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# New Records for Ancient Pests: Archaeoentomology in Egypt

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Recent work on material from New Kingdom and Byzantine Amarna has considerably expanded our knowledge of the insect fauna of Egypt. As well as presenting new fossil records, the paper reviews archaeoentomological work from mummies, offerings and archaeological material and attempts to highlight the necessity of fossil insect study in the archaeology of the Eastern Mediterranean. 

*Keywords:* EGYPT, INSECTS, AMARNA, MUMMIES, BYZANTINE, PHARAONIC.

## Introduction

The use of insects in the study of archaeological environments is a well established scientific technique in northern Europe (cf. Buckland & Coope, 1991), and this work has recently been extended to the Eastern Mediterranean (Panagiotakopulu, 2000). Although archaeoentomological research in Egypt has a history of over 150 years, and the identity of the sacred scarab has been a point of discussion amongst Egyptologists and others (cf. Alfieri, 1956; Huchet, 1995), there has been little detailed research. In part, this is probably more a reflection of the limited amount of taxonomic and habitat information available on species, other than the pests of stored products, than of the availability of well preserved material. A checklist of the beetle (Coleoptera) fauna of Egypt was not published until 1976 (Alfieri, 1976), and effective keys to many groups are not available, although extensive collections of the modern fauna are deposited in Cairo University and museums throughout the world. Recent research (e.g. Panagiotakopulu, 1999; Panagiotakopulu & van der Veen, 1997) has highlighted the potential of fossil faunas from archaeological sites in Egypt. The present paper reviews the available evidence for the archaeology of the Egyptian insect fauna, primarily the beetles (Coleoptera), which are the most frequent identifiable fossils. Some preliminary comment upon recent finds from deposits of *c.* 1350 BC and Byzantine date from Tell Amarna, Middle Egypt, are also included. The finds are related to their general context by reference to other records in Europe, the Near and Middle East.

## Previous Research

The use of insects in the interpretation of past environments might be said to have had its beginnings in Egypt, in a paper by the Oxford entomologist Reverend F. W. Hope on insect remains found in the gut of a mummified ibis (Hope, 1842), probably from either Saqqarah or Thebes. In fact, Hope used the past to interpret the present, employing the study of the gut contents, to contribute to an on-going discussion among ornithologists over the diet of the bird. Whilst in the absence of field observation, ornithologists had doubted that the ibis fed on insects, reptiles and amphibians because of the form of the beak, Hope showed that all these elements occurred in the gut of the mummified examples. Blair (1935) also identified beetles from the gut of a mummified ibis, adding the carabid *Calosoma* (*Campalita*) *chlorostictum* Klug to the fossil list. Hope's identification of the tenebrionids *Akis reflexa* F., *Pimelia pilosa* F. (=*Trachyderma* of Latreille) and the scarab *Scarabaeus sacer* L. was not his earliest research on the fossil insect fauna of Egypt. He had previously described three new species of beetle from mummies (Hope, 1834, 1836), the dermestids *Dermestes roei* Hope, and *D. pollinctus* Hope, and the clerid *Necrobia mumiarum* Hope. His propensity to describe new species is understandable in the context of knowledge of the fauna in the first half of the 19th century, and the species have since been synonymized with the common previously described *D. maculatus* DeG (Alluaud, 1908), *D. frischi* Kug., and *N. rufipes* Deg. (Alfieri, 1976) respectively; Mroczkowsky (1968), however, regarded *D. roei* as a valid species. The fascination with things Egyptian, consequent upon Napoleon's campaign and the reports of the scientists who accompanied him, led to the unwrapping of many mummies (cf. Pettigrew, 1834). The earliest record of beetles concerns a mummy unwrapped by Champollion (Millin, 1814, in Alluaud, 1908), which included specimens which he described as a new species, *Corynetes glabra* Champ., which Alluaud (*op. cit.*) synonymized with *N. rufipes*. In 1825, John



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Atkinson of Leeds had noted "thousands of [insect] larvae" in a mummy from Thebes presented to the City Museum, and J. S. Miller of Bristol had similarly found beetles whilst unwrapping a mummy (Miller, 1825). These were identified as *Dermestes vulpinus* (=*D. maculatus* Deg.) and *Necrobia violacea* (L.) (Atkinson, 1825). In France, Audouin (1835) had identified *Gibbium scotias* (=*G. psylloides* sensu lato) in large numbers in a pot from Thebes, and Pettigrew (1934) notes that Passalacqua had found both a buprestid and scarabaeids, which were believed to have been purposely mummified. More recently, mummification has been the explanation favoured for the large numbers of the specimens of *Prionetheca coronata* Ol. from an archaic and a late Predynastic tomb from Diospolis Parva, and from a grave in Tarkhan near the Fayum, dated to 2900 BC (Levinson & Levinson, 1996). Blair (1935) also noted the use specimens of the brightly coloured buprestid *Sterapsis squamosa* Klug to make a necklace found in a pre-Dynastic tomb at Armant in Upper Egypt.

The early work on mummies was reviewed by Alluaud (1908), who clarified the synonymy of several finds, and research in Egypt was continued by Alfieri (1931), who examined pests of stored products preserved in pots from Tutankhamun's tomb. This aspect of entomology, the history of the pests of storage, with its wide ranging biogeographic and cultural implications, was also taken up by Zacher in a series of papers (1934*a*, *b*, 1937), although he was unfortunately, like many of his predecessors, less than careful in indicating the origin of his material.

## The Carrion Fauna

Mummies, both human and animal, have provided an extensive source of stored meat products for insect attack since the time of their deposition, and it can be difficult to ascertain when the faunas entered the material. As noted by David & David (1995), the problem is highlighted by museum records of woodworm, *Anobium punctatum* (DeG), and museum beetle, *Anthrenus museorum* (L.), neither of which appear to be part of the natural fauna of Egypt (Alfieri, 1976). There are a number of contemporary indications, however, that the Ancient Egyptians were aware of the problems of insect attack. Levinson & Levinson (1985) have drawn attention to an illustration which shows a priest spearing a beetle, and it is probable that the spell in the Book of the Dead, "Begone from me, O Crooked-lips! I am Khum, Lord of Peshnu, who dispatches the words of the gods to Re, and I report affairs to their master" (*Book of going forth by day*, 36), was for the fear of beetles eating away the mummified bodies in the tombs. David (1992) has also suggested that some plants were utilized during the mummification process as insect repellents, a point explored more fully by Panagiotakopulu *et al*. (1995) in relation to crop storage.

Two species belonging to the family Cleridae have been recovered from mummies. *Necrobia rufipes* (Deg.), the red-legged ham beetle, was recovered on the Graeco-Roman mummy from Thebes published by Pettigrew (1834) and Hope (1834, 1836) during the 19th century. The species was also observed by Alluaud (1908) on the mummy of Rameses II (1224–1235 BC) (see also Steffan, 1982). The Graeco-Roman mummy 1770, unwrapped and studied as a part of the Manchester Mummy Project (David, 1978), also provided an individual of *N. rufipes* (Curry, 1979). The electronscan microscopy of PUM III (810 BC), one of the mummies in the Pennsylvania University Museum, revealed specimens of the same genus, probably *N. rufipes*, from the mummy's pelvic region (Riddle, 1980). At the present day, the species is found on dry carrion, bones, skins (Tantawi *et al*., 1996) and in mills, silos and gardens. In foodstuffs, it feeds on dead insects and other carrion (Koch, 1989). Its congener, *N. violacea* (L.) also feeds on dried skins of animals and dried fish, and may be predaceous on the larvae of dermestids in carrion (Dillon & Dillon, 1972). The earliest records of the pest are 19th century finds recovered from a Ptolemaic mummy from Thebes (Hope, 1836) and an undated mummy in the Bristol Museum (Atkinson, 1825). *N. violacea* is not recorded by Alfieri (1976) from Egypt, and unfortunately there must remain some doubt as to when these specimens entered the mummies, although the beetle does appear in England by the 10th century AD (Kenward & Hall, 1995) and must therefore be of Old World origin.

The Dermestidae include a large number of species which feed on animal debris, either dead insects or carrion. *Dermestes maculatus* Deg. is the commonest species of the genus today, imported into the United Kingdom (Peacock, 1993). *D. maculatus* is a synanthropic beetle, but not a household pest in the north, where Hinton (1945) notes that its optimum breeding temperature lies between 18 and 20°C. It is found breeding on animal products, for example, carrion, skins and bones. It was recovered from a mummy from Thebes (Pettigrew, 1836), and was described by Hope under the name *D. roei*. The most frequent insect find from mummies, however, is *D. frischii* Kug. Its larvae and adults are found on all sorts of carrion, dried fish, dried meat and skins, even silkworm cocoons, and Hinton (1945) noted it on mummies in Egypt. It is recorded in houses, storerooms, and mills, but Tantawi *et al*. (1996) note that it was abundant in carrion during the summer in Alexandria. *D. frischii* individuals and larvae had eaten away both the mummies described by Pettigrew (1836). In the head of a mummy from Thebes, Hope (1836) counted 270 "perfect specimens" and twice as many fragments. It was also recovered from the mummy of King Rameses II (Alluaud, 1908), from Pennsylvania University Museum mummy PUM II (Cockburn, Cockburn & Reyman, 1998), Lesne's (1930) mummy from Minya, dated to around AD 150–180, and from mummified animals, such as the ox (Siefert, 1987) and ibises studied by Boessneck (1988). *D. frischii*, together with its congener *D. ater* Deg., was found in the mummy of Han-Em-Kem-Esi from *c.* 1000 BC (Strong, 1981), and are similarly noted from the mummy PUM II examined in the Philadelphia Museum (Cockburn *et al.*, 1975). *D. ater* was also found from a mummy from the Predynastic (4000–3500 BC) cemetery near Naga-ed-der in Upper Egypt (Neolitzky, 1911). Attia & Kamel (1945) also record *D. carnivorus* F. on Egyptian mummies.

The origins of the now cosmopolitan synanthropic species of *Dermestes* provide interesting biogeographic problems. Several, like *D. peruvianus* Lap. are recent imports fro the New World, but, assuming the beetles did not enter the mummies recently, the Egyptian evidence indicates that the association with man-made habitat goes back to at least the Bronze Age. By the end of the 1st millennium BC, *D. ater* had appeared in tombs in both Egypt and China (Chu & Wang, 1975), and it is probable that its natural area of distribution lies across the warm temperate part of the Palaearctic. In Europe the earliest *Dermestes*, unfortunately not identifiable to the species, is from the Bronze Age town at Akrotiri on Santorini in the Aegean, dated to the middle of the second millennium BC (Panagiotakopulu & Buckland, 1991). Further north, Peacock (1993) regarded *D. lardarius* L. as native in Britain, and it is recorded from Bronze Age Runnymede, on the River Thames, near London (Robinson, 1991), but is surprisingly absent from the numerous Roman sites which have been examined, reappearing in the 10th century in Anglo-Scandinavian York (Kenward & Hall, 1995). *D. lanarius* I11., a species found in carrion in dry, sandy situations in Europe (Koch, 1989), and perhaps originally an animal of the steppe, occurred in a Late Bronze Age well at Wilsford, Wiltshire, England (Osborne, 1969); it is a rare accidental import to Britain at the present (Aitken, 1975).

An unidentified species of *Anthrenus*, a genus occasionally associated with stored products, particularly in animal materials, was found in mummified ibises from Tuna el-Gebel (Levinson & Levinson, 1985), and Leek (1978) note larvae from mummified unprovenanced specimens of the fish *Eutropius niloticus*. Larvae and adults of *Anthrenus* have been recovered from the Workmen's Village associated with the construction of the tombs of *c.* 1350 BC at Amarna. Some specimens have been identified as *A. coloratus* Reitt., presently known as a domestic pest in Egypt (Attia & Kamel, 1965). *Attagenus unicolor* (Brahm) is a very common species in Egypt, found in houses, flour mills, warehouses, granaries, dried animal matter, etc. (Attia & Kamel, 1965). It has been very frequently recovered from the Amarna material. Brendell (pers. comm.) has recently confirmed the presence of another species, *A. astacurus* Peyer., from the same site; modern records include Aswan in Upper Egypt and the Hoggar in the Central Sahara, from whence it was described by Peyerimhoff (1931). Another member of the same family, *Thorictodes heydeni* Reitt., was described, as *Thaumaphrastus karanensis*, by Blaisdell (1927) from fossil material from the Roman town site of Karanis in Egypt. *T. heydeni* is a pest on stored cereals, and can be found in cereals, pulses, fishmeal and bones (Peacock, 1993). *Thylodrias contractus* Mots. has been recorded from dry animal matter (Alfieri, 1976), and it is known to feed on animal protein. Its larvae feed on dead insects and other organic material (Peacock, 1993). Larvae of *T. contractus* were found in the mummy PUM II (Steyskal & Kingsolver, in Reyman & Peck, 1998) and in that of Rameses II (Steffan, 1982). Although the date of their entry into the corpses remains suspect, the species is also recorded from Shahr-i Sokhta in Iraq (Constantini, Tosi & Vigna-Taglionti, 1977). Several species of Dermestidae, *Attagenus* spp., *Ctesias* spp. and *T. contractrus* Motsch, have been identified from the garbage dumps at this site, from contexts dated to 2700 to 2200 BC. The above species feed on other insects and organic material, and they can be found in association with humans or in the wild (Peacock, 1993). Perhaps their abundance at early Sahr-i Sokhta points to a Near Eastern origin for the beetles.

Although not recorded from human mummies, the tenebrionid *Alphitobius diaperinus* (Panz.), the lesser mealworm beetle, is recorded from an ox mummy unwrapped in Munich (Siefert, 1987). It is an omnivorous feeder also associated with grain, flour, leather, and bones (Brendell, 1975), where it is perhaps largely predatory on other insects. Despins, Vaughan & Turner (1988) note that it is a voracious predator feeding upon larval Diptera, such as the maggots of the housefly, *Musca domestica* L., and it is likely to occur as a secondary pest in animal materials such as mummies. Its earliest fossil record comes from the Workmen's Village at Amarna, where it occurs in large numbers (Panagiotakopulu, in prep.), and it is present in the fort associated with the Roman quarry at Mons Claudianus in Egypt (Panagiotakopulu & van der Veen, 1997). By the Roman period, it had also reached Roman York (Hall & Kenward, 1990). Its congener, *A. laevigatus* F. (=*piceus* Ol. of Alfieri, 1976), also now cosmopolitan in distribution, has not been found fossil, and its description by Fabricius from a specimen collected by Sir Joseph Banks during Cook's (1770) exploration of New Zealand (Blair, 1914) suggests an Antipodean source, and a probable pathway by which it extended its distribution. The problems of when species entered a corpse are exemplified by a find of *A. diaperinus* from a mummy in Peru (Riddle & Vreeland, 1982), where the species is most unlikely to be a pre-Columbian native.

The spider beetles of the genus *Gibbium* are difficult to tell apart, and the species *G. psylloides* Cz., and *G. aequinoctiale* Boield. have been only recently routinely distinguished (Bellés & Halstead, 1985). The beetles are flightless, and have become widely distributed as a result of accidental transport by trade. *G. aequinoctiale* has a preference for human faeces in which it tunnels, and for slightly warmer temperatures than its congener, around 33°C (Constantine, 1994, 1995). In modern Middle Egypt, it has been found infesting foodstuffs (Panagiotakopulu, unpubl.). *G. psylloides* has been recorded in houses, hotels, mills and granaries infesting grain and bread, yeast, cake, cotton, a range of seeds, paprika, cayenne pepper, spices in general, hay, wool, leather (Dillon & Dillon, 1972). Although the predominant species at Amarna today is *G. aeqinoctiale*, the large number of fossil specimens from Pharaonic Amarna are *G. psylloides*. This species was also found in the mummies of the Two Brothers, which are dated to the early Middle Kingdom period and likewise came from Middle Egypt (David, 1978), and Alfieri (1931) also noted it in the Tutankhamum material. *Gibbium* sp. was one of the pests that were recovered from the Roman fort at Mons Claudianus in the Eastern Desert (Panagiotakopulu & van der Veen, 1997). Costantini, Tosi & Vigna-Taglionti (1977) also noted *G. psylloides* in deposits of *c.* 2900–2400 BC at Shahr-i Sokhta in Iraq.

Many of the dipterous records from mummies have yet to be confirmed as contemporary rather than the result of post-excavation infestation. Pettigrew (1834) observed fly puparia of at least three different species in the mummies he unwrapped. There is also an account by Passalacqua of a packet of embalmed animals mixed together, among which were flies (*idem.*). The housefly *Musca domestica* L. was recorded by the Manchester mummy project (Curry, 1979), and more recently in large numbers from secure archaeological contexts by Skidmore (pers. comm.) in samples from pharaonic Amarna. The blowfly *Chrysomyia albiceps* (Weide.) lays eggs on carrion, and its larvae feed on it. It was found infesting the mummies of the two brothers, the mummy of Asru and PUM II (David, 1978). The cheese skipper, *Piophila casei* (L.), a common pest of stored products, also occurs in the Manchester mummies (Curry, 1979).

## The grain fauna

Whilst elements of the carrion fauna might occasionally have been destructive of stored animal product foodstuffs, species associated with grain are likely to have constituted more serious problems in terms of significant losses during storage. Bulk storage of commodities in centralized granaries provides ideal conditions for the rapid proliferation of a range of pests, which can lead to total destruction of the foodstuff. Levinson & Levinson (1985, 1990, 1994) have discussed the origins of storage pests in the Egyptian context, whilst Buckland (1990) provides a more wide-ranging review of the fossil record. Archaeological evidence for measures to reduce infestation have recently been discussed by Panagiotakopulu *et al.* (1995), and Miller (1987) has suggested that ash spread around saddle querns at Amarna had insecticidal properties.

*Sitophilus granarius* (L.), the grain weevil, is a wholly synanthropic species, recorded from a wide range of stored products including wheat, rye, barley, maize, oats, buckwheat, millet, chickpeas and even chestnuts, acorns and cornmeal (Hoffman, 1954). It is usually, however, found in stored cereal crops. In contrast with its congener, *S. oryzae* (L.), it has never been found breeding in the field. Despite the fact that it is flightless, it has become cosmopolitan, and one of the most important pests of stored grain around the world, able to overwinter in unheated granaries and therefore easily adjusting to colder climates, such as those of Northern Europe. Both Zacher (1938) and Howe (1965) have suggested that acorns might have been the primary host of the weevil, but it is more likely that *S. granarius* moved from the nests of rodents to the stores of Man, even before the beginnings of settled agriculture (Buckland, 1981). In Egypt, Solomon (1965) records grain weevil from barley deposited in a tomb beneath the Step Pyramid of Saqqarah about 2300 BC, and Helbaek (in Solomon, 1965) notes further specimens of *Sitophilus* 600 years older from another tomb in Saqqarah. Chaddick & Leek (1972) provide a record from the 6th Dynasty (*c.* 2323–2150 BC) tomb of Queen Ichetis at the same site. The earliest evidence of *S. granarius* comes from a site at Neolithic Servia in Macedonia (Hubbard, 1979: 227), where casts of the insect are imprinted in a piece of pottery. *S. granarius* is also known from Middle Bronze Age Crete (Jones, 1984), and the Late Bronze Age settlement of Akrotiri (Panagiotakopulu & Buckland, 1991). The earliest record from Western Europe has recently come from Early Neolithic Germany, 5000–4000 BC (Büchner & Wolf, 1997).

One of the most important pests today is the saw-toothed grain beetle, *Oryzaephilus surinamensis* L. This is a secondary pest, typically feeding on grain already attacked by primary pests, especially the grain weevil, and the two species often occur together in fossil assemblages. In present day Egypt, Attia & Kamel (1965) note it from open *shounas*, malt stores, rice mills, grain bins, and on dried fruits and many other preserved products. It is also found in warehouses, mills, farmhouses with granaries, and brewery silos (Zacher, 1927). The adults may be carnivorous, living on the young larvae and caterpillars of other pests in the grain and sometimes they will even consume their own species. The beetle is able to overwinter in unheated stores in NW Europe (Solomon & Adamson, 1955), but it cannot complete its development at temperatures below 18°C, and does not thrive below 22°C (Howe, 1965). According to Hunter *et al.* (1973), its primary natural habitat is under loose bark, and like most of the pests of stored products, it has been distributed around the world through trade. The earliest fossil record comes from Neolithic Mandalo in Macedonia (Valamoti & Buckland, 1995). Material from Late Bronze Age Akrotiri on Santorini could only be identified to the generic level (Panagiotakopulu & Buckland, 1991). *O. surinamensis* is widespread in Roman deposits in the western part of the Empire (Buckland, 1981; Pals & Hakbijl, 1992; Yvinec, 1997), but the situation in Egypt is less clear. Zacher (1934*a*, *b*) records the species from an unlocalized "Minoan period" vessel of *c.* 1350 BC, and material from the Roman quarry site at Mons Claudianus could only be identified as *Oryzaephilus* sp. (Panagiotakopulu & van der Veen, 1997).

The Mediterranean flat grain beetle, *Cryptolestes turcicus* (Grouv.) is largely associated with processed stored products. It is found in rice, grain, dried fruits (Attia & Kamel, 1965), in flour mills (Hill, 1994), in meal and baked products (Koch, 1989). It appears more to be a pest of processed foods than whole grains. Alfieri (1976) has also observed it under the bark of fig branches, and it may be native to Egypt. It has been recovered from Roman Mons Claudianus (Panagiotakopulu & van der Veen, 1997), whilst its larvae have been identified from Pharaonic Amarna. There is also a record from the small Roman town of Towcester in Northamptonshire, England (Girling, 1983).

The bostrychid *Rhyzopertha dominica* (F.), the lesser grain borer, is associated with stored grain in warmer countries (Munro, 1966), and is also known from a range of seeds and foodstuffs (Hickin, 1968). It is one of the most common pests, and although very small, it can cause great damage. Although it was first described from South America (Munro, 1966), it must have originated in the Old World, perhaps India (Kislev, 1991). It has been recorded in botanical remains from the Egyptian site of Kahun, dated to 1900–1800 BC (Panagiotakopulu, 1998), from offerings in Tutankhamun's tomb (1345 BC) examined by Alfieri (1931), and also from Roman Mons Claudianus (Panagiotakopulu & van der Veen, 1997). Material studied from the Workmen's village at Amarna also produced *R. dominica*, and it is also present in samples from the Byzantine monastic site at Kom el-Nana at Amarna.

The origins of the khapra beetle, *Trogoderma granarium* Everts., are obscure. This small dermestid is a serious pest of stored grain throughout Egypt (Attia & Kamel, 1965), and is well adapted to hot, dry conditions (Hill, 1994). Zacher (1934*a*) suggested that the species was a recent introduction to Egypt with Hindi wheat, and Munro (1966) also thought that it had originated in India. Its presence in material from Byzantine Kom el-Nana is therefore particularly interesting. As one other species, *T. irroratum* Reitt. has been described from Egypt, along with subspecies of both *T. granarium* and *T. versicolor* (Creutz.) (Alfieri, 1976), it is possible that the khapra beetle is native to Egypt, or that it was introduced during the Roman period as a result of the Red Sea trade; only further extensive studies of older fossil assemblages will clarify this picture.

The biscuit beetle, *Stegobium paniceum* L., is a pest on a variety of farinaceous foods (Buck, 1958), but also in other foodstuffs and drugs, spices, tobacco, and insect and plant collections (Koch, 1989). It is very cold-hardy and has been found in abundance in pigeon's nests in Britain (Solomon & Adamson, 1955). There are Bronze Age records from England (Osborne, 1969; Robinson, 1991), and the species probably had a wide natural distribution in the Western Palaearctic. In Egypt, the earliest record is in material from Kahun in the Fayum, *c.* 1900–1800 BC (Panagiotakopulu, 1998), and it also occurs in offerings in the tomb of Tutankhamun (Alfieri, 1931), and in the tomb of Kha at Deir el Medina of *c.* 1400 BC (Levinson & Levinson, 1994). Another anobiid, the cigarette or tobacco beetle, *Lasioderma serricorne* (F.), is a pest of tobacco, leather, dried vegetable material (Attia & Kamel, 1965), cayenne pepper, coriander, caraway, dried figs, and yeast (Dillon & Dillon, 1972). Hill (1994) notes that it requires ambient temperatures of at least 19°C and 30% relative humidity in order to complete its development, suggesting an origin in warm temperate to tropical latitudes. It was found in a vessel from Tutankhamun's tomb (Alfieri, 1931). Steffan (1982) records the species also from the mummy of Rameses II. The occurrence of *L. serricorne*, however, at Late Bronze Age Akrotiri (Panagiotakopulu, 2000), Santorini, and in the Amarna material argues that *L. serricorne* was part of the pest fauna of the period, and points to a Near Eastern rather than New World origin.

Amongst the tenebrionids, the flour beetles form a significant group of pests. *Tribolium castaneum* (Hbst.) is found in the wild in India, where it is believed to have originated (Hinton, 1948), although it is now cosmopolitan. It is unable to survive cold temperatures, and so outside the tropics it is largely restricted to heated buildings (Brendell, 1975), although occasionally occurring under bark (e.g. Whitehead, 1999). It is a secondary pest of grain and an important pest on processed cereal products. Other members of the same genus, *T. confusum* and *T. madens* are thought to be of African origin. As *T. confusum* (for a long time confused with *T. castaneum*, hence its name) is cold-hardy, it is a far more important pest worldwide than its congener. Alfieri (in Andres, 1931) recorded *Tribolium* sp. from an Egyptian tomb of the mid 3rd millennium BC, but it is uncertain whether the species was *T. castaneum* or *confusum*, although he later (1976) notes the latter species from an unprovenanced offering in a pot dated to *c.* 1000 BC. *T. castaneum* is recorded from Egypt 500 years earlier (Zacher, 1937). It is also recorded from a pithos that contained flour in the Delta building at Akrotiri on Santorini (Panagiotakopulu, 2000), and it has recently been confirmed at Pharaonic Amarna, where *T. confusum*

*Table 1. Insect records from Pre-Dynastic-Byzantine Egypt*

| Taxon | Amarna New Kingdom | Amarna Byzantine | ManMM | Mummies | Animal mummies | Offering | Archeol. material |
|---|---|---|---|---|---|---|---|
| Anoplura | | | | | | | |
| *Pediculus humanus capitis* DeG. | | | 1198 | ha, hb | | | |
| Dictyoptera | | | | | | | |
| Blattoidea | | | | | | | |
| *Blatta orientalis* L. | | | 1767 | | | | |
| Orthoptera | | | | | | | |
| Acridoidea indet. | | | | | | | MC |
| Hemiptera | | | | | | | |
| Cimicidae | | | | | | | |
| *Cimex lectularius* L. | + | | | | | | |
| Coleoptera | | | | | | | |
| Carabidae | | | | | | | |
| *Calosoma chlorostictum* Klug | | | | | I | | |
| Cleridae | | | | | | | |
| *Necrobia violacea* (L.) | | | | 1c (Ptolem.), 5b | | | |
| *N. rufipes* (DeG.) | + | | 1770 | 1a, 1b, 1c (Graec.), 2, 3, 4, 5, 8 | | | |
| Buprestidae | | | | | | | |
| *Steraspis squamosa* Klug | | | | | | A | |
| Dermestidae | | | | | | | |
| *Dermestes maculatus* DeG. | | | | 1a, 5 | | | |
| *D. frischii* Kug. | + | | | 1a, 1c, 3, 6, 7, 9 | II, III | | |
| *D. carnivorus* F. | | | | 10 | | | |
| *D. ater* DeG. | | | | 9, 11 | | | |
| *Attagenus unicolor* (Brahm) | + | | | | | | |
| *A.* (*Telopes*) *astacurus* Peyer. | + | | | | | | |
| *Trogoderma granarium* Everts | | + | | | | | |
| *Anthrenus* (*Anthrenops*) *coloratus* Reitter | + | | | | | | |
| *Anthrenus* sp. | + | | | | IV, V | | MC |
| *Thylodrias contractus* Mots. | | | | 2, 4 | | | |
| *Thorictodes heydeni* Reitt. | | | | | | | K |
| Cucujidae | | | | | | | |
| *Oryzaephilus surinamensis* L. | | | | | | T2 | |
| *Oryzaephilus* sp. | | | | | | | |
| *Cryptolestes turcicus* (Grouv.) | + | | | | | | MC |
| Bostrychidae | | | | | | | |
| *Rhizopertha dominica* (F.) | + | | | | | KXII, T1 | MC |
| Anobiidae | | | | | | | |
| *Stegobium paniceum* (L.) | + | + | | | P | B, Kha, T1 | |
| *Lasioderma serricorne* (F.) | + | | | | | T1 | |
| Ptinidae | | | | | | | |
| *Gibbium psylloides* (Czen.) | + | + | | | | T1 | |
| *Gibbium* sp. | 21,470, 21,471 | | | P | MC | | |
| Tenebrionidae | | | | | | | |
| *Zophosis* cf. *carinata* Sol. | + | | | | | | |
| *Akis reflexa* F. | | | | | | | |
| *Akis* sp. | + | | | | | | |
| *Mesostenopa* sp. | | | 21,470, 21,471 | | | | |
| *Prionotheca coronata* Ol. | + | | | | | M | |
| *Trachyderma hispida* (Forskal) | + | | | | | M | |
| *Trachyderma* sp. | | | | | | Ab | |
| *Pimelia angulata* Fairm. | | | | | | Ab | |
| *Pimelia* sp. | | | | | | | |
| *Palorus subdepressus* (Woll.) | + | | | | | | |
| *P. ratzeburgi* (Wiss.) | + | | | | | | |
| *Tribolium castaneum* (Hbst.) | + | + | | | | | MC |
| *T. confusum* Jacq. | | | | | | | |
| *Tribolium* sp. | | | | | | | |
| *Alphitobius diaperinus* (Panz.) | + | + | | | II | | MC |
| *Latheticus oryzae* Water. | + | | | | | | |
| Scarabaeidae | | | | | | | |
| *Scarabaeus sacer* L. | | | | | | | |

*Table 1. continued*

| Taxon | Amarna New Kingdom | Amarna Byzantine | ManMM | Mummies | Animal mummies | Offering | Archeol. material |
|---|---|---|---|---|---|---|---|
| *Heliocopris isidis* Latr. | + | | | | | | |
| *Aphodius* sp. | + | + | | | | | |
| Bruchidae | | | | | | | |
| *Bruchidius* sp. | | | | | | KXII | |
| *Bruchus*/*Bruchidius* sp. | + | + | | | | | MC |
| *Callosobruchus* sp. | | + | | | | | |
| Curculionidae | | | | | | | |
| *Sitophilus granarius* (L.) | + | + | | | | S, SI | MC |
| Siphonaptera | | | | | | | |
| Pulicidae | | | | | | | |
| *Pulex irritans* L. | + | | | | | | |
| Diptera | | | | | | | |
| Muscidae | | | | | | | |
| *Musca domestrica* L. | + | | 1770 | | | | |
| Calliphoridae | | | | | | | |
| *Chrysomyia albiceps* (Wiedem.) | | | 21,470, 21,471, 1777 | 6 | | | |
| Piophilidae | | | | | | | |
| *Piophila casei* (L.) | | | 1770 | 6 | | | |
| Hymenoptera | | | | | | | |
| Braconidae | | | | | | B | |
| *Bracon hebetor* L. | | | | | | | |
| Chalcidoidea | | | | | | | |
| *Sycophaga sycomori* (L.) | | | | | | F | |

*Key*
**Mummies**
(on the hair) ha. Predynastic Abydos (Fletcher, 1995) hb. Predynastic Hierankopolis (Fletcher, 1998).
1a Graeco-Roman/Ptolemaic/unprovenanced mummies from Thebes: Pettigrew (1834); 1b Hope (1834); 1c Hope (1836).
2 Pum III, 810 BC (Riddle, 1982).
3 Ramesis II (Alluaud, 1908).
4 Ramesis II (Stefan, 1982).
5a Bristol mummy (Miller, 1825); 5b (Atkinson, 1825).
6 Pum II, unwrapped in Detroit, 170 BC (Cockburn *et al.*, 1975).
7 Minya mummy 150–180 AD (Lesne, 1930).
8 Champollion mummy (Millin, 1814 in Alluaud, 1908).
9 Han-Em-Kem-Esi 1000 BC (Strong, 1981).
10 mummies (Attia & Kamel, 1945).
11 Predynastic cemetery near Naga-ed-der, Upper Egypt (Neolitzky, 1911).
**Manchester Mummy Project**
•1770 Graeco-Roman (332 BC–642 AD).
•Two Brothers, 21,470, 21,471, Early Middle Kingdom.
•1777, Asru from Luxor, Third Intermediate Period (1069–525 BC).
•1767 Graeco-Roman.
all in David (1978), Curry (1979).
1198 Early Dynastic (Fletcher, 2000).
**Animal mummies**
I ibis (Blair, 1935).
II ox (Siefert, 1987).
III ibises (Boessneck, 1988).
IV ibises, Tuna el Gebel (Levinson & Levinson, 1985).
V fish (*Eutropius niloticus*) (Leek, 1978).
*Offerings*
A Predynastic Armant (Blair, 1935).
P New Kingdom pot Thebes (1550–1050 BC) (Audouin, 1835).
B bread of 2049 and 1399 BC (Chaddick & Leek, 1972).
S 2300/2900 BC deposits from two Saqqarah tombs (Solomon, 1965).
SI VIth Dynasty Queen Ichetis tomb, Saqqarah (Chaddick & Leek, 1972).
T1 pots from Tut'ankhamun's tomb (Alfieri, 1931); T2 (Zacher, 1934).
M from Archaic/Predynastic Diospolis Parva 2900 BC Tarkham (Levinson & Levinson, 1996).
K Roman Karanis (Blaisdell, 1927).
K XII Kahun XII Dynasty 1900–1800 BC (Panagiotakopulu, 1998).
Kha tomb of Kha 1400 BC (Levinson & Levinson, 1994).
TT bruchid infestation in pulses from Tut'ankhamun's tomb (Vartavan, 1990).
F fig offerings in a XII Dynasty tomb 1963–1786 BC (Galil, 1967).
B offerings of 1399 BC (Chaddick & Leek, 1972).
Ab Old Kingdom tomb at Abydos (Schluter & Breyer, 1985).
**Archaeological material**
MC Mons Claudianus (Panagiotakopulu & Van der Veen, 1997).

was also present (Table 1). It also occurs in samples from the Roman fort at Mons Claudianus in Egypt (Panagiotakopulu & van der Veen, 1997). *T. castaneum* was found at the 4th century Roman villa at Droitwich, Worcestershire, England, together with *O. surinamensis* and *C. ferrugineus* (Osborne, 1977), and it also occurs in a late Roman well in York (Hall, Kenward & Williams, 1980) and in a similarly dated well at Chichester in southern England (Girling, 1989). The recovery of *T. confusum* and *Cryptolestes turcicus* from a 4th century well at Towcester in England (Girling, 1983) could imply the import of foodstuffs from the Mediterranean region, and although the plant macrofossil record contains nothing exotic, processed foods are unlikely to have survived. Identification of *Tribolium* to the generic level extend the record in Egypt back to the VI Dynasty (*c.* 2323–2150 BC) (Andres, 1931).

*Palorus ratzeburgi* (Wiss.) the small-eyed flour beetle, has been found in mills and granaries, in wheat, barley and flour (Attia & Kamel, 1965). It has also been recorded infesting mouldy grain that had been previously attacked by *Sitophilus granarius* (Brendell, 1975), where it feeds on the faeces of *Sitophilus granarius*, but can be a predator on other pests (Pals & Hakbjil, 1992). The species was found in pig coprolites from the Workmen's Village at Amarna (Panagiotakopulu, 1999), and the fossil record shows that it was transported by the Romans around Europe; *P. ratzeburgi* occurs in 2nd century AD Amiens (Yvinec, 1997), a 2nd century shipwreck at Laurium in Holland (Pals & Hakbjil, 1992), and in Roman York (Kenward & Williams, 1979), Carlisle (Kenward, 1990), and London (de Moulins, 1990). Its congener, *P. subdepressus* Woll. is recorded in cereal stores and grain debris in Egypt at the present day (Alfieri, 1976). Its habitat requirements are similar to those of *P. ratzeburgi*, and although now almost cosmopolitan, it is not established in Britain (Brendell, 1975). It was found in samples from Pharaonic Amarna, whilst it is also recorded from a Roman pit of the 2nd century AD at Alcester, Warwickshire in England (Osborne, 1971).

*Latheticus oryzae* Water., the long headed flour beetle, needs high temperatures to survive, and is found frequently in stores and ships as an import, together with cereals and their byproducts (Brendell, 1975). In warm countries, such as Egypt it can be found in granaries, mills, grain stores, open *shounas*, etc. (Attia & Kamel, 1965). Originally described from material from Calcutta and Arabia (Waterhouse, 1880), the beetle's earliest record comes from Pharaonic el Amarna.

The apparent absence of another tenebrionid pest, the mealworm beetles, *Tenebrio* spp. from Pharaonic deposits is perhaps an indication of a non-African point of origin, although *Tenebrio* sp. appears at Roman Mons Claudianus in Egypt (Panagiotakopulu & van der Veen, 1997). Both *T. molitor* L. and *T. obscurus* F. are recorded from present-day Egypt (Attia & Kamel, 1965), and the former appears in the Bronze Age at Troy in Turkey (Panagiotakopulu, 2000); all fossil records from the British Isles, however, are of the latter, implying a recent spread from the Mediterranean region.

The colydiid *Aglenus brunneus* (Gyll.) is a flightless blind insect which probably originally lived under leaf litter in the forest. It is now a cosmopolitan, if rare, pest, and has been recorded in cellars, stables and tan pits, under manure in greenhouses, under mouldy straw, among sacks of old bones, in haystacks, cowsheds, and in corn mill refuse; in California, it has also been found destroying mushrooms in commercial beds (Hinton, 1945). The beetle can also be found in very old grain residues (Woodroffe, 1967), and now appears to be totally dependent upon Man for its distribution. Its British archaeological record has been discussed by Kenward (1975, 1976), and its existence in archaeological contexts should imply human activities and trade. In Egypt, it is recorded from the fort at the Roman quarry at Mons Claudianus (Panagiotakopulu & van der Veen, 1997). In Britain, a record from Neolithic deposits at the Sweet Track in Somerset (Girling, 1984) is probably from its primary natural habitat, forest litter, but finds from Iron Age Farmoor, Oxfordshire (Robinson, 1979), Roman York (Kenward & Williams, 1979; Hall, Kenward & Williams, 1980), and later sites (Kenward, 1975, 1976) are likely to be anthropochorous, and the Mons Claudianus record may reflect an introduction via stored products ultimately from Europe.

### *The seed beetles*

Most members of the family Bruchidae infest the seeds of legumes in the field. The eggs are laid on the young legume seed pods and the larvae bore into the developing seeds. The life cycle is completed in the seed and adults emerge by biting their way out. In some species, several larvae may feed on one seed (Southgate, 1978). The adults fly readily and are commonly found sitting on flowers and in legumes in springtime. Bruchids infesting peas, *Pisum sativum*, were recorded in a site from the Ukraine, dated to 3500 BC (Pashkevich in Kislev, 1991: 132), and bruchid infestation is also mentioned in the report on the Early Neolithic site at Belverde in Italy (Oliva, 1939). Bruchid larvae, not identifiable to the species level, have been found in deposits from Troy dated to 2000 BC (Panagiotakopulu, 2000). *Bruchus rufimanis* Bohe. is present from the Iron Age at least in Britain (Caseldine, 1987), and *B. rufipes* was found infesting bitter vetch, *Lathyrus clymenum*, at Late Bronze Age Akrotiri, Santorini (Panagiotakopulu & Buckland, 1991). *Bruchus* sp. was recorded infesting *Vicia ervilia* from 12th century BC Tiryns, Greece (Kroll, 1982), and *Bruchidius* sp. was found infesting *Acacia* sp. seeds, dated to 1900–1800 BC from Kahun in Egypt (Panagiotakopulu, 1998). Bruchids were noted infesting pulses from Tutankhamun's tomb (Vartavan, 1990), and also from Pharaonic Amarna. An undescribed species occurred in lentils, *Lens culinaris*, from an Egyptian deposit of 215 ± 48 BC (Burleigh & Southgate, 1975). Bruchids were also found infesting *Vicia ervilia* seeds from an 11th century BC site at Dan in Israel (Kislev, 1991: 132).

Whilst *Bruchus rufipes* is the most common Bruchid field pest in Continental Europe and the Mediterranean region (Harde, 1984), several other species occur in Byzantine material from Kom el-Nana in Middle Egypt, and others are known as fossils from Britain, including both *Bruchus atomarius* (L.) and *B. loti* Payk. from Neolithic Runnymede in the Thames valley (Robinson, 1991). They are as likely to have been part of the natural fauna as to have been imported with seed for crops. The genus *Callosobruchus* is represented by a single head from Byzantine Kom el-Nana in Egypt (Table 1).

Whilst not strictly a seed beetle, the scolytid *Coccotrypes dactyliperda* F. infests the stones of dates, which it may cause to fall prematurely (Hill, 1994). Fossil material from Egypt was recovered from inside a doum palm, *Hyphaena thebaica* (L.) Mart., stone from Graeco-Roman Berenice on the Red Sea Coast (Panagiotakopulu, unpubl.), and the date, *Phoenix dactylifera* L., stones figured by Farmy (1998) from Pre-Dynastic Hierakonpolis clearly show the characteristic axial flight holes of this beetle. Kislev (1992) also includes a record of this species from Roman deposits of AD 135 in a cave near Jericho in Israel.

## Other insects

The evidence of other groups of insect pests from archaeological contexts in Egypt is slight. The earliest record of the cockroach, *Blatta orientalis* L. comes from the Graeco-Roman Manchester mummy 1767, an ootheca (egg case) firmly attached to the bandages (David, 1978), and Kenward (in Dodney *et al*., 1998) has also noted the species in 4th century Lincoln. Chaddick & Leek's (1972) sample from an offering of 1399 BC includes a parasite of either stored product Lepidoptera or Coleoptera, the braconid wasp *Bracon hebetor*. Panagiotakopulu records fragments of locust from Roman Mons Claudianus (Panagiotakopulu & van der Veen, 1997), and Galil (1967) has noted the sycomore gall wasp, *Sycophaga sycomori* in figs in offerings in a 12th Dynasty (1963–1786 BC) tomb.

## Insect parasites

Ectoparasites of humans should also be considered with insect pests. Panagiotakopulu & Buckland (1990) have recently discussed the history of the bed bug, *Cimex lectularius* L., as a result of finds from Amarna, and they also refer to human flea, *Pulex irritans* L. from the same site. The records of head lice, *Pediculus humanus capitis* DeG. have a long history, their eggs, nits, being first noted by Ruffer (1914) on the heads of mummies in the Cairo Museum. Fletcher (1994, 1998) has taken the record back over 5000 years, to the Pre-Dynastic with material from Abydos and Hierakonpolis, and has also noted their presence in the Early Dynastic mummy 1198 in Manchester Museum (Fletcher, 2000). The oldest find is from neighbouring Israel, in the Nahal Hemar Cave (*c*. 6900–6300 BC) (Zias & Mumcuoglu, 1991).

## The fauna of the desert

Tenebrionid beetles are not uncommon finds in tombs. Levinson & Levinson (1996) noted significant numbers of the large tenebrionid *Prionotheca coronata* Ol. in the Petrie Collection in London from Diospolis Parva (*c*. 4000–3200 BC) and Tarkhan (*c*. 2900), and were of the opinion that these represented cult animals, which had been embalmed by removing the mouth parts and the terminal segment of the abdomen. It seems more likely, however, that the loss of mouth parts and terminal segments reflects the activities of other scavenging arthropods, rather than human activity. Similar large assemblages of another, smaller species, *Zophosis* cf. *carinata* Sol., in one case in excess of 400 individuals, from the Workmen's Village at Amarna, suggest a more prosaic explanation than ritual. Both species are fossorial, burrowing through the loose sand and would tend to become trapped in any pitfalls. These are provided by open pottery vessels in graves, and over time, large numbers may accumulate in vessels or similar cavities. An assemblage of *Zophosis* sp. contained within a Ptolemaic pot from Saqqarah is preserved in the Fitzwilliam Museum, Cambridge. Blair (1935) noted the common desert tenebrionid *Trachyderma hispida* (Forsk.) from a pre-Dynastic tomb at Armant in Upper Egypt and Schluter and Dreyer (1985) record both a *Trachyderma* sp. and *Pimelia angulata* Fairm. from an Old Kingdom tomb at Abydos. The different species at these sites must reflect habitat differences between the sites, but insufficient is known about these to provide more detailed explanation. Specimens of the tenebrionid *Mesostenopa* sp. were recovered from the Middle Kingdom mummies of the two brothers during the Manchester Museum Mummy project (David, 1978). The genus is a typical desert scavenger, which may have entered the mummies at a later stage.

## Conclusion

Outside stored products, in its widest sense, there has been little research on insect assemblages from archaeological sites in Egypt. The material from the Workmen's Village at Pharaonic Amarna hints at some of the possibilities (cf. Panagiotakopulu, 1999). With the common desert tenebrionids *Trachyderma hispida* and *Zophosis* cf. *carinata* Sol., several dung beetles, including the large scarabaeid *Heliocopris isidis* Latr., occur, as well as a range of weevils associated with Fabiaceae. The latter may reflect animal fodder, or garden cropping on this now wholly arid site, and hint at a greater availability of water in the past, either by laborious human transport or careful conservation of a limited resource. At Byzantine Kom el-Nana, much closer to the Nile yet now also wholly devoid of vegetation cover, this pattern is even more marked, with much more diverse faunas and a few water beetles, perhaps implying irrigation.

Whilst archaeoentomological research in Egypt has been restricted by the paucity of habitat data for many species, the potential exists for detailed reconstructions of past human environments on the scale of those attempted in northern Europe (cf. Kenward & Hall, 1995). The history of pests of stored products and their spread around the world is nothing less than a record of cultural change and trade activities; with a fair record of pests, one perhaps should be able to pinpoint original pabula and routes of expansion, and in parallel to roughly map human movement. Much more research will be required throughout the Mediterranean zone before a more detailed picture emerges.

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