



HALVDANSHAUGEN – ARKEOLOGI, HISTORIE OG NATURVITENSKAP

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What's eating Halvdan the Black?

Fossil insects and the study of a burial mound in its landscape context

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INTRODUCTION

Death represents the end for one individual, but the beginning for a host of others, mostly invertebrate. The processors, which return the nutrients stored in living animal and plant tissue in most surface and burial regimes, are largely insects, and true flies, Diptera, and beetles, Coleoptera, often form the majority of these. These two groups form the most frequent animal fossils in archaeological and Quaternary sediments (Elias 1994, Panagiotakopulu, in press), a point which might seem unimportant but for two facts: 1. that most individual species have individual habitat requirements, and 2. fossil fragments can be matched exactly with living species. It is thus possible by the process of careful extraction of fossils from their matrix and identification, usually to the species level, to reconstruct past environments, immediate, as in the case of corpse faunas, but more regional in insect assemblages derived from natural accumulations, in fens, river silts and bogs. In addition, many purely archaeological contexts, from farm mounds and urban deposits to the desiccated contents of tombs in arid regions, also preserve insects.

EXTRACTION OF INSECT FOSSILS

Whilst individual cases may require smaller or larger samples, a strategy in which five litre samples are taken from each identified context has become fairly standard, although Kenward (1992) has argued for smaller samples and rapid scan identification in order to push

through the levels of results, however rudimentary, that contract archaeology has inevitably required. Where relatively homogeneous peat successions are utilised, sample units may vary from 50 to 200mm slices, depending upon the estimated or known rates of deposition. Samples must also take due note of any evident stratigraphy (Figures 1 & 2). The most convenient way of field sampling is to place material directly into polythene bags. These are labelled and sealed, and stored in a cold store at -3°C . Where the sample site is an archaeological context across which human or animal activity patterns may vary, as for example a house floor, a closer, more spatially orientated set of samples may be required, although the usual limit to processing and identification in archaeoentomology has not been one attained because of replication of results, but simply a limit to the available finance for the research; for this reason and the limits of taxonomic expertise, most studies have been restricted to single groups, usually the Coleoptera, where access to reference collections and descriptions of the adult animals and their habitats are most advanced. It is only recently, beginning with the work of Peter Skidmore (1996), that the systematic identification of fly puparia has been added to the work upon archaeological insects, although in the natural context, aquatic midges have a longer history of research (*cf.* Brooks & Birks 2001).

The methods used to extract fossil insects from Quaternary sediments essentially derive,



Figure 1. Field sampling of Late Quaternary organic sediments within sands at Finningley, Notts., UK (9/2000).
 Prøvetaking fra organiske avleiringer fra sen kvartærtid i en sandbanke ved Finningley, Notts., United Kingdom (9/2000).

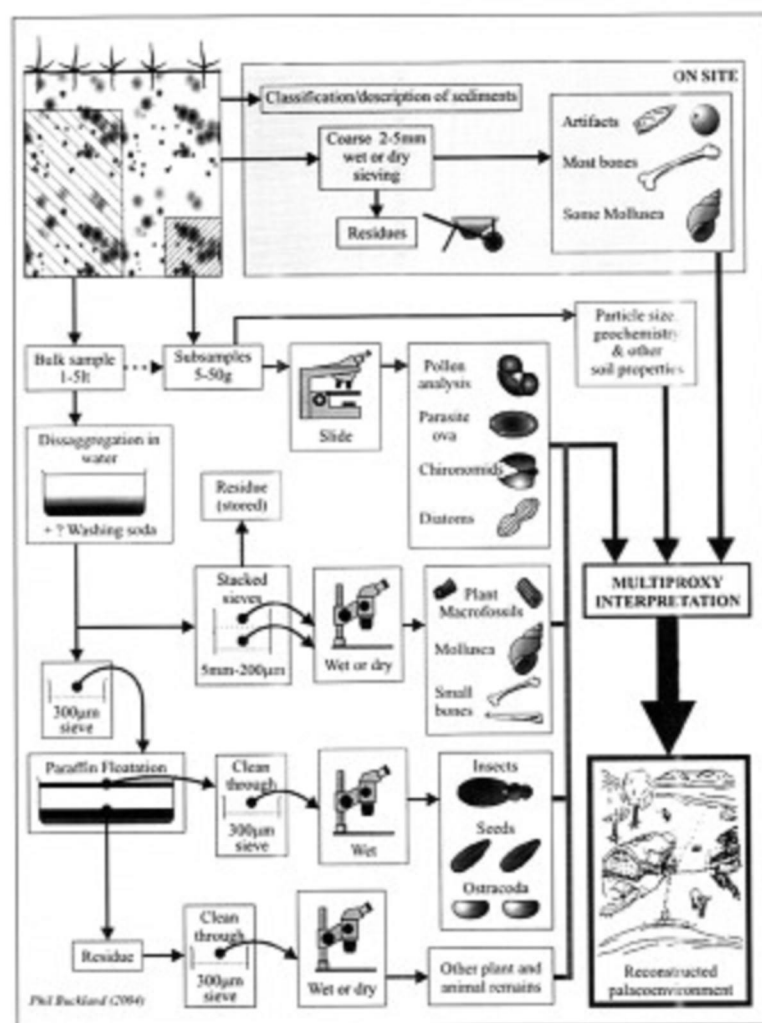


Figure 2. Flow diagram of procedure for field sampling for biological materials.
 Flytediagram som viser prøvetaking av biologisk materiale i felt.



Figure 3. Pouring the insect-rich paraffin (kerosene) flotant off from a sample.

Parafin (kerosen) med flotasjonskonsentrat av insekter tømmes fra en prøve.

sometimes with slight variations, from that published by Coope and Osborne (1968; cf. also Coope 1986, Buckland & Coope 1991, with full bibliography). Samples are disaggregated over a 300 μm sieve, usually only with hot water, although occasionally pre-treatment with sodium carbonate may be necessary to aid disaggregation. The material retained on the sieve is then returned to the bowl and kerosene (liquid paraffin) added. This adsorbs onto the waxy cuticle of the insects and an effective separation is achieved when cold water is added (Figure 3). The flotant can then be poured off, washed with liquid soap and then ethanol, and stored in ethanol. This process of adding water and pouring off the flotant is usually repeated three times, although if there are still substantial numbers of identifiable insects in the third float, further floats may be required. The material can then be sorted in ethanol under a low power binocular microscope (Figure 4), and identified by picking out onto wet filter paper and comparing with modern reference material. It is this necessity for a reasonably complete reference collection, and the time taken to acquire the necessary expertise, that restricts work upon

fossil insects to a relatively few centres. Desiccated material (Figure 5) is better dealt with by the long and tedious task of hand sorting under a binocular microscope, since wetting may be particularly damaging to otherwise well-preserved specimens. Similar problems attend the recovery of charred material, often preserved within burned grain deposits (Osborne 1977) (Figure 6). This technique of course also tends to preserve articulated sclerites in association (Figure 4), whilst floated material is usually disaggregated into its potentially identifiable fragments, heads, thoraces and elytra (Figure 3); disarticulated leg, antennal and underside fragments are rarely identifiable. The process of disaggregation also limits the utility of entomological keys, which frequently rely upon characters not evident in the fossil material.

PREVIOUS RESEARCH

Although Hope (1834; 1842) had identified beetles from both human and animal mummies from Egypt during the early nineteenth century (Panagiotakopulu 2001a), there was little work on suitable European deposits for over one hundred years, and most early



Figure 4. Sort of insect remains, largely Coleoptera, from the site of the early medieval farm at Reykholt, Iceland.
 Ulike insektrester, de fleste fra biller (Coleoptera), fra en lokalitet på en gård fra tidlig middelalder ved Reykholt, Island.

records concern the casual identification of individual large specimens, rather than any attempt to interpret past environments; Strobel and Pigorini's (1864) work on a north Italian Bronze Age Terremare site provides a notable exception to this. The first European record of insects from a burial comes from the Gokstad ship (Nicolaysen 1882), but there has been little subsequent work in Norway. Henriksen (1933) reviewed all the occurrences of insects in Quaternary deposits in Denmark and Skåne, and Lindroth (1949) checked and added to the fossil records of ground beetles (Carabidae) in Scandinavia, as well as examining a number of other Quaternary assemblages in Sweden (Lindroth 1948; 1960). The first study in Norway, however, that attempted to integrate the insect data with other lines of

evidence was that of Russell Coope on an Early Weichselian fauna from Brummedal (Helle *et al.* 1981). In Sweden, Geoffrey Lemdahl began detailed studies of Quaternary insect faunas during the early 1980s (*cf.* Lemdahl 1982; 1983; 1985), and he later identified Lateglacial assemblages from the island of Godøy (Birks *et al.* 1993) on the west coast of Norway. He has since expanded this with work on Kråkenes (Lemdahl 2000), where chironomids and oribatid mites have also been examined (Brooks 1997, Brooks & Birks 2000, Solhøy & Solhøy 2000). Along with Magnus Hellqvist, he has also examined some archaeological assemblages in Sweden (Hellqvist 1999, Hellqvist & Lemdahl 1996, Lemdahl *et al.* 1995). In the urban archaeological context, Kenward (1980; 1988) has

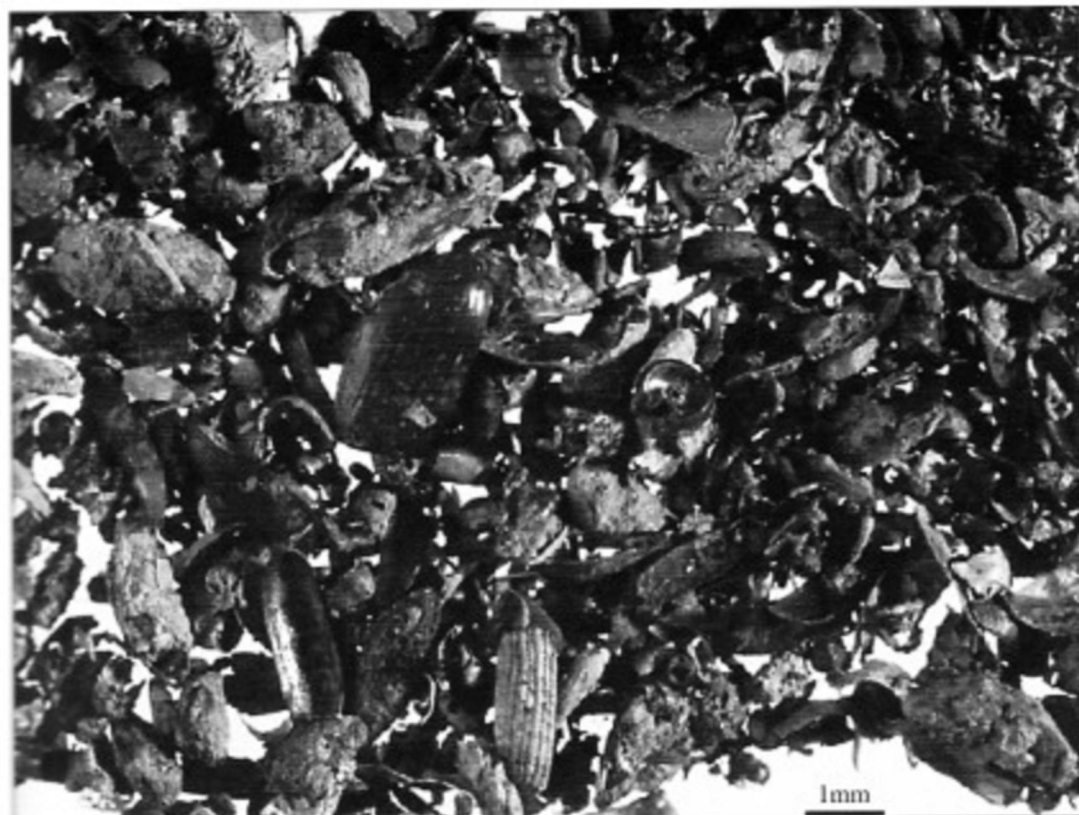


Figure 5. Desiccated insect remains from the site of the Byzantine monastery at Kom el-Nana, Middle Egypt.
Tørkede insektfragmenter fra en lokalitet i det bysantinske klosteret i Kom el-Nana i Midt-Egypt.

examined material from medieval Oslo, and Buckland, Buckland, Panagiotakopulu and Skidmore (Buckland *et al.* 2004) have published faunas from the medieval fishing station at Langenes in Vesterålen, where southern elements in the fauna suggest the import of grain from sites much further south. Most European Coleopteran fossil records, plus substantial amounts of habitat and distribution data have recently been made available on the WWW database BUGS (www.bugs2000.org; Buckland & Buckland 2002).

ECTOPARASITES

Whilst paraffin (kerosene) flotation is often a rapid means of concentrating arthropod remains, in the case of human remains, it is not a substitute for the careful examination of

the corpse. In the early years of the last century, Ruffer (1914) had noted lice (*Pediculus humanus*) in the hair of the mummies of Egyptian, and Ewing (1924) made similar observations on pre-Columbian Peruvian mummies. They are also present in the hair of the Thule mummies from Qilakitsoq, Greenland (Bresciani *et al.* 1989). In the Old World, the association goes back at least to the Pre-Pottery Neolithic of the Near East (Zias & Mumcuoglu 1991), and it is probable that human lice became cosmopolitan as rapidly as their host. Fletcher (1994) has found lice in wigs from Ancient Egypt, and nits, the eggs of head lice, have been found between the teeth of combs (Palma 1991, Schelvis 1991). At Herculaneum in Italy, the nits in the hair of one victim of the AD 79 eruption of Vesuvius



Figure 6. Charred specimens of the grain weevil, *Sitophilus granarius* from an Iron Age grain deposit, Jordan. Forkullede eksemplarer av kornsnutebilleren *Sitophilus granarius*, funnet i et korndepot fra jernalderen i Jordan.

were preserved by mineralization (Capasso & Di Tota 1998). *P. humanus* (Figure 7) has two sub-species, *P. h. capitis*, the head louse, and *P. h. corporis*, the body louse, variously regarded as separate species but extremely difficult to separate, and many identifications of fossil lice can only be to the species level. Sveinbjarnardóttir and Buckland (1982), however, claim to have identified a body louse from the Norse farm at Sandnes in the Western Settlement of Greenland, and there are contemporary references to them in the description of the infested hair shirt of the martyred Archbishop of Canterbury, Thomas á Becket (*op. cit.*). Man's other louse, the crab or pubic louse, *Phthirus pubis*, is recorded from Roman Carlisle (Kenward 1999), post-

medieval London (Girling 1984a) and Reykholt, Iceland (Buckland *et al.* 1992). Whilst the lice probably co-evolved with humans, the so-called human flea, *Pulex irritans*, appears to have a more complex history, since other members of the genus are American. It appears in the Old World in New Kingdom Egypt (Figure 8) (Panagiotakopulu 2001b) and Late Neolithic Orkney at Skara Brae (Buckland & Sadler 1997), and had probably achieved an early almost cosmopolitan distribution as a result of gift-exchange of furs, in which it has able to move from human host to host. Buckland and Sadler (1989) suggest that its primary host had been the Guinea pig, *Cavia* spp. One other insect parasite of humans deserves mention. The bed bug,



Figure 7. A human louse, *Pediculus humanus* from the Norse farm site at Gården under Sandet, Western Settlement, Greenland.

En menneskelus, *Pediculus humanus*, funnet på en lokalitet på den norrøne boplassen Gården under Sandet på Vest-Grønland.

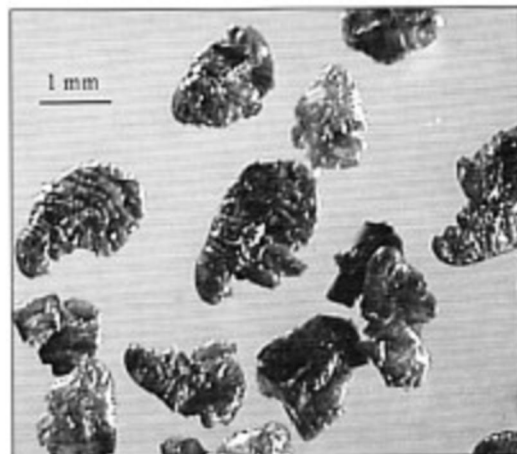


Figure 8. Human fleas, *Pulex irritans*, from the New Kingdom Workmen's Village at Amarna, Middle Egypt. Menneskelopper, *Pulex irritans*, fra Arbeidernes Landsby i det Nye Kongedømmet i Amarna, Midt-Egypt.

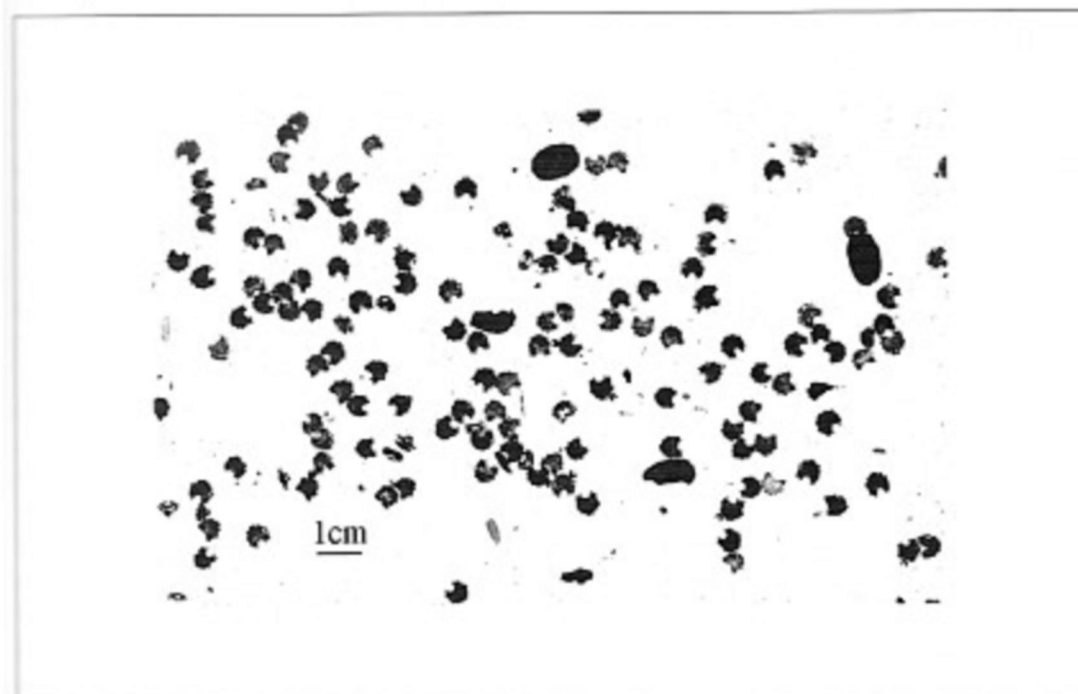


Figure 9. Concentration of the sheep ked, *Melophagus ovinus* from a drain beneath a late medieval floor at the farm site of Stóraborg, Eyjafjallasveit, Iceland.

En konsentrasjon av saue lusflue, *Melophagus ovinus*, fra en avløpsrenne under et senmiddelalderens gulv på gården Stóraborg, Eyjafjallasveit, Island.

Cimex lectularius, probably initially a parasite of roosting bats, first appears in the human context at New Kingdom Amarna in Middle Egypt (Panagiotakopulu & Buckland 1999).

Ectoparasites are not restricted to humans and their presence in the archaeological context has been used to argue not only for the presence of their hosts, but also for industrial activity. Large numbers of the wingless blood-sucking fly, *Melophagus ovinus* and the sheep fleece louse, *Damalinia ovis*, in a drain beneath the late medieval farm at Stóraborg, Iceland (Figure 9), were interpreted as the residue from wool preparation, utilising urine in the washing (Buckland & Perry 1989). Similar concentrations have since been noted at a number of sites, including York (Kenward 1998) and Ypres (Schelvis 1999). Kenward has also recorded a range of other ectoparasites from Anglo-Scandinavian York, including lice of cat, *Felicola subrostratus*, cattle, *Damalinia bovis*, goat, *D. caprae*, horse, *D. equi*, and pig, *Haematopinus apri*, and fleas of rodents, *Nosopsyllus fasciatus* and *Ctenophthalmus nobilis* (Kenward & Hall 1995). A tick, *Ixodes ricinus*, is also recorded from the same Coppergate site (*op. cit.*). It remains to be seen whether Panagiotakopulu's (2004) hypothesis of an Egyptian origin for the principal vector in bubonic plague, the rat flea, *Xenopsylla cheopis*, can be supported from the fossil evidence.

RAISING THE DEAD?

The remains of insects, particularly Diptera (true flies), have been widely used in forensic science, from establishing the time and season of death of murder victims to the sourcing of organic materials by their pest content (Smith 1986, Erzinçlioğlu 2000). They have similar potential in the archaeological context. Gerhard Bersu used the evidence of empty puparia of bluebottles, *Calliphora* sp., identified by Hincks (1966), in the remains of textiles from a Viking burial at Cronk Moar on the Isle of Man, to show that the corpse had

lain in state before burial, although in a footnote Freeman pointed out that egg laying onto a body would take place within a few hours of death. At the Augustine Burial Mound in New Brunswick, Canada, a more complex burial ritual could be discerned from the flies (Teskey & Turnbull 1979). Erzinçlioğlu (2000) notes that the fauna was dominated by *Phormia regina*, a species which will only breed above ground, and the next most frequent, *Protophormia terraenovae*, is similarly an outdoor species. It is apparent that the bodies had been exposed before final interment, an interpretation providing supported for the archaeological data. *P. terraenovae* is a Holarctic species, and there are also Quaternary records from Quaternary bison and woolly rhinoceros skulls in Belgium (Gautier 1974, Gautier & Schumann 1973) and from mammoth in England (Erzinçlioğlu 2000). Large numbers of the puparia of the lesser screw worm fly, *Cochliomyia macellaria* were associated with the mummy of a child from Huanchico in Peru. These must have developed from eggs laid on the exposed corpse before the mummy bundle was interred (Riddle & Vreeland 1982).

Despite the fact that the scuttle fly *Conicera tibialis*, commonly called the coffin fly, is often the prime processor of buried corpses, able to enter coffins two metres below the surface, remains of their puparia have not been noted in archaeological contexts. Faunas from regular graves in churches and churchyards are usually dominated by the so-called coffin or graveyard beetle, *Rhizophagus parallellocollis*. Partly this may be a reflection of the relative durability of the chitin of the Coleoptera, but it must also reflect their position in the food chain. Large numbers of *R. parallellocollis* are recorded from within a skull from a medieval grave beneath Glasgow Cathedral (Buckland 2002), from the burial of Archbishop Greenfield (*ob.* 1316) in York Minster (Buckland & Panagiotakopulu, in prep.) and in the chasuble of Abbot Dygon (*ob.*) in St. Augustine's Abbey, Canterbury (Girling

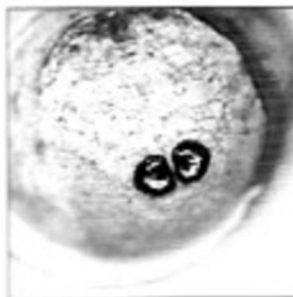


Figure 10. The diagnostic anal spiracles of a house fly, *Musca domestica* from the New Kingdom Workmen's Village, at Amarna, Egypt.

De karakteristiske ånderåbninger (spirakelåbningene) bakerst på kroppen til en husfluelarve, *Musca domestica*, fra Arbeidernes Landsby i det Nye Kongedømmet, Amarna, Egypt.

1981); it has also been recovered from the coffin of Anne Mowbray (*ob.* 1483) (Girling, *idem.*) in London (Stafford 1971), and from a nineteenth century grave in central Sheffield (Buckland, R. 1999). The species thus appears characteristic of burials, but it is also recorded from under bark (Peacock 1980) and in other foul rubbish situations, and there has been some discussion over its actual food requirements. Horion (1960) thought that it lived on the mouldy wood of the coffin, whilst Palm (1959) considered that it fed on the corpse itself. Peacock (1980), using Buckland's (1979) discussion of the York material, suggested that it was probably predatory on the numerous Diptera processing the corpse. In the case of the York Minster fauna, large numbers of *R. parallellocollis* were associated with the undoubtedly predatory staphylinid *Quedius mesomelinus* in the lead-lined stone sarcophagus.

In dry flesh, hide and flesh beetles, the Dermestidae, may be common, and several species of *Dermestes* have been recovered from Egyptian mummies (Panagiotakopulu 2001a). One species, *D. ater*, is recorded not only from an Egyptian mummy of *ca.* 1000 BC (Strong 1981), but also from a Chinese one of *ca.* 100 BC (Chu & Wang 1975). Whilst dermestids may invade a corpse during storage in a museum collection, Panagiotakopulu (2003) was able to show the contemporaneity of specimens of *D. frischii* with a cartonnage mask in the Turin Museum by the fact that the beetles were incorporated in the resins used in mummification. Other finds in the Turin

Collection (*op. cit.*) serve to illustrate another problem, that of biogeography. The biscuit beetle, *Stegobium paniceum*, is also recorded from Peruvian pre-Columbian mummies, along with another species recorded from Egypt, the lesser mealworm, *Alphitobius diaperinus* (Panagiotakopulu 2001a, Riddle & Vreeland 1982). The Old World evidence is sufficiently unimpeachable to suggest that the New World specimens are museum contaminants, utilising an old stored product. Other now cosmopolitan insects, including the house fly, *Musca domestica* (Figure 10), have also been recorded from Egyptian mummies (Curry 1979, Panagiotakopulu, *in press*), and these were probably attracted to the corpse during preparation for burial. Probably of Old World tropical origin (Skidmore 1985), the house fly is one of man's early fellow travellers, appearing in both Switzerland (Nielsen *et al.* 2000) and Sweden (Göransson 2002) during the Neolithic.

The absence of a carrion fauna can be equally significant. The discrepancy between the dates on the bodies and the enclosing peat at Lindow in Cheshire, England, is best resolved by examination of the insect faunas (Skidmore 1986, Dinnin & Skidmore 1995). At any time of the year an exposed corpse rapidly accumulates an insect fauna and despite processing of multiple samples none of the body fragments produced a carrion fauna; close examination of the skin showed no evidence of insect attack. Whilst Barber (1995) interpreted this as evidence for the peat being peeled back, the bodies inserted, and the peat

blanket replaced, Buckland (1995) suggested that the individuals had been disposed of in deep peaty pools on the bog, very soon or immediately after a death, which at least in the case of Lindow II looks like a ritual murder (Buckland *et al.* 1994).

The best preservation occurs in anaerobic (usually waterlogged) or desiccating conditions, but the material from an Anglo-Saxon grave at Sewerby in East Yorkshire was preserved by mineral replacement next to metal artefacts (Girling 1985), and Teskey and Turnbull (1979) point out that copper beads in the Augustine graves led to the preservation of the fly remains. Greig (in Buckland *et al.* in press) has also noted that the fungicidal activity of copper salts preserves pollen in graves. This requires that metal grave goods be carefully examined and the enclosing sediment be sampled before conservation.

INSECTS, STORED PRODUCTS AND GRAVE GOODS

As well as the incidental preservation of insect remains by metal grave goods, organic offerings may also contain insects, either pest species associated with foodstuffs or as offerings themselves. Levinson and Levinson (1996) argued that the presence of the large tenebrionid beetle *Prionotheca carinata* in graves in Upper Egypt showed that, like the scarab (Alfieri 1956), it was once a venerated species; it seems more probable, however, that this essentially fossorial insect was an accidental visitor trapped in the tomb, although there are cases of the more colourful buprestids, jewel beetles, being used on necklaces. Pots from Egyptian tombs frequently contain large numbers of the desert tenebrionid *Zophosis* sp., which have fallen into the open pit falls of the jars and been unable to escape.

Whilst not the insect itself, it should be noted that Evershed and his colleagues (1997; 2002) have recently been able to detect chemically residues of both honey and beeswax on Bronze Age Greek pottery, and Needham and

Evans (1987) had previously recorded honey from a Neolithic sherd from a site by the Thames at Runnymede. The implication is that it would be worthwhile to test apparently empty vessels in graves for their former contents. Most insect records from tombs, however, relate to pests associated with offerings. No evidence is available from European burials, but research in Egypt provides some idea of the potential. Cereals are frequent offerings in tombs, and the grain weevil, *Sitophilus granarius* (Figure 6), is recorded from Old Kingdom Saqqara (Howe 1965) and several later tombs (Panagiotakopulu 2001a). Flightless and not known in the wild, records north of the Alps, with the exception of two Neolithic LBK records from Germany (Büchner & Wolf 1997, Schmidt 1998), are all Roman or later, and along with the saw-toothed grain beetle, *Oryzaephilus surinamensis*, and the flat grain beetle, *Cryptolestes ferrugineus*, it probably owes its wider distribution to the transport of cereals to support the Roman army (Buckland 1991). Kenward (Kenward & Hall 1995) has argued that this assemblage essentially disappeared from northern Europe in the post-Roman period, and only became widespread again after the Norman Conquest. Certainly the extent of Roman trade is indicated by the pest fauna. *O. surinamensis* first appears in Egypt at the remote desert quarrying site of Mons Claudianus, along with the blind flightless colydiid *Aglenus brunneus* (Panagiotakopulu & van der Veen 1997). Both are probably primarily members of the European *Urwald* fauna. Whilst the saw-toothed grain beetle occurs in the wild in leaf litter, birds' nests and under bark (Horion 1960), *A. brunneus* is probably originally an inhabitant of deep forest litter; both have found their habitats duplicated in man-made situations and have become strongly synanthropic and largely cosmopolitan. The latter is first recorded from Neolithic deposits in the Somerset Levels in England (Girling 1984b), but is more typical

Taxon	Host	Pollen	Plant Macrofossil
<i>Tingis ampliata</i>	<i>Carduus arvensis</i>	<i>Carduus/Cirsium</i> spp.	<i>Carduus/ Cirsium</i> spp.
<i>Ceutorhynchus pollinaris</i>	<i>Urtica dioica</i>	<i>Urtica</i> spp.	<i>Urtica dioica</i>
<i>Brachypterus glaber</i>	<i>Urtica</i> spp.	<i>Urtica</i> spp.	<i>Urtica dioica</i>
<i>Phalacrus caricis</i>	<i>Carex</i> spp.	Cyperaceae	<i>Carex</i> sp.
<i>Limnobaris dolorosa</i>	Cyperaceae, Juncaceae	Cyperaceae	<i>Carex</i> sp. <i>Juncus inflexus</i> grp., <i>J. cf. gerardii</i>
<i>Ochina ptinoides</i>	<i>Hedera helix</i>		
<i>Rhynchites aeneovirens</i> <i>Rhynchaenus pilosus</i>	<i>Quercus</i> spp.	<i>Quercus</i> spp.	
<i>Plateumaris braccata</i>	<i>Phragmites australis</i>	Poaceae	<i>P. australis</i>
<i>Oulema obscura</i> (=lichenis)	Poaceae	Poaceae	<i>Glyceria fluitans</i> <i>Puccinella distans</i> <i>Poa cf. palustris</i>
<i>Chrysolina polita</i>	Usually on <i>Mentha aquatica</i> ; Labiatae		
<i>Phyllotreta</i> spp. <i>Psylliodes cuprea</i> <i>Ceutorhynchus contractus</i>	Brassicaceae	Brassicaceae	
<i>Chaetocnema concinna</i>	Polygonaceae		
<i>Gastrophysa viridula</i>	<i>Rumex</i> spp.		
<i>Apion apricans</i>	<i>Trifolium pratense</i>		
<i>Rhynchaenus rusci</i>	<i>Betula</i> spp.	<i>Betula</i> spp. <i>Salix</i> spp.	<i>Betula pendula/ pubescens</i>
<i>Rhamphus pulicarius</i>	Betulaceae & Salicaceae	<i>Betula</i> spp. <i>Salix</i> spp.	<i>Betula pendula/ pubescens</i> <i>Salix</i> sp.
<i>Sitona hispidulus</i>	<i>Trifolium</i> spp.		
<i>Ceuthorhynchidius troglodytes</i>	<i>Plantago lanceolata</i>	<i>Plantago</i> sp	(<i>P. maritima</i>)
<i>Mecinus pyraister</i>	<i>P. lanceolata</i> & <i>P. media</i>	<i>Plantago</i> sp.	(<i>P. maritima</i>)
<i>Gymnetron antirrhini</i>	<i>Linaria vulgaris</i>		
<i>Leperisinus varius</i>	<i>Fraxinus excelsior</i>	<i>Fraxinus</i> sp.	

Data from McGrail (1981)

Table I. Insect, pollen and plant macrofossil identifications from Brigg, N. Lincs.
Identifiserter insekter, pollen og plante-makrofossiler fra Biggs, N. Lincs.

of foul urban deposits (Kenward 1975). It did, however, reach Snorri Sturlason's farm at Reykholt in Iceland during the medieval period (Figure 4), where it may be associated with foul residues of imported grain, perhaps used

in brewing.

The insect evidence can occasionally be taken too far. The much vaunted claim for drug use in Ancient Egypt rests partly on the presence of the tobacco beetle, *Lasioderma ser-*

ricorne, in the mummy of Ramses II. A New World crop, the data have been re-assessed by Buckland and Panagiotakopulu (2001) – the use of tobacco powder as an insecticide in the nineteenth and early twentieth century is well attested. Entomologists can be equally imaginative, and the name *Oryzaephilus surinamensis* given by Linnaeus provides a good example: ‘the rice lover from Surinam’ combines an Old World crop with a Central American country, and until Coope and Osborne (1968) found the species in the late Roman well at Barnsley Park in Gloucestershire, most regarded the beetle as a recent import to Europe. Despite its recovery from the tomb of Tutankhamun (Zacher 1937), the lesser grain borer, *Rhizopertha dominica*, was similarly regarded as an American immigrant (Hill 1994). Probably of Old World tropical origin, it had reached Santorini in the Aegean by the Bronze Age (Panagiotakopulu & Buckland 1991).

As well as providing evidence for grave goods and offerings and for mortuary practice, insect faunas may also be preserved on the old ground surface beneath barrows, and these may give a clear indication of the nature of both the immediate and surrounding landscape before burial. Beneath the massive Neolithic mound of Silbury Hill in Wiltshire, Robinson (1997) found an open grassland landscape, with an extensive dung fauna, an insect assemblage not dissimilar from the nearby Late Bronze Age feature at Wilsford (Osborne 1969). In the latter case, however, the contrasting views of archaeologists, wanting a ‘ritual shaft’, and the more prosaic palaeoecological explanation of the feature as a well should be noted (Ashbee *et al.* 1989).

LANDSCAPES AND HOLOCENE CLIMATE

Whilst there is no doubt that an overall regional picture of the vegetation is best obtained from pollen (Moore *et al.* 1991), its combination with study of the contemporary insect faunas and other groups makes it a

much more powerful tool. In Norway, this has been most recently illustrated in the multidisciplinary study of the Lateglacial succession from the lake on Kråkenes (Birks *et al.* 2000). Not only are insects more sensitive to climate change, but their food requirements may be such that they are confined to one species or a group of species not separable in the pollen diagram. An example is provided by Table I, which summarises the plant hosts of the fauna identified from beneath the Bronze Age boat from Brigg in the Ancholme Valley in North Lincolnshire, and also indicates whether pollen or plant macrofossil evidence was available.

The lines of evidence are complimentary, but in addition, whilst specific phytophages were not recovered, the insects support the plant macrofossil evidence for the tidal nature of the deposition site, with a range of halophytic ground beetles and hydrophilids. The overall picture is of *Phragmites* reed swamp fringing a channel with *Spartina maritima*, into which there was some occasional freshwater flow (Buckland 1981). The level of precision which the integration of several lines of evidence allows is particularly useful in this context. The several species whose host plants were not recovered from the site or from habitats not immediately apparent probably represent individuals which had either died elsewhere and been transported to the location, or had been attracted to the shiny surface of the water body. The taphonomy of such assemblages can be particularly difficult, although it is unlikely that the species which develop in dead wood, the chafer *Gnorimus nobilis* and the longhorn beetle *Pyrrhidium sanguineum*, had moved far from their pabula in old decaying parkland or woodland trees. The nature of *Urwald*, woodland with essentially no human impact, has recently become the subject of much discussion, partly because of a need to justify ‘naturalistic grazing regimes’ in the management of nature reserves (*cf.* Kirby 2003). The starting point is a very valid ques-

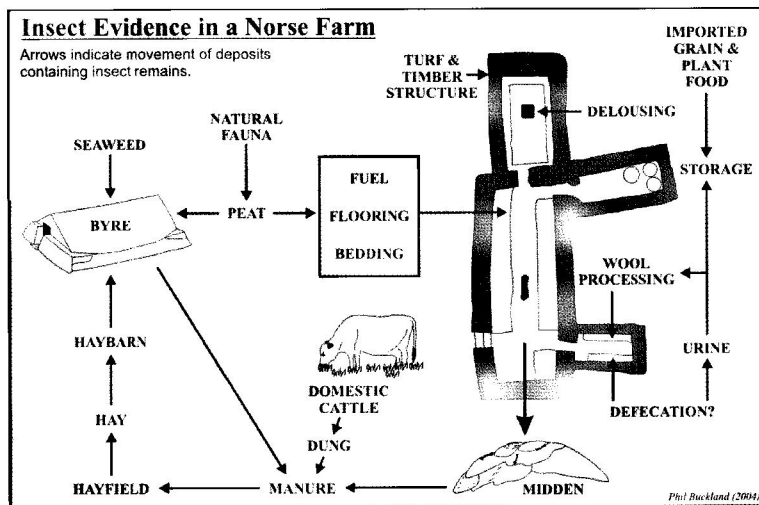


Figure 11. Flow diagram indicating the pathways by which insect remains are incorporated in the sediments of a Norse farm. Flytediagram som viser kretslopet som fører til at insektrester blir inkorporert i sedimentene på en norrøn gård.

tion raised by Franz Vera (2000; 2002), what impact did large herbivores have on the early-to mid-Holocene north European forest? Most palynologists appear to discount grazing pressure in forest structure, although there are hints at some compromise (cf. Bradshaw *et al.* 2003). It is unfortunate that there are so few studies of insect faunas from the mature forest phase of the Holocene, but old grassland species, such as the large click beetle *Agrypnus murina* (Girling & Robinson 1987), do occasionally occur in pre-Neolithic assemblages. Their frequency, however, is much less than in the previous interglacial, when the large herbivores were supplemented by elephant, hippopotamus, and rhinoceros (Coope 2001). On the evidence of the insect faunas, summers during Isotope Stage 5e (the Eemian/Ipswichian interglacial) were perhaps 3°C warmer than the present interglacial (Coope & Beesley 1987), and this may have contributed to the formation of temperate savannah (*sensu* Rackham 1998). The woodland elements in all interglacial assemblages examined until the late Holocene are remarkably similar, dominated by dead wood and related taxa, the so-called saproxylic fauna. As Robinson (2000) has discussed, Landnám leads to significant changes, best indicated by

the faunas, and associated pollen evidence from Hampstead Heath, London (Girling & Greig 1977, Girling 1989, Greig 1989). Increases in the dung fauna mark Neolithic impact on the forest, and the dead wood fauna rapidly declines. Although the English lowland forest is clearly dominated by *Tilia*, lime, represented in most mid-Holocene samples by the bark beetle *Ernoporinus caucasicus*, the Elm Decline, almost synchronous across north-west Europe at ca. 5200 BP, provides the best palynological indicator for large scale Neolithic impact, and much has been made of the presence of the elm bark beetle, *Scolytus scolytus*, at Hampstead Heath, although the occurrence, as Robinson (*op. cit.*) has stressed, is before the palynological fall in elm. Evidence from sites as far north as Aberdeenshire (Clark 2002, Clark & Edwards, in prep.) shows that *S. scolytus*, and probably the fungus of elm disease, *Ophiostoma ulmi*, are part of the natural Holocene forest biota; any increase in frequency of the disease, if not the accidental introduction of a more virulent strain, must reflect woodland under stress and that impact is likely to be increased human pressure.

Whilst insects, particularly the Coleoptera have been used effectively to reconstruct major

swings in Quaternary climate, indeed anticipating the results from the Greenland Summit ice cores by nearly thirty years (*cf.* Ashworth 1972, Coope & Brophy 1972, Lowe & Walker 1997), the nuances of Holocene climate are less easily detected. Insufficient detailed research has yet been carried out to evaluate the 8200 BP event, evident in both ice core and other palaeoecological data (Nesje & Dahl 2001, von Grafenstein *et al.* 1998) in terms of fossil insect faunas. The Early Medieval Warm Period and the succeeding Little Ice Age, however, do seem to have a signal, but interpretation can hardly be regarded as independent of other lines of evidence (Buckland & Wagner 2001). The insect evidence does seem to imply that the major change in climate during the Holocene did not take place until the late medieval period. As Osborne (1965) noted almost at the beginning of systematic study of fossil beetle faunas, most regional extinctions and major curtailments of distribution, consist largely of elements of the *Urwald* fauna, and more reflect human impact, the destruction of once widespread habitats, particularly that of old wood on the forest floor, rather than climate change (Buckland 1979, Buckland & Dinnin 1993, Wagner 1997).

HUMAN ENVIRONMENTS

From individual burials to landscape scale studies, fossil insects provide levels of details unattainable from other lines of evidence. Extensive research with the more limited faunas of North Atlantic islands has enabled an interpretative model of the pathways by which insect remains come to be incorporated in archaeological sediments to be constructed (Figure 11, based on Buckland *et al.* 1993), and Buckland *et al.* (1994) provides a more detailed examination of what accumulates on house floors. Much of the interpretation rests upon the careful sampling and spatial location of multiple samples from floors and middens, most recently effected at the site

of Gården under Sandet in the Western Settlement of Norse Greenland (Buckland *et al.* 1998, Panagiotakopulu *et al.* in prep.). The importance of fodder of various forms, from grass and sedge hay to twigs and seaweed, is particularly evident in this research (Amorosi *et al.* 1998), but equally the distribution of ectoparasites remains of both humans and domestic animals can be particularly revealing in terms of room usage and site abandonment. The end of Norse Greenland has been the subject of detailed insect faunal and multidisciplinary study since new excavations were begun in the late 1970s (Buckland *et al.* 1983, Barlow *et al.* 1998), and the retention of all insect remains from samples has allowed reassessment and addition of other groups, particularly the Diptera, to interpretational models (Panagiotakopulu *et al.*, in prep.). Similar research in York has been dogged by a lack of integration with the purely archaeological data, although Kenward and Hall's (1995) overview of the Coppergate plant macrofossil and insect evidence is particularly impressive.

The potential of fossil insects in archaeological interpretation has seldom been fully realised, largely because of two factors: 1. the time taken to process, identify, and feed back interpretation to the excavator limits their utility in constraining site interpretation and sampling strategies during excavation, although this was attempted at Reykholt in Iceland (Buckland *et al.* 1992), and 2. a single large fauna of Coleoptera and Diptera may take many weeks of research to identify and interpret, and archaeologists and their funding bodies are rarely prepared to pay, or wait for the results. The case of the Iron Age and Roman wells at Dragonby in North Lincolnshire provides a good example. English Heritage felt able to fund work on some of the plant macrofossil assemblages (van der Veen 1996), but the insect work had to be carried out at the author's expense (Buckland 1996), despite the fact that it was

clear that the range of imported species in some of the wells enabled the excavator to differentiate Iron Age from Roman. This is not to demean the plant macrofossil study, which produced important results (*see also* van der Veen *et al.* 1993), but it indicates that priorities for palaeoenvironmental research tend to be decided on traditional as well as financial grounds; many archaeologists are aware of pollen and plant macrofossils, but few would consider insect study a high priority. Early attempts at York to integrate fully the often conflicting lines of palaeoecological data often floundered in the headlong rush to publication in fascicules, which whilst making the primary data rapidly available, tended to divorce the environment from the archaeology (e.g. Buckland 1976, Whitwell 1976). As Osborne (1983) later showed by practical experiment, a little more thought and consultation would have shown that the grain fauna in the Roman sewer had probably been introduced in human faeces, rather than as stray individuals from adjacent granaries. The large numbers of the relatively thermophilous ant, *Ponera punctatissima*, however, would have thrived in the heated bath house, in an environment which did not return until the nineteenth century. A similar faecal origin, in imported grain, also seems likely for the weevils and saw-toothed grain beetles in the midden at the high status farm of Bessastaðir in Iceland (Amorosi *et al.* 1992).

ARCHAEOENTOMOLOGY – A FUTURE?

In the longer term, the future of archaeoentomology, as it has been termed (Panagiotakopulu 2001a), as opposed to Quaternary entomology, at least in the British Isles, does not look promising. The two English Heritage laboratories, Oxford and York, where the research was carried out, have recently either been closed or scaled down. Both Robinson (2003) and Kenward (Hall *et al.* 2003), however, continue to publish important new stu-

dies. It is no longer part of main stream research at Sheffield. At Belfast (Whitehouse 2004) and Birmingham (Smith 2000, Smith *et al.* 2000), concentration is currently on human impact on 'natural' landscapes, although some on-site work continues at the latter (*cf.* Smith 2002). In Scandinavia, Böcher (Coope & Böcher 2000), Buckland (Buckland & Buckland 2002) and Lemdahl (2000) are concentrating on the problems of the Late Quaternary. In this research area, Coope (e.g. 2001; 2002) continues to make a major contribution, and Elias, working largely in Beringia (*cf.* Elias 2000), has continued his research in North America from London, although their joint work (Elias & Coope 2000) on the Upper Palaeolithic site at Hauterive-Champréveyres, near Neuchâtel in Switzerland should be noted by archaeologists working on this period.

CONCLUSION

The study of insect remains from archaeological and natural sediments can provide key evidence for the nature of past environments, not only the immediate ones, of direct interest to the archaeologist, but also of wider landscape contexts into which the excavated evidence needs to be fitted. In addition, the contribution of studies of fossil insect faunas to analysis of climate change has been profound, and the work of Russell Coope in particular has substantially modified our views of the Quaternary and the rapidity with which climates can change. The recovery and identification of insect remains should be a key element in any archaeological project which involves waterlogged or desiccated sediments.

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SAMMENDRAG

Hva spiser opp Halvdan Svarte?

Fossile insekter og studiet av gravhauger i lys av fortidens landskap

De første arbeider som beskrev insekter i arkeologisk sammenheng, stammer fra studier av egyptiske mumier tidlig på 1800-tallet. Insekter ble imidlertid sjelden brukt for å tolke arkeologiske funn før på 1960-tallet, da en effektiv teknikk for å skille ut insektfragmenter fra utgravd materiale ble utviklet av Geoffrey

Russel Coope og Peter J. Osborne ved University of Birmingham i England. Deres forskning gjaldt tolkning av klima og miljø ut fra insektfaunaen i yngre kvartær. Osborne fattet imidlertid interesse for spor av insektfauna som ble avdekket ved arkeologiske utgravninger. Hans arbeid ble videreutviklet av Harry K. Kenward, som i starten konsentrerte seg om avleiringer i York fra romertiden, folkevandringstiden og yngre jernalder og senere av Mark Robinson ved Oxford som hovedsakelig studerte lag fra sen-holocen i Themsendalføret. Med støtte fra Leverhumle Trust i Storbritannia kunne Paul C. Buckland studere historien til insektfaunaen på atlantiske øyer, et arbeid som har fortsatt inntil nylig. De fleste av disse insektarkeologiske studiene tar for seg faunaen av biller (Coleoptera), men Harry K. Kenward identifiserte i tillegg teger (Hemiptera) og Peter Skidmore og Eva Panagiotakopulu fluer (Diptera). Panagiotakopulu har videre gjennomført omfattende studier av ektoparasittfragmenter fra arkeologiske utgravninger.

For å identifisere insektartene er man fortsatt sterkt avhengig av en omfattende referansesamling. Når det gjelder tolkning av funnene, har utviklingen av en EDB-basert database, BUGS, gjort arbeidet mye lettere. Her finnes opplysninger om de insekter som er funnet i kvartære avleiringer og deres habitatkrav, utbredelse og fossile historie.

I Skandinavia ble det gjort pionerstudier over den kvartære insektfaunaen av Kai L. Henriksen og senere av Carl H. Lindroth. I senere tid har Geoffrey Lemdahl utført omfattende studier av insektfaunaen i naturmiljøer fra senglasial periode til holocen og sammen med Magnus Hellqvist også i arkeologisk sammenheng. Med unntak av Philippe Ponels arbeider i Frankrike har det i den senere tid vært få studier andre steder i Europa, og de fleste undersøkelsene omhandler dessuten insektsamfunn i naturmiljøer. Dette gjelder også Amerika der insekter sjelden blir brukt til å tolke arkeologiske funn. Unntak er Alison

Bains arbeider med materiale fra tiden etter Columbus i østlige deler av USA og Canada og noen arbeider av Scott A. Elias i Midtvesten. Med unntak av Egypt er det utført svært få studier i Afrika, Asia og Australia. Dette skyldes delvis at de publiserte resultatene ikke er samlet, og at arkeologer ikke inkluderer kostnadene ved disse tidkrevende analysene i prosjektbeskrivelsene.

Denne artikkelen prøver å skissere noen av de sammenhenger som er avdekket ved å studere insektfragmenter og å skissere metoder for å skille ut fragmentene i utgravd materiale. En omfattende litteraturliste gir en oversikt over viktig litteratur som særlig er relevant for Skandinavia.

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