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ARCHAEOENTOMOLOGICAL STUDY OF THE INSECT REMAINS FOUND WITHIN THE MUMMY OF *NAMENKHET AMUN* (SAN LAZZARO ARMENIAN MONASTERY, VENICE/ITALY).

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Abstract: The unwrapping of an Egyptian mummy attributed to *Namenkhet Amun*, a priest of the Amon temple (Karnak), has revealed the presence of several insect remains within the wrappings as well as in the abdomen. The study of this specific thanatophilous entomofauna, previously defined as *Funerary-Archaeoentomology* (HUCHET, 1996), provide precious information as to the different *postmortem* stages; including duration and processes of the mummy's embalming.

Key-words: Funerary-Archaeoentomology, mummification, Coleoptera, Cleridae, *Necrobia*, Dermestidae, *Anthrenus*, *Attagenus*, Diptera, Calliphoridae, *Chrysomya*.

Résumé : Le débandelettage de la momie égyptienne de *Namenkhet Amun*, prêtre du temple d'Amon (Karnak) a pu mettre en évidence la présence de restes d'insectes, tant sur les bandelettes qu'à l'intérieur de l'abdomen. L'étude de cette entomofaune thanatophile spécifique, précédemment définie sous le terme d'*Archéoentomologie funéraire* (HUCHET, 1996), est à même de fournir de précieux renseignements quant aux différentes étapes *postmortem*, dont la durée et les processus liés à l'embaumement de la momie.

Mots-clés : Archéoentomologie funéraire, momification, Coleoptera, Cleridae, *Necrobia*, Dermestidae, *Anthrenus*, *Attagenus*, Diptera, Calliphoridae, *Chrysomya*.

Introduction

In May 1995, a multidisciplinary European team[2] led by Dr C. de Vartavan unwrapped an Egyptian mummy attributed to *Namenkhet Amun* (XXV^{e}–XXVI^{e}

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[2] The scientists and technicians involved onsite in the "Project St. Lazare" are : C. de Vartavan (Egyptologist and archaeobotanist), head of the mission, V. Asensi Amoros (xylologist); A. Emery Barbier (palynologist); M. Fontugne (^{14}C dating); H. Gompel (gastroenterologist); M. Lescot (botanist); D. Massazza (engineer) and A. Pasquale (medical imaging); S. Pennec & M. Plantec (restorers and textile specialists) and A. Tchapla (chemist).

dyn.) kept at the Armenian Monastery of San Lazzaro in Venice (Italy) (Fig. 1). The main purpose of this investigation was the identification of the different embalming substances, particularly botanical, as well as the mummification techniques used by embalmers during the Late Epoch (± VIIth to IVth B.C.). During the unwrapping, several insect remains were discovered on different parts of the mummy: on or inside the wraps as well as inside the abdomen as revealed by endoscopic examination.

The mummy kept at the Armenian Monastery of San Lazzaro in Venice (Italy) was sent from Egypt by Boghos Bey Youssoufian, a prominent Armenian minister in this country, on July 18, 1825. It was revealed that the mummy bandages were made of linen (*Linum usitatissimum* L.), specially designed for that purpose and not resulting from salvaged material as frequently noticed in many other Egyptian mummies. C^{14} dating performed upon inner sawdust and bandage samples provided an age range of – 430 and – 450 BC, corresponding to the Late Egyptian period (XXVth –XXVIth dyn.). The study carried out upon the sarcophagus shows that it was made up of two distinct woods - tamaris (*Tamarix sp.*) for the planks and sycamore fig tree (*Ficus sycomorus*) for the tenons (ASENSI AMOROS & VOZENIN-SERRA, 1998). The sarcophagus accompanying the mummy indicates that it is was the mummy of *Namenkhet Amun*, Sedjef Superior of the Amon Temple (Karnak). A carefully oil embalmed mummy, wrapped in bandages with red fringes indicating priesthood; a status further confirmed by the fact that the body was completely shaved.

Fig. 1. The particularly well-preserved face of the mummy of Namenkhet Amun, stored in the museum of the Mekhitarists' Armenian monastery in Venice (Italy). The nose was probably broken when the lid was put on the coffin in which he was made to rest. (Photo P. Landmann).

Insect remains

The first insect remains were discovered and sampled during the initial phase of mummy unwrapping. A subsequent internal examination of the thorax, carried out by endoscopy *via* the medullary canal or the evisceration opening, revealed other insect fragments partially glued in an alcohol-soluble testaceous color resin. The chemical study of this resin (TCHAPLA *et al.*, 2004) revealed the presence of a greasy substance of animal and/or vegetable origin suggesting an oil-embalming - a rare and unusual practice. As pointed out by C. de Vartavan (pers. com., 2007), oil embalming corresponds to the one described in *Papyrus Boulaq N° III* and *Louvre 5158*, where the deceased is embalmed from head to foot with two distinct oils.

The presence of many coprolites of arthropod testifies of an intense post-mortem activity in the core of the mummy. Exoskeletons of certain insect remains were partially covered with a fine and pulverulent powder. ASENSI AMOROS & VOZENIN-SERRA (1998) subsequently explained that this powder was sawdust from two distinct tree species: cedar (a *Cedrus* sp.) and tamaris (a *Tamarix* sp.).

Insects and mummies: an old common history

The association of insects and Egyptian mummies is attested since nearly three centuries. Italian naturalist A. VALLISNIERI (1713), who played a decisive role in the spontaneous generation debate, was early interested on the so-called "parasites" and secondary hosts frequently present in mummies (fig. 2).

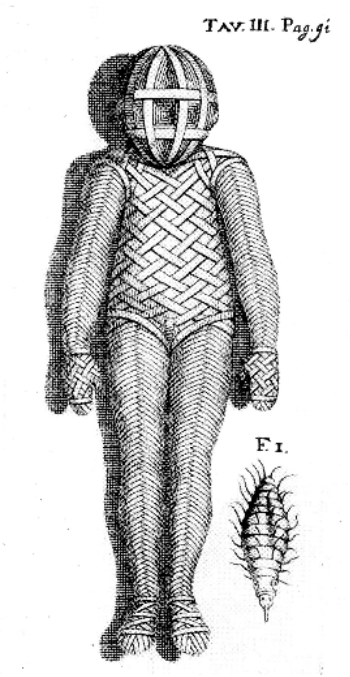

Fig. 2. – Egyptian mummy and associated insect as published in VALLISNIERI (1713).

The insect illustration proposed by VALLISNIERI, although somewhat "anthropomorphic"[3], makes it possible to recognize an immature stage of a fly belonging to the genus *Fannia* Rob. Desv. (Diptera : Faniidae), probably *F. canicularis* (L.), a common and cosmopolitan species best-known as "the lesser housefly". The different species of *Fannia* are known to develop in relatively advanced cadavers. *F. canicularis* is also frequently quoted as a vector of urogenital myiasis when poor hygiene conditions occur (SMITH, 1986). Remains of this species were recently evidenced in the mummy of Aset-iri-khet-es (Ptolemaic Period) (GERISCH, 2001).

More than any other ancient civilisation, Egyptians and insects were intimately linked. An evident proof of this close relationship is the symbolism surrounding the famous Scarab beetle "*Khepri*"[4] (*Scarabaeus sacer* L. and allied

[3] Presence of distinct eyes whereas fly larvae are anophtalmous [eyeless].
[4] In Egyptian, the name Kheper (or Khepri, Khepra, Khepera) means: "to come into being".

species) in the Egyptian mythology, and for which the former dedicated a real cult (LATREILLE, 1819; ALFIERI, 1956; CHERRY, 1985; CAMBEFORT, 1987; KRITSKY, 1991, 1993; HUCHET, 1995). Most scarabs depicted in Egyptian iconography or figuring in grave goods (e.g. winged or heart-shaped scarab beetle amulets) belong to dung beetles (Scarabaeidae) specialized as "rollers" (telecoprids) which build a dung ball and transport it over a certain distance before burying it. During the reproductive period, male and female work together, dig a tunnel ending by an excavated chamber where the female lays a single egg in the pear-shaped brood ball. The neonate larva would feed on the dung, grown and pupates. After a certain underground period, the adult emerges and digs up to the soil surface. With regard to their specific biology, the ancient Egyptians believed that scarab beetles were created from dead matter and thus *Khepri* was associated with renewal, rebirth, and implicitly with resurrection.

The relation between both protagonists has not always been so "harmonious" since insects were frequently implicated in conspicuous depredation as well as a vector of multiple diseases. In this respect, as dreadful destructive agents, they played a large part among the ten Plagues of Egypt - swarm of horseflies and desert locust (*Schistocerca gregaria* (Forskal, 1775)) at the origin of crops destruction, famine, diseases and death. The former Egyptians and more particularly the embalmers were aware of the irreversible damage done by insects upon dead bodies (GUILHOU, 1994, 2006; HUCHET, 1995). The *Coffin Texts*[5] mention that, from their reduced size, they are able to surreptitiously colonize and promptly destroy cadavers. GUILHOU (1994) suggested that, among the different rites conducted in the *Ouryt*[6] by the embalmers, the protection of the corpse against the necrophagous insects probably occupied a major place. In the *Book of the Dead* (chap. 36), where the latter are mentioned under the term *ḫ3yt,* a vignette shows a priest repelling a necrophagous beetle followed by the incantation: *"Begone from me, O Crooked-lips"* (fig. 3).

Fig. 3. Vignette showing a priest spearing a necrophagous beetle (Book of the Dead, chap. XXXVI, P. Barguet, 1967).

[5] *CT* I, Chap. 49, 215f-216a.

[6] Initially, a sacred edifice intended to shelter and protect the body of Osiris (Papyrus Louvre I.3079). During the Middle Kingdom, the *ouryt* is evocated as the place where the priests carry out the initial embalming treatments upon the decaying corpse.

GREENBERG (1991) mentioned the following inscription present on a slip of paper found in the mouth of a mummy: "*The maggots will not turn into flies within you*"[7]. Despite tremendous efforts and more and more sophisticated embalming techniques, the necrophagous insects or even termites as brought to evidence by DERRY (1911) have considerably ruined embalmers' work and, perhaps, consequently, prevented the solar resurrection of some venerable Pharaos. If mummified bodies could be preserved over thousands of years, their associated insects could benefit from the embalmer's preservation know-how. These are those we meet today.

At the beginning of XIXth century, Champollion, while unwrapping, discovered beetle remains located between the fingers of an Egyptian mummy: "*Ce fut en examinant les mains attentivement que nous aperçumes, dans l'interstice des doigts, plusieurs coléoptères morts, de couleur rosé-violet dans tout son éclat…"* (MILLIN, 1814). According to contemporary beliefs, insects inhabiting mummies were considered as representative of a specific entomofauna, no longer existing. The specimens, entrusted to the Swiss entomologist M. Jurine were described as a new species under the name *Corynetes glabra*[8] (MILLIN, 1814). From this time on, the fascination for Egyptian civilisation, following from the recent Napoleonic campaign, increased considerably and created a general craze for mummies, including "unwrapping dinner parties".

Generally, insects associated with mummies were mainly be attributed to two distint insect orders: Diptera (flies) and Coleoptera (beetles). Flies are usually the prominent *postmortem* invaders due to their ability to swiftly locate carrion and begin ovipositing in the first minutes following death. Their relative frequency in Egyptian mummies tends to prove that the different initial preparation stages of bodies performed by embalmers probably didn't induce notable modification in the natural processes of decomposition. According to TAPP (1984), "*the ancient Egyptians tended to leave the brain to liquefy for a few days before attempting to remove it* ". On this assumption, flies larvae probably played a significant role or even assisted the embalmers in the brain liquefaction process as suggested by GREENBERG & KUNICH (2002).

[7] Papyrus Gizeh no. 18026:4:14.

[8] This species (*C. glabra* Jurine apud Champollion, 1814) will be later synonimized by ARROW (1908) with the cosmopolitan *Necrobia rufipes* Degeer.

THE THANATOPHAGOUS FAUNAL SUCCESSION

A corpse, from death to skeletal stage, functions like a true ecosystem on which multiple micro-organisms succeed to one another, thus participating to the remineralisation of the organic matter. At the end of the XIXth century, French entomologist MÉGNIN (1894) in his landmark book "*Fauna of Cadavers"* highlighted the colonization of a corpse by a predictable succession of arthropod species in direct relation with the various stages of *post-mortem* decay. According to this author, insects and other arthropods (mites) intervene concurrently with autolysis and putrefaction progress until the ultimate phase of skeletonization. Their recognition and the study of their biological cycles in relation with the environment allow in most cases a very accurate estimation of the *Post Mortem Interval* (PMI).

Contrary to forensic entomologists who mainly use living fly larvae taken on corpses, the puparia[9] (fig. 7) are, in many cases, the only "fossil witnesses" usable by archaeoentomologists. If, obviously, the PMI could not be traced in an archaeological context, the study of arthropods remains (sclerites) could however provide relevant information, in particular in the estimation of the corpse exposure duration, taphonomical processes (HUCHET *et al.*, in press) or other aspects concerning the reconstruction of mummification processes.

RESULTS

Overall the insects recovered are relic witnesses of the embalming and belong to the classical invertebrate necrofauna gravitating around dead bodies. Among them, two species – the blowfly *Chrysomya albiceps* (Wiedemann, 1819) and the Clerid beetle *Necrobia rufipes* (DeGeer, 1775) (fig. 5) are frequently found during forensic investigations. Both species have a very distinct ecology and invade corpses at a definite time, in relation to the different *postmortem* stages.

[9] During the nymphose, the external cuticle of the third instar larvae (maggots) will harden to constitute a small rigid barrel-shaped cocoon (puparium) from the interior of which the metamorphosis will be accomplished. These puparia, strongly chitinized, have a propensity to be preserved remarkably in archaeological context.

The analysis of the entomological remains from the San Lazzaro Mummy highlighted the presence of five taxa (MNI[10] = 14) belonging to four distinct families and three different orders (Table 1). Except for the specimen of Pseudoscorpion (Arachnida: Chthonioidea) which remains unidentified (exuvia), the sampling only includes species already known from Egyptian mummies.

Insects associated with mummies are not necessarily "antic" or contemporaneous with their wrappings. Many beetle species, in particular those belonging to Dermestidae and Anobiidae families, are known to be major pests, causing severe damage to stored products (LEPESME, 1944; HINTON, 1945; DELOBEL & TRAN, 1993) and consequently upon all organic remains on display in museums. Among the samples collected, we are inclined to think that some insect remains could probably be attributed to a subsequent contamination as suggested by their localisation (on the outer wrappings) and state of preservation incompatible with the age of the mummy. However, some of the remains (the blowfly *Chrysomya albiceps* (Wiedemann) (fig. 7) and the beetle *Necrobia rufipes* (DeGeer)) (fig. 4) are indisputably contemporaneous with the mummy wrapping since both species belong to the classical invertebrate necrofauna frequenting carrion. Moreover, blowflies require a moist food source to lay and a fully desiccated body is resolutely not attractive. Finally, those remains were found inside the abdomen, partially glued with balms, an evident proof of their great antiquity.

[10] Minimal Number of Individuals.

Fig.4 (left) – *Necrobia rufipes* Degeer (= *N. mumiarium* Hope, 1834) (Col. Cleridae) recovered from bandage stuffing. (Photo: H.-P. Aberlenc, 2007). Scale = 1mm.

Fig. 5. – *Necrobia rufipes* Degeer. Present-day specimen. (Photo: M.C. Thomas, Florida Department of Agriculture and Consumer Services, Bugwood.org). Scale = 1mm.

Fig. 6. (left) – Original drawing of *Necrobia mumiarum* Hope (= *Necrobia rufipes* DeGeer) as published in Pettigrew's book (1834).

Fig. 7. – Puparium of the blowfly *Chrysomyia albiceps* (Wied.) recovered from inside the abdomen of *Namenkhet Amun*'s mummy. (Photo: H.-P. Aberlenc, 2007). Scale = 1mm.

Table 1. Summary table of insect and other arthropod remains associated with the Egyptian mummy of *Namenkhet Amun* (XXVth–XXVIth dyn.).

Samples	*location*	*Order*	*Family*	*Species*	*Stage*
P1	outer wrapping of the mummy	Coleoptera	Dermestidae	*Anthrenus sp.* [*cf. A. (Nathrenus) verbasci* (L.)]	**larva (exuvia)**
P2	occipital area	Coleoptera	Dermestidae	*Anthrenus sp. Attagenus sp.(cf. unicolor* Brahm)	**larvae (exuvia)**
P12/bis	bandage stuffing	Coleoptera	Cleridae	*Necrobia rufipes* De Geer	**adults**
P13/bis	bandage	Coleoptera	Dermestidae	*Attagenus (s. str.) unicolor* Brahm	**larva (exuvia)**
P17/bis	fabric fragment	Coleoptera	Dermestidae	*Anthrenus (Nathrenus) verbasci* (L.)	**larva (exuvia) + adult**
P24	neck region	Diptera	Calliphoridae	*Chrysomyia albiceps* (Wied.)	**Puparium + nymph inside**
P30	interior of the abdomen	Diptera	Calliphoridae	*Chrysomyia albiceps* (Wied.) (fig. 7)	**Puparium + nymph inside**
P74	interior of the abdomen	Coleoptera Diptera, Arachnida (Chthonioidea)	Cleridae Calliphoridae ?	*Necrobia rufipes* De Geer (fig. 4) *Chrysomyia albiceps* (Wied.) ?	**adults puparium exuvia**

THE BEETLES (COLEPTERA)

- **CLERIDAE**

Necrobia rufipes DeGeer

The Cleridae or "Checkered beetles", include nearly 3 500 species worldwide (CORPORAAL, 1950). To a great extent, most genera are pollen eaters (adults) while larvae are predaceous and usually feed on various kind of insects. Within the family, the species belonging to the genus *Necrobia* Olivier ("bone beetles") are primarily scavengers and well known to colonize cadavers at a relatively advanced stage of *postmortem* decay. They have been sometimes used in the PMI estimation in forensic entomological investigations (BENECKE, 1998; KULSHRESTHA & SATPATHY, 2001). MEGNIN (1894) included the *Necrobia* species in the fourth biocenosis corresponding to the caseic fermentation stage, when the proteinic matter degradation generates an odour reminiscent of overripe cheese. In warm regions and particularly in sub-desertic regions, BELLUSSI (1933) evidenced that the *Necrobia*, associated with *Dermestes* beetles, could play a significant scavenging role upon human cadavers.

The Natural History of *Necrobia rufipes* DeGeer ("the red-legged ham beetle"), recovered from *Namenkhet Amun*'s mummy, is intimately linked with ancient Egypt as this species appears amongst the oldest insects recovered from mummies[11]. After Champollion's first discovery (MILLIN, 1814), many specimens attributable to this species, recovered from the head of a Theban mummy, were erroneously described as a new species by the Rev. F.W. HOPE (1836) under the evocative name of *Necrobia mummiarum* (fig. 6). *N. rufipes* was successively observed by ESCHER-KÜNDIG (1907) from an Egyptian mummy, by ALLUAUD (1908), from the mummy of an Ammon priest of the XXI^{e} dynasty, then mentioned by KEIMER (1938), from an anonymous Egyptian mummy as well as from organic material found in a jar. Further specimens of *N. rufipes* were also discovered within the bandage of the Graeco-Roman mummy 1770 (Manchester Museum) (DAVID, 1978; CURRY, 1979; HARRISON, 1986), and evidenced in the pelvic region of the mummy PUM III kept at the Pennsylvania University Museum (RIDDLE, 1980). Finally, remains of this

[11] Contrary to the citation of some recent authors (PANAGIOTAKOPULU, 2001; GERISCH, 2001), *N. rufipes* has never be recovered from the mummy of Rameses II, as studied by STEFFAN (1982, 1985). Moreover, as clearly indicated by this last author (1982: 533), the french entomologist Alluaud has never conducted any study upon this famous mummy as erroneously indicated by CHADDICK & LEEK (1972), followed by PANAGIOTAKOPULU (2001).

species were recently evidenced by ISIDRO (2006) during the endoscopic examination of the mummy called the "*Lady of Kemet*" (Egyptian Museum of Barcelona).

- **DERMESTIDAE**

The insects belonging to this family and especially those of the genus *Dermestes* L. are frequently found associated with mummies (NEOLITZKY, 1911; LESNE, 1930; STRONG, 1981; TAYLOR, 1995). Oddly enough, no remains of *Dermestes sp.* were encountered here. The only representatives of this family recovered from the mummy of *Namenkhet Amun* belong to the genera *Anthrenus* Geoffroy and *Attagenus* Latreille (respectively identified as *A. (Nathrenus) verbasci* (L.) and *Attagenus unicolor* (Brahm)). Both species are frequently designated under the name of "*Carpet beetles*". According to ATTIA & KAMEL (1965), the latter is a synanthropic species, very common in Egypt, with a more or less polyphagous diet including both dried animal or plant matter. This species has been recently cited from archaeological context at Amarna (PANAGIOTAKOPULU, 2001). Another species of *Attagenus* has been recovered from the remains of the "two brothers[12]" (XIIth Dynasty, ± 2000 BC) kept in the Manchester Museum collection of Mummies (CURRY, 1979). Although the remains could not be recognized by CURRY, the SEM photo provided in this paper allows to assign the unidentified wing case fragment to *Attagenus pellio* (L.).

Beetles belonging to the genus *Anthrenus* Geoffroy have been occasionally cited from mummified remains. Remains attributed to *A. museorum* (L.) were recovered from mummified fish (*Eutropius niloticus*) (LEEK, 1978), from the mummy called "1770" ((Roman period) kept at the Manchester Natural History Museum (HARRISON, 1986) and from a mummy of Ptolemaic period (ANDELKOVIC *et al.*, 1997). Personal studies conducted upon the very extensive collection of mummies in the Musée de l'Homme (Paris), reveals that *Anthrenus* species (*A. museorum* or more frequently *A. verbasci*) are represented in most of the mummies, whatever their geographical origin. Classic hosts of desiccated remains stored in Museums, their presence is linked, in most cases, with subsequent contamination. From this evidence, I am inclined to think that the species recovered here (*Anthrenus verbasci* (L.)) is, in all likelihood, not contemporaneous of *Namenkhet Amun*.

[12] *Khnum-Nakht* and *Nekht-Ankh*.

THE FLIES (DIPTERA)

- **CALLIPHORIDAE**

Chrysomyia albiceps (Wiedemann)

The insect remains discovered inside the abdomen of the San Lazzaro mummy refer to *Chrysomyia albiceps* (Wiedemann) (Diptera: Calliphoridae), the most frequent carrion-fly species in Egypt according to OMAR (1995). Its presence in Pharaonic Egypt was attested a long while ago and this species has already been frequently encountered to be associated with human mummies: "Two Brothers' grave" (DAVID, 1978; CURRY, 1979), the mummy called "1777" (XXVth Dyn.) (DAVID, 1978; CURRY, 1979; DAVID & TAPP, 1992) and the "1770" mummy (HARRISON, 1986).

According to the experiments carried out in Egypt by OMAR (1995), *C. albiceps* (Wied.) shows a clear predilection for corpses of a important sizes. Larvae of *C. albiceps* (Wied.) indeed need a consequent food supply to supplement their cycle. Thus, a premature desiccation of the corpse would prevent the ontogenetic development, particularly during the hottest periods of the year.

The attraction of *Chrysomyia albiceps* (Wied.) for dead bodies results from two distinct behaviours: nutrition and oviposition. The first phase remains however paramount for the newly formed females since it is inherent to the start up and subsequent maturation of the ovaries (= anautogeny). Oviposition is preferentially made upon the body fluid exuding from open wounds, if present, or natural body opening. In the particular case of mummies, the evisceration slit may be particularly attractive since the neonate larvae could easily reach the internal viscera.

C. albiceps larval cycle is relatively rapid and varies generally between 5 to 6 days. The larval mode of extra-oral digestion (gastric juice regurgitates) induces a rapid liquefaction of the flesh. The time spent on a corpse largely varies according to whether the insect colonizes the corpse to feed or to lay. The length of oviposition (eggs laying) of *C. albiceps* spread out between 40 mn and one hour (OMAR, 1995) and according to MARCHENKO (1985), the more favourable heat range for egg laying is 25 to 27°C.

C. albiceps remains present in the mummy of *Namenkhet Amun* correspond to pupal stage (puparia) (no adults were found). The puparia (as well as the larvae) are very distinctive, their body bearing transverse rows of fleshy processes (fig. 7). As frequently noticed from insect remains recovered from mummies, their pupariae present a distinctly depigmented cuticle. This depigmentation can be interpreted in several ways, or even be the result of a combination of different factors: age of the sampling, time of confinement in the grave's darkness, or finally discoloration resulting from substances used in balms (aromatic oils and unguents) as suggested by HOPE (*in* Pettigrew, 1834).

DISCUSSION

Recently, MACKE & MACKE-RIBET (1994) emphasized the role played by insects in the reconstruction of embalming phases in ancient Egypt. Their study, based upon 342 mummies[13] from the Valley of the Queens, evidenced that, to a large extent, insects recovered from mummies could be attributed to the 1st and 3rd successive faunal waves. According to these authors, removal of internal organs, probably conducted quickly after death by embalmers, prevents, or at least decreases, the formation of gaseous putrefaction (bloated stage) which usually attracts the 2nd wave of necrophilous flies. When temperatures are favourable, *C. albiceps* usually invades cadavers in the first days after death (GRASSBERGER *et al.*, 2003; BARROS DE SOUZA *et al.* 2008). However, as demonstrated by TANTAWI *et al.* (1996), when interspecific competition occurs with other Calliphorine species, *C. albiceps* acts as a secondary species. The forensic experiments conducted by these authors upon rabbit carcasses in Alexandria (Egypt) show clearly that the blowfly *C. albiceps* (Wied.) is mainly active in summer, but occurs also in fall or spring. Its presence in winter is exceptional since this species is less adapted to cooler temperatures than other Calliphorine carrion flies. This suggests that the death of *Namenkhet Amun* occured probably during the warm season. In the present case, the absence of other blow flies is to be noted, if this is not correlated to the aggressive predaceous behaviour of the 2nd and 3rd larval instars (ZUMPT, 1965; BRAACK, 1987; GRASSBERGER *et al.*, 2003), would indicate that *C. albiceps* was probably the local dominant species and acted here as a primary species. The duration of the biological cycle of *C. albiceps* varies inversely in relation with the temperature. According to the experiments made by GRASSBERGER *et al.*

[13] Four mummies of New Empire, thirty one mummies of theThird Intermediary Period and three hundred and seven mummies of Roman epoch.

(2003) upon the life-cycle length variations of *C. albiceps* at different temperatures, the minimal duration of development (from oviposition to adult stage) ranges approximatively from 8 to 19 days (at 35°C and 20°C respectively). Comparable results were obtained by RICHARDS *et al.* (2008).

The presence, inside the abdomen, of several un-emerged puparia (the nymph found dead inside) englued in balms, as well as the size of those specimens, abnormally smaller than usual, could probably be interpreted as following: After reception of the body in the *Good House,* the embalmers proceeded rapidly to the excerebration and evisceration of *Namenkhet Amun* to prevent the decay of the internal organs. It is probably during this short period that *C. albiceps* oviposited upon the fresh corpse. According to HERODOTUS or DIODORUS SICULUS, the corpses were subsequently covered and filled in with natron during several weeks (roughly 35 days as indicated by the ancient authors) to dry out body fluids. We hypothesise here that, during this desiccating stage, probably a great number of 3rd instar larvae were able to run away from the body to pupate outside. Some individuals, trapped inside the abdomen couldn't fully complete their cycle. In this assumption, the dwarfed size of the puparia recovered from the mummy would result of maggots' development under unfavourable conditions. This assessment would be in accordance with GARNER (1986)'s experiments upon the effects of natron as insect repellent. This author showed clearly that if a colony of insects (Dermestid beetles in the present case) could survive and grow for several months in the hostile environment of natron bed, the average size of adult beetles is significantly reduced.

After the desiccating stage in natron, the latter was removed and then, the body usually washed and dried out. Subsequently, the abdominal cavity and thoracic cage are stuffed and packed out with sawdust, linen, resin soaked bandages and various aromatics balms. It is probable that most of the insect remains were removed during a thorough washing and that those remaining were subsequently embedded in balms.

The exact time when *Necrobia* have colonized the body remains uncertain. Usually, *Necrobia ruficpes* is known to invade exposed cadavers at the beginning of the butyric fermentation stage (ie 20 to 40 days after death according to BORNEMISSZA, 1957). Its activity continues until the dry decay stage (several months after death), when the corpse is drying out or almost dry. BYRD & CASTNER (2001) highlighted however that, sometimes, adults may be found on

carrion in earlier stage. In the present case, the only presence of adults (any larval remains were found within the sampling) would indicate that the colonization by *Necrobia* probably occurred tardily in the mummification process. It could be hypothesized that those insects invaded the mummy during the ultimate stage of drying (once the body was removed from natron and washed by embalmers, ie approximatively 40 days after death). An earlier infestation of the corpse, in particular when the mummy was in natron, cannot however be dismissed. According to the experiments conducted by LEEK (1969), natron delays the decomposition process but doesn't prevent it. Moreover, it was noted that throughout the duration of the desiccating process persists a distinct odour of putrefaction. GARNER (1986) demonstrated that the presence of natron limits but does not inhibit the colonisation by insects. The putrefied smell emanating from the corpse and more particularly the presence of *C. albiceps* larvae could justify the colonisation by *N. rufipes* during this period. Finally, a late infestation could however have taken place during the ultimate stage of embalming processes, i.e. before the mummy was wrapped. Some specimens could have entered the abdomen via the evisceration slit, and would have survived for some times as suggested by the presence of coprolites in the core of the mummy. According to STOREY (1916), in Egypt *Necrobia rufipes* is active from March to October. This would concur with the previously supposed period of death of *Namenkhet Amun*.

CONCLUSION

The study of the insect remains recovered from the mummy of the scribe *Namenkhet Amun* revealed the presence of a distinct thanatophilous entomofauna in the core of the mummy. Among the recovered specimens, two species, the blowfly *Chrysomya albiceps* Wied. and the Clerid beetle *Necrobia rufipes* (DeGeer) proved to be precious indicators in the reconstruction of the *postmortem* events and processes of embalming. It could be argued that the infestation of the mummy of *Namenkhet Amun* by *C. albiceps* (Wied.) occured shortly after death, as long as the corpse represented a potential proteinic source. The presence of *Necrobia rufipes*, which colonizes bodies tardily, in the later dry stages of decay, emphasized that the mummification processes lasted over a long period, which can be related to the "7 decades" mentioned by *Herodotus*. The phenology of both species would suggest that *Namenkhet Amun* probably died during the warm season. Finally, the low representation of insect remains associated with the *Namenkhet Amun* mummy highlighted a very

carefully performed embalming process, consistent with the social rank of the deceased.

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BIBLIOGRAPHY

ALFIERI A., 1956. – La véritable identité du scarabée sacré de l'Egypte pharaonique. *Bulletin de la Société entomologique d'Egypte* XI: 451-452.

ALLUAUD C., 1908. – Note sur les Coléoptères trouvés dans les momies d'Egypte. *Bulletin de la Société entomologique d'Egypte* I: 29-36.

ANDELKOVIC B., ANDUS L. & STANKOVIC S., 1997. – The entomological and bacteriological analyses of the Belgrade mummy. *Journal of the Serbian Archaeological Society* 13: 379-384.

ASENSI AMORÓS V. & VOZENIN-SERRA C., 1998. – New evidence for the use of cedar sawdust for embalming by ancient Egyptians. *Journal of Egyptian archaeology* 84: 228-231.

ATTIA R. & KAMEL A. H., 1965. – The fauna of stored products in U.A.R. *Bulletin de la Société entomologique d'Egypte* 49: 221-232.

BARGUET P., 1967. – *Le Livre des Morts des Anciens Egyptiens*. (Collection "Littératures anciennes du Proche Orient" Vol. 1), Editions du Cerf, Paris: 307 pp.

BELLUSSI A., 1933. – Considerazioni tanatologiche e indagini entomologiche dirette all'accertamento dell'epoca della morte di quattro persone decedute nel deserto. *Zacchia* (11 & 12): 59-74.

BENECKE M., 1998. – Six forensic entomology cases: description and commentary. *Journal of Forensic Science* 43(4): 797-805.

BORNEMISSZA G. F. 1957. – An analysis of Arthropod succession in carrion and the effect of its decomposition on the soil fauna. *Australian Journal of Zoology* 5: 1-12.

BRAACK L. E. O., 1987. – Community dynamics of carrion-attendant arthropods in tropical African Woodland. *Oecologia* 72: 33-49.

BYRD J. H. & CASTNER J. L., 2001. – Insects of forensic importance: 43-79. *In*: Byrd J.H. & Castner J.L.(eds), *Forensic Entomology, the Utility of Arthropods in Legal Investigations*. CRC Press, Boca Raton, Florida: 418 p.

CAMBEFORT Y., 1987. – Le scarabée dans l'Egypte ancienne. Origine et signification du symbole. *Revue de l'Histoire des Religions* cciv(1): 3-46.

CHADDICK P. R. & LEEK F. F., 1972. – Further specimens of stored products insects found in ancient Egyptian tombs. *Journal of Stored Product Research* 8: 83–86.

CHERRY R. H., 1985. – Insects as Sacred Symbols in Ancient Egypt. *Bulletin of the Entomological Society of America* 31: 14-16.

CORPORAAL, J. B. 1950. – Cleridae. *In*: Hinks, W. D. (Ed.): *Coleopterum Catalogus Supplementa*, pars 23 (edito secunda). W. Junk's-Gravenhage: 373 p.

CURRY A., 1979. – The insects associated with the Manchester mummies. *In*: A. R. David (ed.), *The Manchester Mummy Project (Multidisciplinary Research on Ancient Egyptian Mummified remains)*. Manchester University Press, Manchester: 113-118.

DAVID R., 1978. – The fauna. *In*: R. David, (ed.), *Mysteries of the Mummies. The Story of the Manchester University Investigations*. Book Club Associates, London: 160-167.

DAVID R. & TAPP E., 1992. – *The Mummy's Tale : The scientific and medical investigation of Natsef -Amun, priest in the temple of Karnak*. Manchester University Press, Manchester: 176 p.

DERRY D. E., 1911. – Damage done to skulls and bones by termites. *Nature* 86: 245-246.

DIODORE DE SICILE – *Naissance des dieux et des hommes*. Traduction par M. Casevitz. Livre 1, Les Belles Lettres, Paris, 1991: 239 p.

ESCHER-KÜNDIG J., 1907. – Funde von Insekten in der Schädelhöhle einer Mumie. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* 11(6): 238-242.

GARNER R. C., 1986. – Insects and mummification. *In*: A. R. David (ed.): *Science in Egyptology*. Manchester University Press: 97-100.

GERISCH B., 2001. – Archäoentomologische Untersuchungen an Mumien, Grabbeigaben und Gräbern des alten Ägypten unter besonderer Berücksichtigung der Mumie Aset-iri-khet-es. *In* : *Mummy: Results of Interdisciplinary Examination of the Egyptian Mummy of Aset-iri-khet-es from the Archaeological Museum in Cracow*. H. Szymanska & K. Babraj eds. Polish Academy of Arts and Sciences: 131-166.

GRASSBERGER M., FRIEDRICH E. & REITER C., 2003. – The blowfly *Chrysomya albiceps* (Wiedemann) (Diptera: Calliphoridae) as a new forensic indicator in Central Europe. *International Journal of Legal Medicine* 117(2): 75-81.

GREENBERG B., 1991. – Flies as Forensic Indicators. *Journal of Medical Entomology* 28(5): 565-577.

GREENBERG B. & KUNICH J. C., 2002. – *Entomology and the Law. Flies as Forensic Indicators*. Cambridge University Press, Cambridge, United Kingdom: 356 p.

GUILHOU., 1994. – Rituel funéraire au Moyen Empire : L'*ouryt* et la lutte contre les insectes nécrophages. *Bulletin du cercle lyonnais d'égyptologie Victor Loret* 8: 25-34.

GUILHOU N., 2006. – La protection du cadavre dans le Livre des Morts : geste rituels et devenir de l'Être. *Egypte, Afrique & Orient* 43: 31-38.

HARRISON I. R., 1986. – Arthropod parasites associated with Egyptian mummies with special reference to 1770 (Manchester Museum). *In*: A. R. David (ed.): *Science in Egyptology*. Manchester University Press: 171-174.

HÉRODOTE. – *L'enquête*. Traduction par A. Barguet. Bibliothèque de La Pléiade, NRF, Gallimard, Paris, 1964: 1873 p.

HINTON H. E., 1945. – *A Monograph of the Beetles associated with Stored Products*. I. Trustees of the British Museum, London: 443 p.

HOPE F. W., 1834. – Footnote (p. 53-55). *In:* PETTIGREW T.J., *History of Egyptian mummies, and an account of the worship and embalming of the sacred animals by the Egyptians: with remarks on the funeral ceremonies of different nations, and observations on the mummies of the Canary islands, of the ancient Peruvians, Burman priests, &c.* Longman, Rees, Orme, Brown, Green & Longman, London: xxi + 264 p.

HOPE F. W., 1836. – Notice of several species of Insects found in the heads of egyptian mummies. *Transactions of the Royal Entomological Society of London* 1, Journal of Proceedings: XI-XIII.

HUCHET J.-B., 1995 – Insectes et momies égyptiennes. *Bulletin de la Société linnéenne de Bordeaux* 23(1): 29-39.

HUCHET J.-B., 1996 – L'Archéoentomologie funéraire : une approche originale dans l'interprétation des sépultures. *Bulletins et Mémoires de la Société d'Anthropologie de Paris* (N.S.) VIII(3-4): 289-302.

HUCHET J.-B., DEVERLY D., GUTIERREZ B. & CHAUCHAT C. (in press). – Taphonomic evidence of an human skeleton gnawed by termites in a Moche-civilisation grave at Huaca de la Luna, Peru. *International Journal of Osteoarchaeology*.

ISIDRO A., 2006. – Las momias: tipología, historia y patología. *Revista Española de Antropología Física* 26: 37-62.

KEIMER L., 1938. – Insectes de l'Egypte ancienne. [Etudes égyptologiques publiées de 1931 à 1937 dans les Annales du Service des Antiquités de l'Égypte]. Le Caire.

KRITSKY G., 1991. – Beetle Gods of Ancient Egypt. *American Entomologist* 37(2): 85-89.

KRITSKY G., 1993. – Beetle Gods, King bees & other insects of Ancient Egypt. *KMT* 4(1): 32-39.

KULSHRESTHA P. & SATPATHY D. K., 2001. – Use of beetles in forensic entomology. *Forensic Science International* 120 (1-2):15-17.

LATREILLE P. A., 1819. – Des insectes peints ou sculptés sur les monumens (sic) antiques de l'Egypte. *Mémoires du Muséum d'Histoire naturelle* (Paris) 5: 249-270.

LEEK F. F., 1969. – The problem of brain removal during embalming by the ancient Egyptians. *Journal of Egyptian Archaeology* 55: 112-116.

LEEK F. F., 1978. – *Eutropius niloticus*. *Journal of Egyptian Archaeology* 64: 121-122.

LEPESME P., 1944. – *Les Coléoptères des denrées alimentaires et des produits industriels entreposés*. – Encyclopédie entomologique XXII (série A), Lechevalier éd., Paris: 335 p.

LESNE P., 1930. – Le Dermestes des cadavres (*Dermestes frischi* Kug.) dans les tombes de l'Egypte ancienne. *Bulletin de la Société entomologique d'Egypte* (N.S) XIV: 21-24.

MACKE A. & MACKE-RIBET C., 1994. – Intérêt de l'entomologie pour préciser le déroulement de l'embaumement en Egypte ancienne ou la médecine légale au secours d'Hérodote. *Journal de médecine légale droit médical* 37(7-8): 495-503.

MARCHENKO M. I., 1985. – Characteristic of development of the fly *Chrysomya albiceps* (Wd.) (Diptera, Calliphoridae). *Entomologicheskoe Obozrenie* 64: 79-84.

MEGNIN P., 1894. – *La faune des cadavres : application de l'entomologie à la Médecine légale*. Encyclopédie Scientifique des Aide Mémoire, sous la direction scientifique de M. Léauté. G. Masson (ed.), Paris: 214 p.

MILLIN A. L., 1814. – Note sur une nouvelle espèce d'insecte du genre *Corynctes* (sic) de Fabricius, observée à Grenoble ; communiquée par M. Champollion-Figeac. *Magasin encyclopédique* 3: 41-46.

NEOLITZKY F., 1911. – Ein Dermestes aus altägyptischen Gräbern. *Deutsche Entomologische National Bibliothek* II N° 14: 111-114.

OMAR A. H., 1995. – Studies on *Chrysomyia albiceps* (Wiedemann), one of the most important carrion flies in Egypt. *Journal of the Egyptian Society of Parasitology* 25(3): 607-624.

PANAGIOTAKOPULU E., 2001. – New Records for Ancient Pests: Archaeoentomology in Egypt. *Journal of Archaeological Science* 28: 1235-1246.

RICHARDS C. S., PATERSON I. D. & VILLET M. H., 2008. – Estimating the age of immature *Chrysomya albiceps* (Diptera: Calliphoridae), correcting for temperature and geographical latitude. *International Journal of Legal Medicine*. 122(4): 271-279.

RIDDLE J. M., 1980. – A survey of ancient specimens by electron microscopy. *In*: A. & E. Cockburn (eds.): *Mummies, Disease and Ancient Cultures*. Cambridge University Press: 274-286.

SMITH K. G. V., 1986. – *A manual of forensic entomology*. Trustees of the British Museum (Natural History), London: 205 p.

STEFFAN J. R., 1982. – L'Entomofaune de la momie de Ramsès II. *Annales de la Société entomologique de France* (N.S) 18(4): 531-537.

STEFFAN J. R., 1985. – L'Entomofaune de la momie. *In*: *La Momie de Ramsès II*. Editions "Recherche sur les Civilisations", Muséum National d'Histoire Naturelle / Musée de l'Homme, Paris: 107-115.

STOREY G., 1916. – List of Egyptian insects in the collection of the Ministry of agriculture. *Technical and Scientific Service (Entomological section)*. Bulletin n°5. Ministry of Agriculture, Egypt, Cairo. Government Press: 52p.

STRONG L., 1981. – Dermestids - an embalmer's dilemma. *Antenna* 5: 136-139.

TANTAWI T. I., EL-KADY E. M., GREENBERG B. & EL-GHAFFAR H. A., 1996. – Arthropod succession on exposed rabbit carrion in Alexandria, Egypt. *Journal of Medical Entomology* 33(4): 566-580.

TAPP E., 1984. – Disease and the Manchester mummies – the pathologist's role. *In*: R. David & E. Tapp (eds), *Evidence embalmed. Modern medicine and the mummies of ancient Egypt*. Manchester: Manchester University Press: 89.

TAYLOR J. H., 1995. – *Unwrapping a Mummy: The life and death of Horemkenesi*. Egyptian Bookshelf, British Museum Press, London: 111 p.

TCHAPLA A., MÉJANELLE P., BLETON J. & GOURSAUD S., 2004. – Characterisation of embalming materials of a mummy of the Ptolemaic era. Comparison with balms from mummies of different areas. *Journal of Separation Science* 27(3): 217-234.

VALLISNIERI A., 1713. – *Nuove osservazioni, ed esperienze intorno all'ovaja scoperta ne' vermi tondi dell'uomo, e de' vitelli, con varie lettere spettanti alla storia medica, e naturale*. In Padova : nella stamperia del Seminario, appresso Gio. Manfré: 184 p.

ZUMPT F., 1965. – *Myasis in man and animals in the Old World. In*: A text book for Physicians, Veterinarians, and Zoologists. Butterworths and Co. Ltd, London: 267 p.

Համառոտ

Ամոնի տաճարի (Կարնակ) քրմերից մեկի[a] Նամենխեթ Ամոնին վերագրվող մումիան բացելուց հետո, կտավի ծալքերում, ինչպես նաև որովայնում հայտնաբերվել են մի շարք միջատների մնացորդներ: Մարդու մահից հետո, միջատների այս յուրատեսակ ուսումնասիրությունը, որը նախկինում սահմանվել է որպես Թաղումային միջատաբանություն (Huchet, 1996), կարող է անգնահատելի տեղեկություններ տալ հետմահու փուլերի մասին՝ ներառյալ զմռսելու տևողությունն ու գործընթացը: