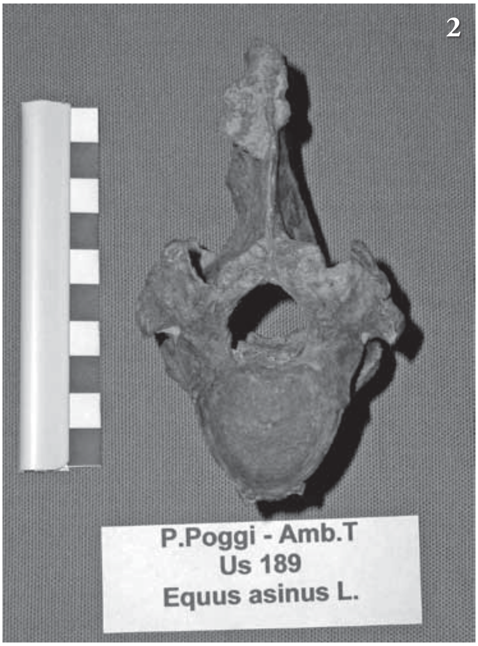
Forelimb

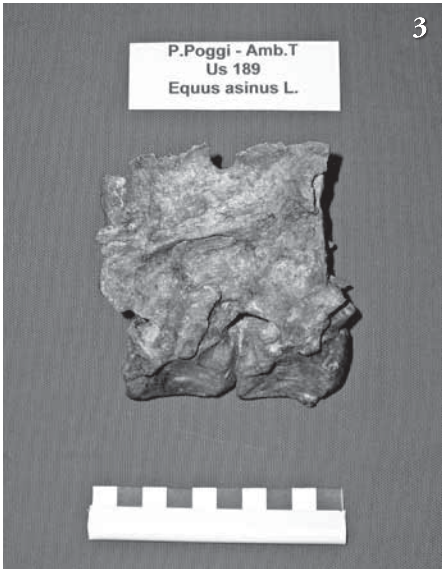
Left shoulder: on the caudal corner, there is an evident exostoses with partial ossification of the cartilage of prolongation (Fig. 8). In lateral view (Fig. 9) we have noticed marked signs caused by muscle insertions on the caudal edge of the bone. Clear vascular grooves were found on the cranial edge. The disappearance of the cranial surface of the dentate muscles insertion can be seen in medial view. The subscapularis fossa (Fig. 10) is particularly marked.

Left first phalanx: the dorsal surface is latero-laterally smooth and convex (Fig. 11). The palmar surface is plain, and the rough triangular ridge is more pronounced than usually (Fig. 12). On the proximal epiphysis the prominence of the attachment site for the extensor muscle tendon has disappeared. On the palmar surface of the distal epiphysis, the surface for the attachment of the superficial flexor muscle tendon has also disappeared. The articular surface corresponding to the second phalanx is almost flat, and the tubercle for the connection to the collateral ligament is eroded (Fig. 13).

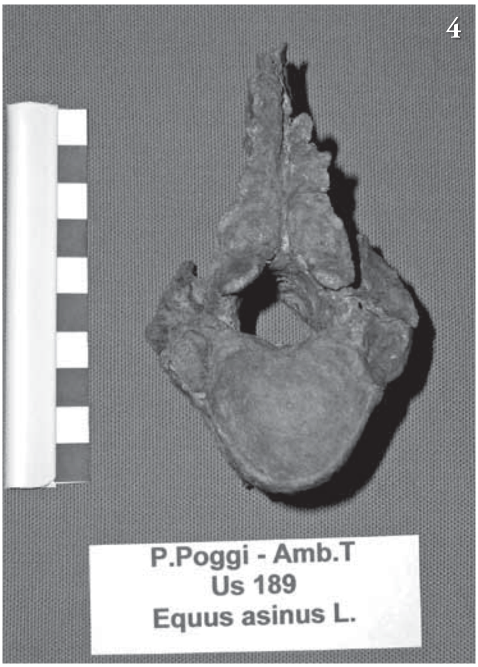
CONCLUSIONS

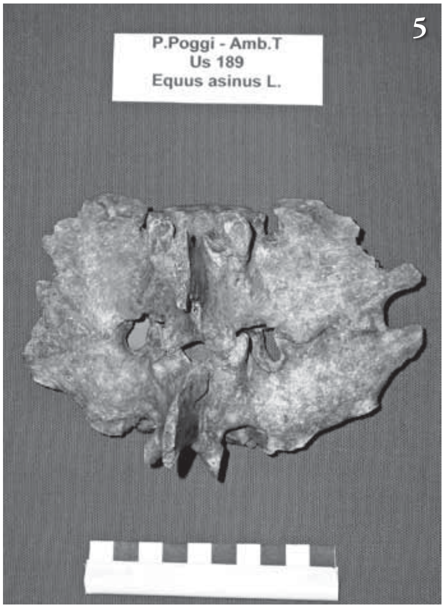
From the osteological analysis it has been argued that this equid probably underwent intense muscular solicitation which is responsible both of the lateral flexion and the extension. The intensity of the physical activities has caused biomechanical disorders as highlighted by the 4 vertebrae studied. Regarding the lateral flexion, it is evident the compression of the right articular surface with the consequent lack of symmetry of vertebrae. Further evidence for the hypothesis of an overload of work is given by the abnormal production of an osteophytic bridge, related to an inflammatory and degenerative process, with the subsequent vertebral fusion. In addition, the excessive activity of the supraspinatus muscle tendon is evidenced by the erosion of the top of the spinous processes. In the protraction and retraction movements of the shoulder the most used muscle is the dentate muscle of the neck (Denoix & Pailloux, 1997). Following the observations of macroscopic findings we point out that the animal has made a movement to extend the neck forward and, at the same time, to bring the distal epiphysis of the shoulder back, involving in both cases the dentate muscle of the neck and the ascending pectoral muscle. The movement that results is in clockwise direction and, of course, typical of an animal pulling a load too heavy for its size. However, the conditions

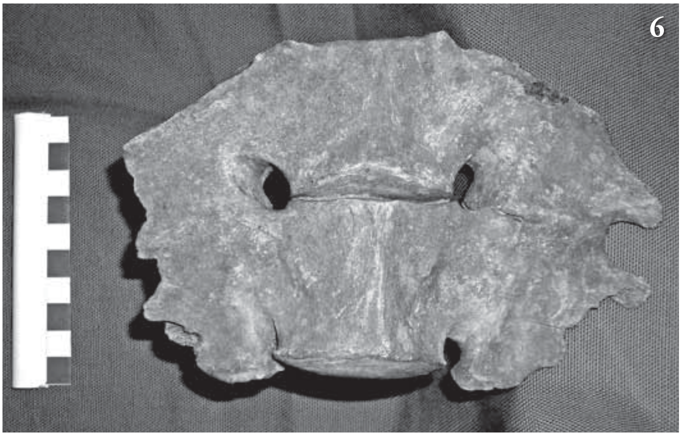


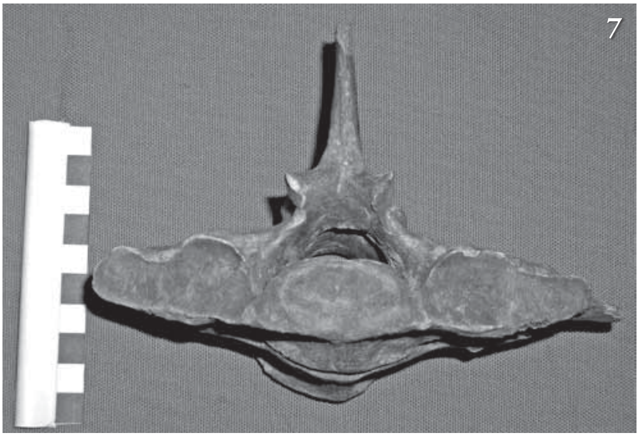


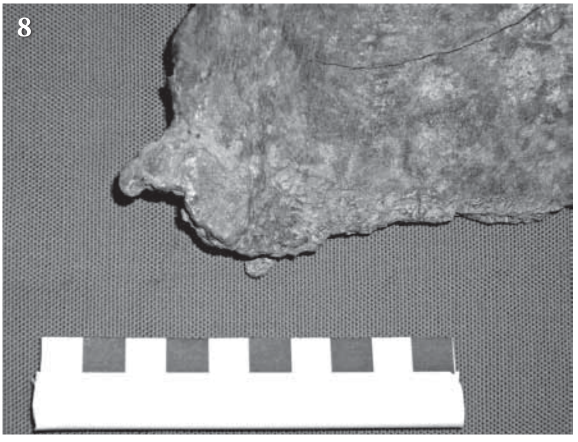
Figg. 2-5 – **2**. 17th and 18th thoracic vertebrae, cranial view. Archeological site of Palazzo Poggi. **3**. 17th and 18th thoracic vertebrae, right lateral view. Archeological site of Palazzo Poggi. **4**. 17th and 18th thoracic vertebrae, caudal view. Archeological site of Palazzo Poggi. **5**. 5th and 6th lumbar vertebrae, dorsal view. Archeological site of Palazzo Poggi.



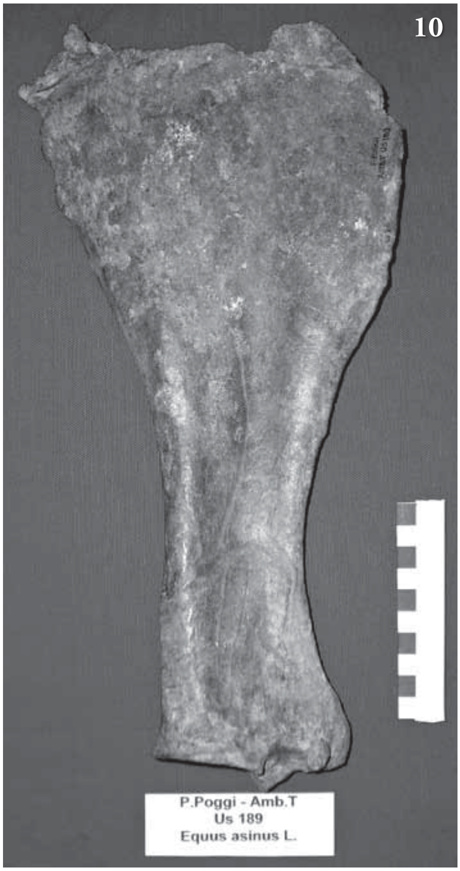




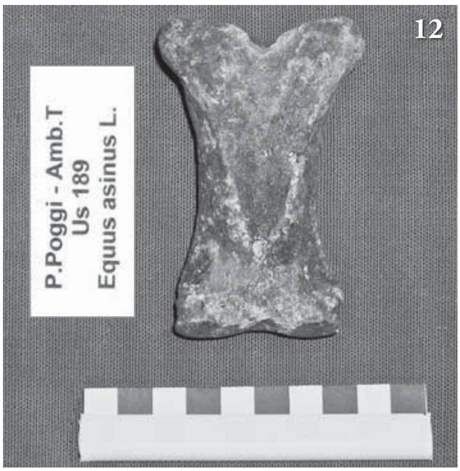




Figg. 6-8 – **6**. 5th and 6th lumbar vertebrae, ventral view. Archeological site of Palazzo Poggi. **7**. 5th and 6th lumbar vertebrae, caudal view. Archeological site of Palazzo Poggi. **8**. Left shoulder, caudal corner, lateral view. Archeological site of Palazzo Poggi.



Figg. 9-12 – **9**. Left shoulder, lateral view. Archeological site of Palazzo Poggi. **10**. Left shoulder, medial view. Archeological site of Palazzo Poggi. **11**. 1th left phalanx (pastoral bone), cranial view. Archeological site of Palazzo Poggi. **12**. 1th left phalanx (pastoral bone), palmar view. Archeological site of Palazzo Poggi.



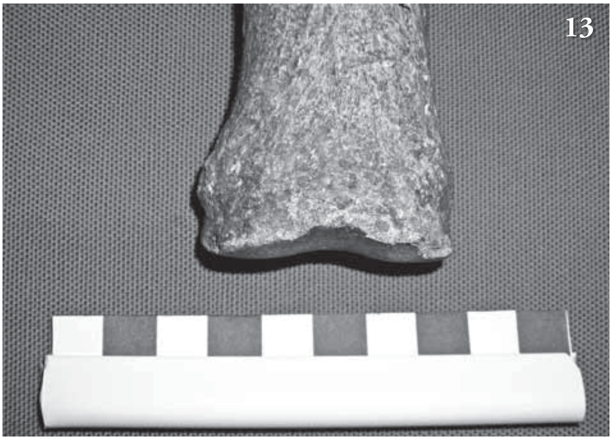


Fig. 13 – 1th left phalanx (pastoral bone), distal view. Archeological site of Palazzo Poggi.

of the phalanx suggests an abnormal foot fulcrum due to the excessive weight (Denoix & Pailloux, 1997).

Finds pathologies (Chaix & Meniel, 2001; De Grossi Mazzorin, 2008) allow us to affirm that the intensive work of the animal *Equus asinus L.* affected both skeletal and myological component. We have also deduced that the animal probably did a remarkable muscle strain of neck and thoraco-lumbar area, perhaps caused by an excessive weight on the front of the body. In addition, the vertebral compression on the right denotes a rotary movement (in a clockwise direction, e.g. grindstone movement) which affected the force applied by the left forelimb in the rotation movement. Pathological observations provide clinical evidences of serious walking impairment and probable pain.

Pathological evidences, slaughtering cuts made across the jaw, and marks of scarification of the diaphysis of the metatarsal bone suggest that the exploitation of this animal subsisted until the death.

Historical sources also confirm that the equids were slaughtered only in extreme situations, because they represented a highly skilled workforce.

Acknowledgments. We thank Prof. Michelangelo Zecchini and the Superintendence for Archeological Heritage of Tuscany for allowing the study of osteological finds. We thank Prof. Claudio Sorrentino for the support of the archeozoological research and Dr. Daniela Corrado for the translation and revision of the text.

RIASSUNTO

Analisi archeozoologica, anatomica e biomeccanica di un esemplare di *Equus asinus* L., da Palazzo Poggi (Lucca)

L'Ambiente T dello scavo urbano di Palazzo Poggi (Lu) collocabile cronologicamente tra il VI e IX sec. d.C. ed identificato come area di macellazione, ha restituito reperti osteologici faunistici riferibili ad un esemplare maschio di 5 anni di *Equus asinus L.* affetto da patologie a livello delle vertebre toraciche e lombari, della scapola e della prima falange anteriore. Le osservazioni anatomo-patologiche hanno fornito il quadro clinico di un esemplare con gra-

vi problemi deambulatori, molto probabilmente dolorante, che in vita doveva aver compiuto un'azione di traino di carichi troppo pesanti e mal distribuiti, eseguendo un movimento di rotazione continua. I risultati di uno sconsiderato uso lavorativo associati a tracce di macellazione all'interno della mandibola e di scarnificazione sulla diafisi del metatarso suggeriscono che questo soggetto sia stato, probabilmente, sfruttato fino alla morte e dopo macellato oppure che, ormai inutilizzabile per qualsiasi attività, sia stato abbattuto e, dopodiché, macellato. Entrambe le ipotesi rimandano ad una società estremamente provata dal momento che numerose fonti attestano che gli equidi venissero macellati solo in situazioni estreme (Fumagalli V., 1983), purché non affetti da malattie contagiose, per non compromettere in alcun modo la forza lavoro (Montanari M., 1983; Montanari M., 1997).

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