Environment, Insects and the Archaeology Of Egypt*

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Introduction

Egypt lies in the overlap zone between two biogeographic realms, the Ethiopian (Afrotropical), which also includes the southern part of the Arabian Peninsula, and the Palaeartic, represented by the warm temperate zone of the Mediterranean. Apparent in its now much depleted vertebrate fauna (cf. Manlius 2000; Manlius and Gautier 1999) and in its flora, where Mediterranean elements extend down into Middle Egypt (Zahran and Willis 1992), the overlap is also evident in its less well-studied insect faunas. Intuitively the Nile provides a natural pathway for African elements to reach the Mediterranean and this would have been more so during the early Holocene when stronger monsoonal circulation made much of the present desert savannah (e.g. Haynes et al. 1989). Yet there are surprisingly few southern species in Egypt’s invertebrate fauna, which is overwhelmingly circum-Mediterranean in its affinities. Egypt has approximately 2,700 recorded species of beetle (Coleoptera). Using the ground beetles, Carabidae, as an example, of the ~200 species recorded from Egypt, ~95% are also found in Europe and the Near East, and a similar calculation for the water beetle families Dytiscidae and Haliplidae shows ~42 species of which 64% also occur in Europe. The scale of this overlap declines as distance from the Mediterranean coast increases, but Upper Egypt still shows affinities with the Palaeartic as well as the Ethiopian Realm. Two major factors influence this pattern. One is the complex history of the Nile and its floodplain, with periods during the Quaternary when its flow appears to have failed completely (Said 1993; Butzer 1998). The other is the scale of destruction and redistribution of biota by human activity.

No part of the Egyptian landscape can be viewed as ‘natural’ at the present day. The scale of manipulation has accelerated in parallel with the country’s increasing population, and it is doubtful whether anything approaching the ‘natural’ has existed since at the latest the Roman period. Whilst increasing mid-Holocene aridity may have created the desert, its present form is essentially capri-/ovigenic, and none of the neatly partitioned and irrigated floodplain has escaped weeding, fertilising or more recently the application of insecticides. Such impacts, from grazing pressure to storage loss and disease can potentially be traced in changes in the insect fauna, and the frequent survival of fossil assemblages in archaeological contexts as a result of desiccation provides one source of this information. What are

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lacking are long continuous sequences from the floodplain and Delta, without which we have little idea of the nature of the riverine landscape at the beginning of settled agriculture. It is unclear whether wet, impenetrable African gallery forest extended as a finger down to the Mediterranean forest zone preceding early settlement. Perhaps natural grazing pressure, largely by elephant and hippopotamus, was sufficient to provide those clearings into which early farmers could move, as aridity, and perhaps pastoralists, drove them off the savannah. This has some bearing on Barry Kemp’s model (1989, fig. 7) of the early development of urbanization in the Nile valley, where his phase I can be preceded by a landscape of either forested or partly open floodplain. The debate over the nature of the pre-clearance landscape is an aspect currently under review in Europe consequent upon Frans Vera’s recent re-evaluation (2002; cf. also. Hodder et al. 2005) of the palaeoecological record, but mid-Holocene Egypt needs a similar discussion, once there is sufficient evidence.

To the east across Sinai, the Holocene pattern of forest and steppe is apparent from work in Jordan and Israel (cf. Hunt et al. 2004; Robinson et al. 2006). Southwards Lake Edward in Uganda (Beuning et al. 1997) has yielded a history of flow in the White Nile. However throughout Egypt, despite the potential of the continually aggrading floodplain and delta of the river, before the construction of the Aswan High Dam, no long cores have been recovered and studied for their palaeoecological record.

The record of fossil insects from archaeological sites in Egypt has recently been reviewed (Panagiotakopulu 2001a), and Levinson and Levinson (1994) have also considered the insect pests of stored products. Whilst this paper covers some of the same ground for a different audience, it is also intended to point out directions in which future research might move.

Archaeoentomology in Egypt

The involvement of scientific method in archaeology might be said to have had its origins in Egyptology, in the early nineteenth century vogue for the public display of unwrapping of mummies (e.g. Pettigrew 1834). Both John Atkinson (1825) and Frederick Hope (1834) reported the red-legged ham beetle, *Necrobia rufipes* (Deg.) (= *N. mumiaria* Hope), from mummies, and Hope added two species of bacon beetle, *Dermestes maculatus* Deg. (= *D. roei* Hope and *D. elongatus* Hope) and *D. frischii* Kug. (= *D. pollinatus* Hope) from the head of a mummy from Thebes, brought to England by Wilkinson. His description of the specimens as new species reflects the current state of taxonomy in the early nineteenth century as zoologists got to grips with the naming of species. Hope (1842) took the study a stage further in his examination of insects from the gut of a mumified sacred ibis, *Threskiornis aethiopicus*, a species last seen in Egypt in 1891 (Houlihan 1996), but present by the tens of thousand in the animal necropolis at Tuna el-Gebel, where his specimen probably came from (Kemp, pers. comm.). Armchair ornithologists had decided that the shape of the beak precluded the bird feeding on insects, yet Hope’s dissection found the sacred scarab, *Scarabaeus sacer* L., and two large tenebrionids, *Akis reflexa* and *Pimelia pilosa* in the gut; *T. aethiopicus* was conclusively shown to be at least partly insectivorous. A later examination of a sacred ibis’ gut contents, by Blair (1935) added a carabid, *Calosoma chloristictum* Klug, to the list of prey.

Ectoparasites were early noted on human mummies. The founder of palaeopathology, Marc Armand Ruffer had detected nits and lice (*Pediculus humanus* Deg.) in the hair of mummies in the Cairo Museum (Ruffer 1914). More recently, Joann Fletcher has noted their high frequency in Old Kingdom wigs made from human hair from Abydos (Fletcher 1994; 2000); Romans could be equally lousy (Palma 1991). Bed bugs (*Cimex lectularius* L.) and human fleas (*Pulex irritans* L.; fig. 1) occur at New Kingdom Amarna (Panagiotakopulu
and Buckland 1999; Panagiotakopulu 2001a). Lice are likely to have achieved a worldwide distribution with their human host, and must share a long record of co-evolution (Reed et al. 2007); they are also recorded from New World mummies (e.g. Horne 1979), but both bed bug and flea probably had other primary hosts, the former probably in the roosts of bats or pigeons (Panagiotakopulu and Buckland 1999), and the latter an early introduction via pathways of gift exchange of furs from South America, where the primary host appears to have been the guinea pig (Cavia porcellus Erxl.; Buckland and Sadler 1989; Dittmar and Guillen 2003; Panagiotakopulu 2001a). The importance of insects as vectors in disease and their impact on past societies has been the subject of much research, and popular as well as academic publication (e.g. Zinsser 1935; Busvine 1976; Wolf et al. 2007). Panagiotakopulu (2004b) has recently reconsidered the origins and dispersal of bubonic plague in terms of the biogeography of rats and fleas and the forced coincidence of introduced Indian black rat (Rattus rattus L.), endemic Nile rat (Arvicanthis niloticus L.) and people, which resulted from the annual floods of the Nile. The hypothesis of a disease, present but not fatal to the native rodent, being transferred to a new host and thereafter reaching plague proportions in humans requires testing against the fossil record, both insect and small mammal, and this is one of several examples where close cooperation between the archaeologist, archaeoentomologist and palaeopathologist will yield interesting results. Panagiotakopulu (2004b) has also commented upon the large numbers of Diptera in archaeological deposits in Egypt and their role in the spread of Trachoma, river blindness, the frequency of which in Minya in Middle Egypt the intrepid English traveller Amelia Edwards was moved to remark upon (Edwards 1877).

It is perhaps not surprising that insects associated with stored meat products are equally at home in mummies (Panagiotakopulu 2001; Strong 1981). At least one of these species, D. frischii, occurs in the Neolithic of the Jura in the south of France (Ponel 1997), although whether it is an indigenous circum-Mediterranean species, or had spread from the East with the first farmers remains to be seen. Further north, in England, only two outdoor species, D. lardarius L. and D. lanarius Ill., are known to be present by the Late Bronze Age (Osborne 1989; Robinson 2000); the latter is now only a very rare import to Britain. At least one widespread dipterous pest, the house fly (Musca domestica L.), which in the north requires the artificial heat provided by man-made accumulations of animal dung and other warm decaying litter, may be of Egyptian or Near Eastern origin (Skidmore, pers. comm.; Panagiotakopulu 2004b). Common in samples from Egypt, by the Neolithic, house flies were present at Thayngen-Weier at nearly 500m a.s.l. in Switzerland (Guyan 1981; Nielsen 1989) and in southern Sweden (Skidmore, pers. comm.).

The propensity of such pest species, both dipterous and coleopterous, to infest museum specimens long after excavation has recently been highlighted by Buckland and Panagiotakopulu’s (2001) re-examination of the fauna and flora of the mummy of Rameses II, and this might explain Attia and Kamel’s (1965) record of another bacon beetle (Dermestes carnivorus F.), from ‘pharaonic mummies’. Hinton (1945), following Fauvel (1889), regarded this as a North American species, although Smith (1994) notes it as introduced to British Columbia.

The problems of ascribing primary, natural distributions to now cosmopolitan species is best approached from the fossil record. Despite their binomial names suggesting New World origins, both the saw-toothed grain beetle (Oryzaephilus surinamensis L.), and the lesser grain borer (Rhyzopertha dominica F.), have Palaearctic fossil records, which include Egypt (Zacher 1934; Panagiotakopulu 1999). The former is also recorded from a charred grain deposit from the Neolithic of Greek Macedonia (Valamoti and Buckland 1995), although it only becomes widespread in Roman deposits (Buckland 1991), whilst the latter, whose thermal requirements suggest a warmer (Munro 1966), perhaps semi-arid tropical
origin, is present on Bronze Age Santorini (Panagiotakopulu and Buckland 1991), but may not to have reached northern Europe until the late medieval period, where it is associated with the rice weevil \textit{(Sitophilus oryzae \textit{L.})} in an early fifteenth century pit in Southampton (Grove 1995). The origins of the grain weevil \textit{(S. granarius \textit{L.})}, have been the subject of much discussion (summarized in Buckland 1991). It is probable that its natural habitat lies in the underground stores of wild grasses, including cereals, collected by rodents in the Fertile Crescent, and that its transfer to human granaries took place as soon as storage of plant foods became widespread. It is present in Old Kingdom Egypt (Solomon 1965; Howe 1972) at Saqqara, and had spread across Central Europe with the Linear Bandkeramik (LBK), where it is known from two sites in Germany (Büchner and Wolf 1997; Schmidt 1998). Although relatively cold-hardy (Hunter et al. 1973), it only thrives outside the Mediterranean zone under conditions of large scale storage and transport, becoming almost ubiquitous in the Roman Empire, occurring from a fort on the Antonine northern frontier at Bearsden,\(^1\) near Glasgow, to close to its desert frontier in Egypt at Mons Claudianus (Panagiotakopulu and van der Veen 1997). Its presence in LBK deposits must be some indication of the nature of this expansion of early agriculture. Another probable primary denizen of rodent burrows is the colydiid \textit{Aglenus brunneus} (Gyll.) (cf. Dajoz 1977), which Girling (1984) found in an otherwise natural Neolithic assemblage from the Sweet Track in Somerset, England. At the present day, the species is strongly synanthropic, occurring in mouldy plant residues in barns, stables and cellars, habitats more widespread during the past (Kenward 1975; 1976); in the Roman period, this blind flightless beetle was accidentally taken with other grain pests to the remote quarry site of Mons Claudianus in the Eastern Desert (Panagiotakopulu and van der Veen 1997).

Whilst the historical biogeography of the pests of stored products has its own intrinsic interest, and may occasionally be used to support some curious hypotheses (cf. the discussion of \textit{Lasioderma serricorne} (\textit{F.}), the tobacco beetle, in Buckland and Panagiotakopulu 2001), their ubiquity in archaeological deposits in Egypt has other implications.

In any society where large scale transportation and storage of cereals forms an integral part of organization, insects extract a tithe. Hoffman (1954) notes that one pest alone, \textit{S. granarius} (fig. 2), annually destroyed 5\% of French cereal production before 1939, and losses in less developed countries remain much higher. Haile (2006) quotes a number of figures for various crops and pests, including village level storage losses for sub-Saharan Africa of between 25 and 40\%, and losses on individual sites may be virtually total, leading to starvation. Problems of storage loss during the First World War led to a report recommending air tight storage, where the build up of carbon dioxide as the grain respires suffocates grain pests (Dendy and Elkington 1920). Buckland (1978) has argued that sealed pit storage during the Iron Age in Britain precluded expansion of insect grain pests until the establishment of centralized granaries after the Roman invasion. In the Mediterranean other techniques either partly efficacious or palliative were necessary. It has been argued that fire ash around saddle querns at Amarna functioned as an insecticide (Miller 1987), and Panagiotakopulu and others (1995) have discussed the evidence for the use of a range of natural plant and mineral insecticides, based upon evidence from Classical sources and the well preserved charred assemblages of crops which had been stored in pithoi at Bronze Age Akrotiri on Santorini. Whilst the presence of alien plant materials might be detected in the routine study of plant macrofossil assemblages, if not interpreted, the use of substances such as tephra and diatomite is less easily observed. Both work by the cutting of the thin tegumen between sclerites of the pest species leading to desiccation and death, but the archaeological detection of such substances remains enigmatic.

\(^1\) Crowson’s identification, \textit{Sitophilus} sp. in Dickson et al. (1989) is most likely to be this species.
Archaeoentomological landscapes: potential and pit falls, the case of Pharaonic Amarna

In several ways, Amarna should be the ideal site for archaeoentomological research. Desiccation has lead to near perfect preservation of insect chitin and the short period of occupation, perhaps less than two decades in the middle of the 14th century BC on a pristine site on the desert edge between the Nile floodplain and the escarpment east of the river, means that the problem of recycling of earlier materials in mudbrick structures and deposits is minimal. Unfortunately the site has been extensively turned over and what escaped the early excavators has often been the quarry of treasure hunters. Well stratified deposits, however, do occasionally survive, although perhaps potentially the best, the bases of the numerous wells, are too deep – and therefore too expensive – to get at. In 1921 Eric Peet was excavating in the central part of the city on behalf of the Egypt Exploration Society (Peet and Woolley 1923), and he examined a house that clearly had two phases. The later had been constructed on the demolished remains of a previous house, itself partly built into a shallow gravel pit in the desert surface. Remains of the doorposts of the second house bore hieroglyphs that indicated that it had belonged to Ranefer, who had charge of the Pharaoh’s horses. His house may have been built on a slight platform as a mark of status, but more important from the palaeoecological viewpoint is the fact that the older structure had been partly infilled with material other than building debris, and this had been dug through by Peet’s workmen in the centre of the outer hall; elsewhere some floors remained intact sealing the deposits. In 2003, Peet’s sections were cleaned back and the house re-excavated for detailed planning. In the sections of the pit cut through the house floor and accumulation beneath, down into the underlying sandy gravel of the desert surface, it was evident that there were several irregular trampled surfaces within layers of midden, gravel and other debris. The outer wall of the later house had been constructed in a trench cut down through the deposits to a hard surface within the accumulation, roughly at the level of the surrounding desert, and no obvious midden lay above this level outside the structure. That man-made sediments extended deeper in Peet’s pit indicated that both phases had been built into a pre-existing feature, probably a shallow pit for the extraction of building materials, dug before the city had extended as far to the south-east. The hard surface presumably related to the construction of the first phase house on the site, but it is difficult to be certain whether the overlying material relates to casual dumping of midden material into an abandoned property, something which can be seen on deserted lots and derelict houses today in Minya, or to the deliberate import of debris from a range of sources to make the platform on which the later house stood. The frequency with which deposition was interrupted by clean gravel spreads, often with a hardened surface, suggests that accumulation was intermittent and there can be no doubt that at least the northermost outer wall of the earlier house had been reduced to its foundation course before midden accumulated over it. As well as a virtually complete locust (fig. 3), the preserved insect evidence shows a relatively foul assemblage, dominated by large numbers of the puparia of the housefly (Musca domestica L.), which had been breeding in the rotting organic material, which appears to have included herbivore dung. The insects do not resolve the question as to whether the debris was still foul, or had dried out before deposition over the ruins of the early house. Despite its vernacular name, the lesser mealworm (Alphitobius diaperinus Panz.), present in the deposits, would have predated on the maggots of house flies, but the dispersed sclerites of individuals, rather than the complete animals, including larvae, from the Workmen’s Village at Amarna (Panagiotakopulu 1999a), suggest that the living population probably lay elsewhere, although much invertebrate and vertebrate reworking is likely to have taken place in the midden deposits. Cereal debris, including much straw and both charred and unburnt
grain, was evident throughout the deposit and examples of the grain weevil (*Sitophilus granarius* L.) indicate that this was storage rather than field accumulation, although again, as Osborne’s (1983) practical experiments in archaeoentomology have shown, these, along with the more fragmented plant detritus, could have passed through either human or animal guts. Scattered examples of the small flightless spider beetle (*Gibbium psylloides* Czen.) may have strayed from its usual habitat, in foul rotting material, often faecal, but very large numbers in a pot in the rubble filling beneath the southern part of the house perhaps is indicative of partly dried excreta. There are taxonomic problems with the genus *Gibbium* and older identifications, including the large numbers recorded from a New Kingdom pot in the Berlin Museum by Zacher (1934), need to be checked for the congener *G. aequinoctiale* Boield., but both species are characteristic of singularly foul residues, the latter being recorded tunnelling into human faeces down a coal mine in England (Constantine 1995).

Excavations at Amarna and adjacent Kom el-Nana have provided rare opportunities to consider various other aspects of New Kingdom and Byzantine environments. This has range from fish (Luff and Bailey 2000) to plant remains (e.g. Smith 2003), and has resulted in several more synthetic studies (e.g. Kemp et al. 1994; Samuel 2000). Insect work had began with pig coprolites from the Workmen’s Village (Panagiotakopulu 1999a), but later moved on to more general aspects of the environment of this part of the site (Panagiotakopulu 1999b). As well as the expected desert fauna, dominated by large tenebrionids, what is apparent is the relative frequency of fodder and dung elements in the assemblages. Their ubiquity goes beyond casual dispersal from the irrigated areas by the Nile, some 3 km away. All foodstuffs and water for both man and animal would have had to have been brought up to the settlement, and casual inclusion of living and dead insects would have been inevitable, but there remains the possibility that it was possible to grow some fodder crops on the wadi floor at the time the site was occupied in the mid 14th century BC. The insect evidence implies the cultivation of a legume, although a more varied mix is possible.

The frequency of desert tenebrionids in the relatively loose sand filling of archaeological features raises several taphonomic problems, not the least of which is when they actually ended up in the fossil record. Occasionally there can be no doubt, one specimen of the large fossorial species *Trachyderma* cf. *hispida* from a charred deposit in the City was complete, partly charred and intimately associated with the sediment. Other isolated specimens are less secure and the need for recovery by the archaeoentomologist, aware of the taphonomic implications, rather than casual collection by archaeologist during excavation is apparent. Where large numbers of the same species are found in an otherwise empty pot – an example in the collections of the Fitzwilliam Museum in Cambridge has over 100 specimens of *Zophosis* cf. *carinata* and there are similar assemblages from the Workmen’s Village at Amarna – interpretation is more difficult, and it is probable that the empty pot has functioned as a buried pit fall trap for the tunnelling insects over a considerable period of time. Levinson and Levinson (1996), influenced by the position of the scarab (*Scarabeus sacer* L.) in Egyptian cult (cf. Alfieri 1956), interpreted large numbers of the large, impressively spinose tenebrionid *Prionotheca coronata* Ol. in pots in Predynastic tombs at Hu (Diospolis Parva) in Upper Egypt and from Early Dynastic Tarkhan in Lower Egypt as evidence for ritual deposition, but it is much more likely that they represent accidental victims of empty vessels. Although the difference in species – none of these assemblages are mixed – must indicate differences in the environment, sufficient habitat data have yet to be evaluated to elucidate this.
A Byzantine Window

The most diverse insect faunas from an archaeological site in Egypt come from the Byzantine monastic site of Kom el-Nana, which lies towards the southern limit of Amarna, north east of the modern village of Hagg Qandil, and now surrounded by its irrigated fields. An aerial photograph, taken in the 1920s however, shows the mounds of the site surrounded by desert, and it is only with the provision of modern irrigation methods that agriculture has become possible in the immediate environs. Had the site been intermittently inundated, insect chitin would not have survived, and the fauna, which accumulated in an abandoned room in the monastic complex, indicates cultivation in the immediate vicinity (fig. 4). Many of the fragments were packed together into accumulations suggestive of faecal pellets, although it is difficult to suggest what animal, perhaps lizards. Much of the assemblage is synanthropic, including the grain weevil, flour beetles (Tribolium spp.) and the khapra beetle (Trogoderma cf. granarium Everts), the latter providing the earliest fossil record of an important warm temperate to tropical pest of stored cereals, thought to have originated in India or SE Asia (Peacock 1993).

What is particularly remarkable in the Kom el-Nana assemblages is the diversity of dung beetles. In themselves, these suggest a different landscape from the present Egyptian one, in that many require fresh dung deposited onto grazed pasture to complete their life cycle. Extensive collecting around Amarna at the present day has produced only one dung beetle, and suitable habitats have virtually disappeared from the intensively managed landscape. That extensive lush pastures, rather than intensive cultivation, by the Nile must have existed in the New Kingdom is evident in tomb paintings. A fragment from the tomb of Nebamun at Thebes (TTE2) in the British Museum, datable only a few years prior to the Amarna Period, shows a large herd of cattle with their herdsman (Houlihan 1996: pl.xxii), and similar themes appear in other wall paintings. Large, managed flocks of geese are also shown in the same tomb. Whilst this is a long way from the Byzantine period, the pattern is the same, one of extensive areas of productive pasture, rather than intensively cultivated, individually ‘owned’ small fields, each farmer with his own cow, a buffalo or donkey for traction, sustained wholly on fodder and crop waste, and all animal dung collected as fuel; small numbers of sheep and goats are fed off the edge of the desert.

This encapsulates Egypt’s own ‘tragedy of the commons’ (cf. Harden 1968), enacted several times, perhaps from the apparent ease of the Arab Conquest to Mohammed Ali and Nasser, if not before. Large estates have the luxury of extensive, less intensive agricultural systems, which have space for elements in the natural biota, which compete with individual owners for resources, in this case dung, now extensively collected as fuel. It was these estates that sustained the herds for temple sacrifice until the system fell apart in the Graeco-Roman period, when grain production for a Mediterranean world took over (cf. Bagnall 1993; Bowman 1990). In a ‘World System’, however, estates are not broken up for the good of the fellaheen, but sequestered for cash crops, cotton or sugar cane monoculture in the nineteenth century, and the natural is driven out. Yet returning the land to the ‘people’ in small scale individual ownership is equally deleterious. Efforts to maximize their output, cultivating up to the river, irrigation dike and desert edge, leads to destruction of any remaining natural environments and desertification, as the population pushes towards the Malthusian breakpoint. Several times Egypt has reached this point in the past, perhaps beginning with the collapse of the Old Kingdom, probably the result of disastrous variation in the Nile flood. In the present landscape there is no space for wildlife, be it dung beetle or gazelle, and the fossil record is our only window on the past. With sufficient sites, it will be possible to chart the progress of Egypt from riverine forest and savannah in the Early Holocene to the intensively managed irrigated agriculture and desert of the Late Holocene.
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FIG. 1
Fleas (Pulex irritans L.) from the Workmen’s Village, Amarna.

FIG. 2
Charred wheat from deposits beneath the floor of Ranefer’s house, Amarna. The grain shows evidence of intense infestation by the weevil *Sitophilus granarius* L.
FIG. 3
Complete specimen of the migratory locust (*Schistocerca gregaria* Forskål) from the midden deposit beneath Ranefer’s house, Amarna.

FIG. 4
Insect remains from the Byzantine monastery at Kom el-Nana.