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The application of fossil insect studies to the Somerset Levels

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The technique of investigating fossil insect assemblages was developed initially to investigate Pleistocene deposits and its value in this area has been successfully demonstrated from many sites, (Coope, 1970, 1977). More recently, insect analysis has been applied to archaeological deposits resulting often in very detailed information about man's environment, (Osborne, 1969, 1971). The number of sites which have now been investigated range from the late-Glacial insect fauna associated with a palaeolithic tool from Messingham, North Linsolnshire (Buckland, 1976) to recent urban deposits including the assemblage from 17th. century pits in Southwark (unpublished data).

Since 1974 insect analysis has been extended to the peat deposits associated with the Neolithic and Bronze Age trackways of the Somerset Levels. The archaeology of many of these trackways has been described (Coles and Orme, 1977 is a recent example), and palaeoecological techniques employed to interpret the wealth of organic remains preserved in the waterlogged deposits include pollen and macrobotanical analyses (Hibbert 1977, Beckett and Hibbert 1976) and identification and dendrochronology of the trackway timbers (Morgan 1977). Radiocarbon dating provides a framework for the archaeological and ecological information from the Levels (Coles and Coles 1975, Coles and Fordham 1977). So far insect analysis has been carried out at five sites associated with prehistoric trackways and data is available on the successive insect assemblages in parts of the Somerset Levels for much of its history.

The value of insect studies in the Somerset Levels

With the continuing application of insect studies to archaeological deposits, a great deal of information is being acquired on the environmental background to man's activities and man's effect on the landscape with the resulting changes to the insect fauna. As more sites are completed this interaction will be more fully understood. At the same time correlation between sites allows a general account to be made of the evolution of the British beetle fauna and once such a pattern has been established it is possible to isolate faunal changes which appear not to be man-induced but which result from other factors such as climatic variation.

The concentration of insect studies within a limited area, in this case the Somerset Levels, presents several advantages over the acquisition of data from widely separated sites and can, consequently, lead to a valuable contribution to existing knowledge. One particular aspect is the provision of data relating to climatic change. Osborne (1976) has detailed the evidence of climatic change from a range of post-Glacial sites which shows that certain trends can be identified from changes in species' distribution. By assessing data from one area, however, it is possible to avoid two problems inherent in between-site comparisons. The first is that theoretically, the limited geographical spread of the Levels sites should permit the identification of even small scale alterations in species' distribution resulting from temperature fluctuations. Also, most of the peatlands in the Levels are effected by the same ecological processes which lead to uniform changes over the area whereas unrelated sites usually exhibit marked differences in environmental components such as bed-rock and water-regime, all of which must be taken into account when appraising faunal differences.

Another feature which makes the Somerset Levels an important area for insect studies is the occurrence in the uniform peat lands of contrasting landforms of the islands which interrupt the peat deposits and the higher ground which surrounds them; the areas linked by the complex of prehistoric trackways. These higher areas, composed of limestone or more limited outcrops of the sands and gravels of the Burtle Beds, are generally devoid of organic deposits. The peats at the island edges, however, while dominantly providing evidence on the environment of this marginal situation, can potentially supply indications of the land use of the islands and hence man's activities on them.

One final advantage for the application of any new technique in the Somerset Levels is the existing wealth of well documented archaeological and palaeoecological data which allow close correlations to be made between the direct (archaeological) evidence of man's activities and his possible effect on the landscape and, equally important in this region, the effect of natural environmental changes upon man.

Techniques

At each of the trackway sites investigated a similar sampling procedure has been adopted. After the trackway is recorded, samples of peat are collected vertically at 5 cms. intervals through the track level into the overlying and underlying deposit. This is to enable comparisons to be made between the trackway environment and conditions before and after its usage to establish whether any changes can be identified. To provide the fullest understanding of the trackway environment additional samples are collected from around the trackway timbers. Where ever possible, samples for insect analysis are collected in conjunction with those for botanical studies so that the fullest assessment can be made of the differing lines of evidence provided by these remains.

Insect solerites are recovered from the samples by the paraffin flotation method (Coope and Osborne 1967) modified for use on peat samples. Identification is made by direct comparison with modern insect specimens then the fossil remain are stored either on prepared card slides or in labelled tubes of pure alcohol. Amongst fossil assemblages the most readily identified order is Coleoptera or beetles. In many of the Somerset Levels samples, Coleoptera are outnumbered by members of other orders, particularly Hemiptera (bugs) Diptera (flies) and Hymenoptera (ants and parasitic wasps), but these can rarely be identified as precisely as beetles.

The interpretation of insects thus identified is based upon faunal assemblages. Whilst individual beetles might be important indicator species providing evidence of a particular habitat or temperature requirement, overall interpretation is restricted to analysis of dominant faunal units. Similarly, ecological changes are established from the evidence of the replacement of faunal units with those requiring different habitats. Here, particular beetles may be used as marker species to demonstrate these trends, but no weight is placed upon the occurrence or absence of single species. Insects are mobile animals and although many of them demand very precise types of habitat, it is too presumptive to expect all of them to be in their right habitats all of the time. In fact, many of the records reported in entomological journals are made to draw attention to a species' presence in an unusual or unexpected situation. In a fossil assemblage a seemingly atypical species in a fauna which otherwise shows strong ecological trends is likely to be a chance arrival, possibly the result of a dispersal flight. Provided that environmental inferences are based upon faunal assemblages, there is little chance of undue weight being placed upon such casual immigrants. If a seemingly incompatible habitat is suggested by more than one species there is a need for careful analysis of the different factors, but as a rule, fossil assemblages

often show a high degree of agreement within samples. A particular feature of insect investigations from the Somerset Levels is the very close correspondence of habitat requirements of the successive faunas and it is not unusual for beetles tied to interdependent habitats to account for 100% of the stenotopes (ie host specific) in any sample. In this respect, the faunas contrast strongly with those from urban situations where the artificial surroundings can result in apparently anomolous groupings whose interpretation can be problematical, (Kenward 1976, 1977).

Insect faunas from the Somerset Levels

Sample monoliths for insect analysis have been sited in two contrasting areas of the Somerset Levels; the central peat bogs and the island edge situations. The relationship of these sites is shown in a diagramatic section across the Levels (Figure 1).

The three central peat bog sites are Rowland's, a Neolithic hurdle track dated at 4210±90 bp (Coles and Orme 1977), Abbot's Way, another Neolithic track which is dated at about 4000 bp (Coles and Orme 1976a) and the Bronze age structure at Meare Heath with dates of around 2850 bp (Coles and Orme 1976b). At the sites of the Neolithic, sampling has been extended to the underlying clay horizon and there is a complete record of the successive insect faunas until the time of the trackway construction at both sites. This record is continued at the site of Meare Heath, although the age of the most recent peat here is not known. The peat stratigraphy and the approximate levels of the trackways are shown in Figure 2 .

The insect fauna extracted from the peat monolith at Abbot's Way (Girling 1976) is perhaps the most typical of these central peat bogs. Restricted to the basal samples at the clay/peat interface are ground beetles such as Dyschirius aeneus Dej. which live on bare wet clay.

Figure 1

Diagramatic section through the Somerset Levels.

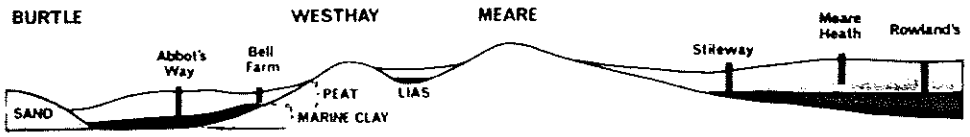
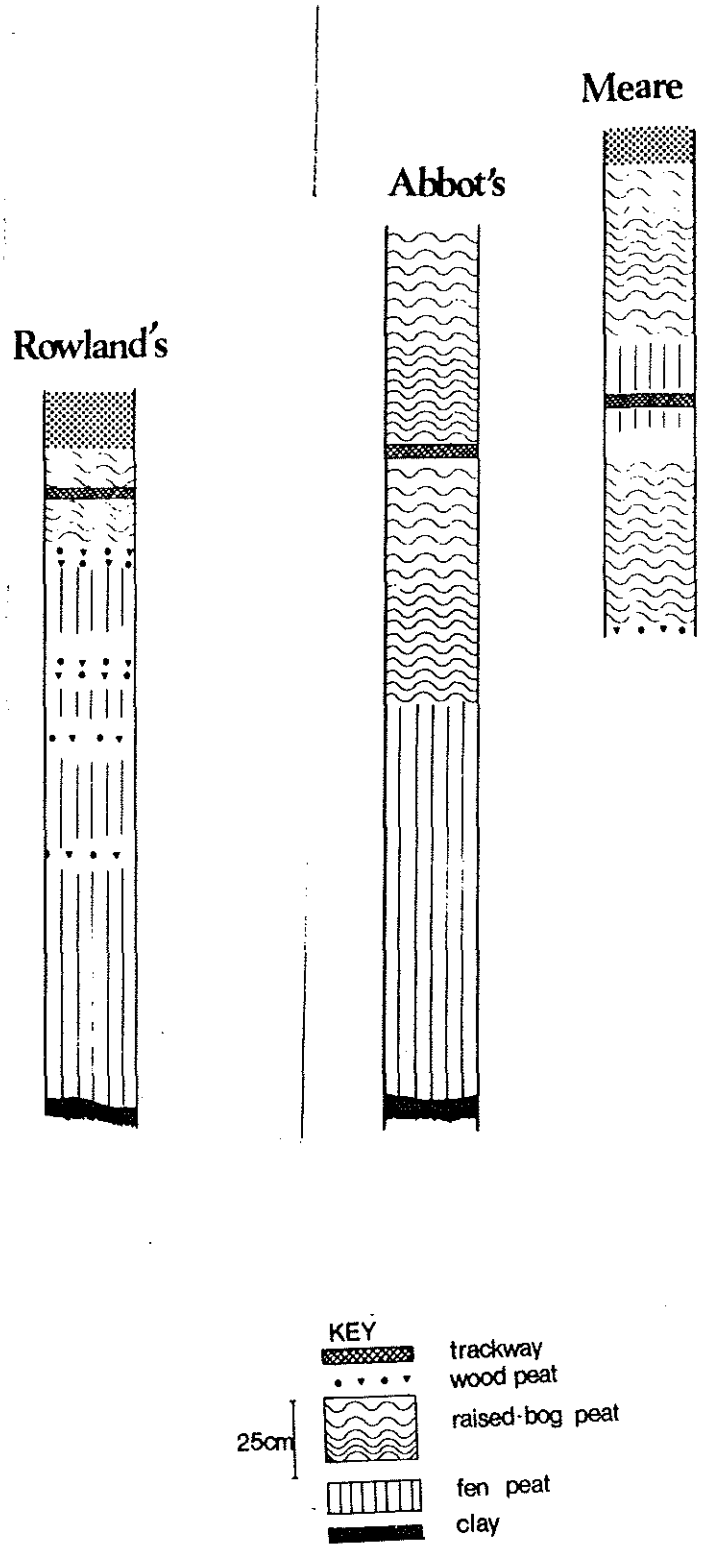


Figure 2

Stratigraphic relationship of trackways



In these and the next four samples there is an extensive reed swamp fauna which indicates an area of reeds, rushes and sedges amongst expanses of eutrophic water. The commonest beetle from these samples is Plateumaris braccata, (Scop.) a phytophage which feeds on Phragmites communis, and numbers of other species also indicate the presence of this plant, amongst them Odacantha melanura (L.) which overwinters in the stem. A proportion of the beetles live in decaying reeds and these appear to increase in succeeding samples. A rich and varied aquatic fauna is present in the lower samples, and those species which have narrow habitat ranges live exclusively in reed swamp and eutrophic fen pools.

Higher in the peat there is a reduction in the numbers of species requiring reed swamp habitats accompanied by a relative increase in eurytopic beetles which indicate that as plant material accumulates and the level of the peat rises, the influence of nutrient rich flood water and possibly ground water is lost and the peat becomes dependent upon rainfall. This eventually progresses to the development of a raised bog. This sequence is strongly reflected by changes in the beetle fauna. Towards the trackway level the stenotopic beetles are almost exclusively raised bog species demonstrating that the Abbot's Way was constructed across a raised bog. A particular feature of beetle faunas from raised bog deposits is the paucity of species and numbers of individuals. Characteristic members of this restricted fauna include Agonum ericeti (Panz.) and Bradycellus ruficollis (Steph.), ground beetles found on acid heaths or bogs and the phytophages Plateumaris discolor (Panz.) which lives on cotton grass and Micrelus ericae (Gyll.) a heather feeder.

This succession from reed swamp and fen peat assemblages to improvished raised bog fauna is closely paralleled in another central peat bog area, the site of Rowland's track, and numbers of the recorded species are common to both sites. One feature not recorded at Abbot's

Way however is the development of carr woodland at about 60 cms. below Rowland's track. Its presence here might reflect the closer proximity of the site to higher ground. The carr woodland phase has been identified from the presence of 11 species of wood dependent beetles, amongst them leaf miners, bark beetles and fungus feeders which are restricted to a 35 cms. layer of peat and occur no where else in the samples. There is another slight difference between th. two sites; Rowland's track appears to cross a drier landscape than the Abbot's Way. Evidence for this is provided by differences in the proportions of indicator species, notably aquatic beetles, extracted from peat at the trackway levels.

At the third central peat bog area, the site of the excavation of the Bronze Age trackway at Meare Heath (Coles and Orme, 1976) a different situation was encountered; the monolith was collected through a recurrence surface. The characteristic raised bog fauna was extracted from the basal part of the monolith, then, coinciding with a stratigraphic change to humified peats, a sudden influx of large numbers of beetles requiring eutrophic habitats was noted. The most important element of this fauna is the large numbers of aquatic species which live in nutrient rich water and which are more typical of fen and reed swamp conditions. Amongst these are Hydrovatus clypealis Sharp., Porhydrus lineatus F. and Noterus clavicornis (Deg.). These species provide strong corroborative evidence for flooding of calcareous water on to the raised bog surface, previously inferred from botanical studies (e.g. Clapham and Godwin 1948). The trackway, occurring at this level, appears to have been constructed as a direct result of this flooding. Certain beetle species restricted to the start of this flooding phase may have been carried into the area in flood debris but the continued occurrence of a suite of related ground beetles, aquatics and phytophages indicated that the bog was strongly modified by the calcareous water. Higher in the peats, there is a return to the raised bog conditions although these are not as strongly developed as those at the monolith base.

In direct contrast, faunas from the two island edge situations both indicate the presence of mature deciduous forest in these areas. An extensive old forest beetle assemblage has been recorded at Stileway on the south east slope of Meare Island, (Girling 1978). The tree dependent beetles, amongst them bark beetles, wood borers, leaf miners and tree fungus feeders, include four species no longer found in Britain. Further records of these species and a fifth extinction have been made at a similar site on the edge of Westhay island from a woody peat deposit at Bell Farm (unpublished data). These assembalges indicate that the islands were at least partially forested during the Neolithic and that areas of woodland probably survived well into the Bronze Age. At Stileway the total fauna indicates that the dense woodland there grew in marshy conditions and it is possible that this area was avoided by man because it was too wet and also too difficult to clear.

Regional correlations

So far in the Somerset Levels information has been obtained from five sites on their ecological record and the environmental background to man's activities in each area. It is now possible to begin a regional analysis of these data and the resulting pattern will become more detailed as further sites are completed. It has already been shown that in the central peat bog areas man's trackway construction was not confined to any particular phase of peat bog development. Also, although some cultivation on higher ground is suggested by pollen evidence (eg Hibbert 1977), beetle evidence indicates that forest clearance was not complete on the islands. The presence in the Somerset Levels of tree dependent beetles which are now extinct in Britain adds to the growing list of similar species from post-glacial deposits which demonstrate the profound effect which man's forest clearance has had on the British beetle fauna, (Osborne 1965).

One area in which regional information is important is the interpretation of climatic evidence. Climatic factors different from those of today are indicated by marked changes in the distribution of particular species. It is difficult to assess the possible role of climate when considering the anthropologically induced changes in the forest fauna, therefore consideration is limited to beetles which live in less vulnerable habitats. Three such species now extinct in Britain have been recorded. At Abbot's Way Oodes gracilis Villa and Anthicus gracilis (Panz.) were recorded from the basal part of the monolith where their presence suggests that higher summer temperatures than those of today prevailed between about 3500 and 3000 years bc. Supporting this conclusion, from the same position in the Rowland's monolith there is a further record of A.gracilis, together with Micropeplus caelatus Er., a species now restricted to south west Ireland and scattered localities in south Europe. At both sites these species are accompanied by numbers of beetles confined to the south of the country and the suggested higher temperatures would be acceptable to all the members of both assemblages. The three extinctions from this country all require eutrophic conditions which have been shown to be restricted to the base of both monoliths. In the absence of positive faunal proof, the disappearance of these thermophiles cannot be attributed to cooler conditions, although clearly at least one such phase post-dating these occurrences has resulted in their extinction. The presence of two northern species higher in the monolith at Rowland's is so far unsupported by other evidence but work is continuing on elucidating possible cooler phases in the Levels.

In conclusion, the continuing studies of insects from the Somerset Levels is providing both local and regional evidence about the development of the peat deposits and the background to man's activities in the area. Information obtained in this way is adding to the understanding of the history of the British beetle fauna and the influence upon it of climatic and anthropogenic factors.

Abstract

Aspects of archaeological insect studies, including methodology and interpretation, are illustrated with reference to studies carried out in the Somerset Levels. In this area five sites, three peat bog and two woodland situations, have so far been investigated. The ecological record at each site has been traced from beetle evidence and complementary studies and the background to man's activities has been established. Correlations between these sites can be made to produce a regional account of the changes in the Somerset Levels from which environmental inferences, such as prevailing climate, can be made with greater confidence than from isolated sites, as such inferences can be tested in other parts of the Levels as more sites are completed.

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