Palaeoenvironment of a mesolithic peat bed from Austin Friars, Leicester

by Myra Shackley and Sally-Anne Hunt

ABSTRACT

A mesolithic peat bed, dated to 9920±100 bp (HAR-4260) (bp = radiocarbon years before the present calculated from A.D. 1950 within + or − of 100 years in this case. Ed.) was recovered from Austin Friars, Leicester. Analysis of preserved fauna and flora, especially insects and seeds, indicated that the peat had formed in a shallow pond or lake, with vegetated, marshy edges subject to periodic flooding. The pond was set in open countryside characterised by a lack of trees and preponderance of light-demanding species, living in a cold, damp tundra climate at the very end of Late Glacial Zone 111 (9000-8300 B.C.) extending into the Post Glacial (8300-4000 B.C.).

1 THE SITE

Excavations were carried out between 1973-8 on the site of the Augustinian friary established during the 13th century outside the western limits of the city of Leicester. The peat bed was found during the course of the excavations (Mellor and Pearce 1981) in the Austin Friars area, which is low lying land occupying an area between two branches of the river Soar (Fig. 1). The area has a high water table created by its situation between the river and canal which impeded excavation, especially during the winter months, but provided excellent waterlogged conditions for the preservation of organic materials. Periodic flooding is indicated throughout the life of the friary, both from archaeological and historical sources.

The restarting of building on the site late in the 14th century involved the partial backfill of the north ditch (shown in Fig.2). Two similar sections were cut across this ditch northwards, labelled e-e (Fig.3 and 4) and a sample taken from the infill material. At the bottom of section e-e a layer of peat, overlying river gravel and sealed by grey clay was noted. The full extent of the deposit was not known but *c.* 1.5m was exposed in the section and Mellor and Pearce (1981) thought that this formed part of a larger deposit. The depth of the peat bed was approximately 200mm and no obvious signs of stratification were present. No great significance was paid to the peat bed at the time, since it was not of importance to the medieval excavations and it seems to have been capped by a layer of grey clay under the thick blue clay which provided an anaerobic seal ensuring good preservation of the organic material. Further evidence for this peat bed appeared during the excavation of the section dug to the south of the wall and it seems likely that the peat bed had been completely covered by the blue clay before disturbance by the digging of the ditch.

The whole of the exposed peat deposit was removed after roughly dividing the exposure into six vertical sections (each *c.*200mm high) whose deposits weighed 6-7 kg each. These samples were removed in complete blocks where possible to minimise damage to enclosed fossils, which aided pollen extraction from the mini-sections at a later date. Samples were

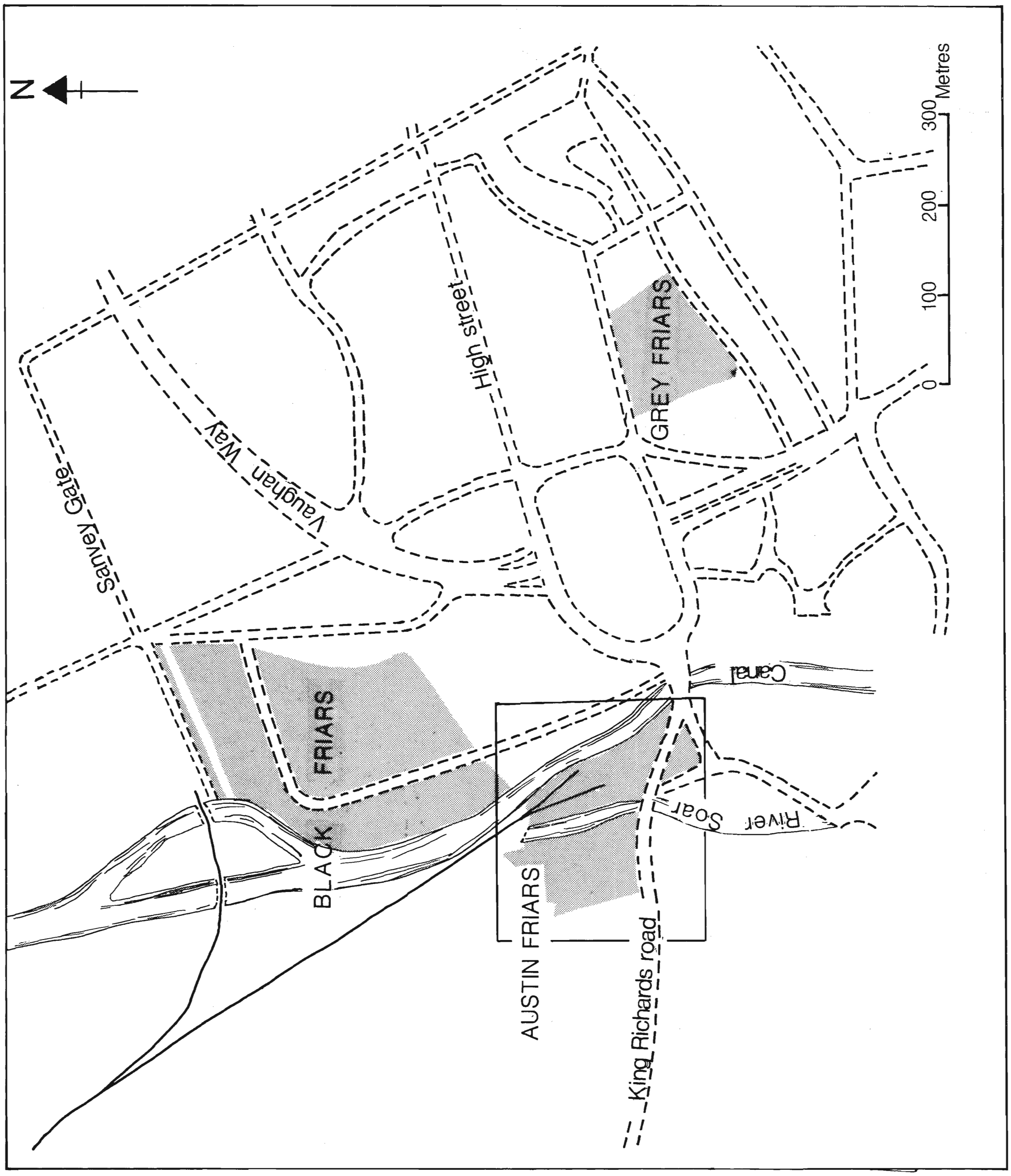

Fig. 1 Location of Austin Friars (after P. Clay, 1981)

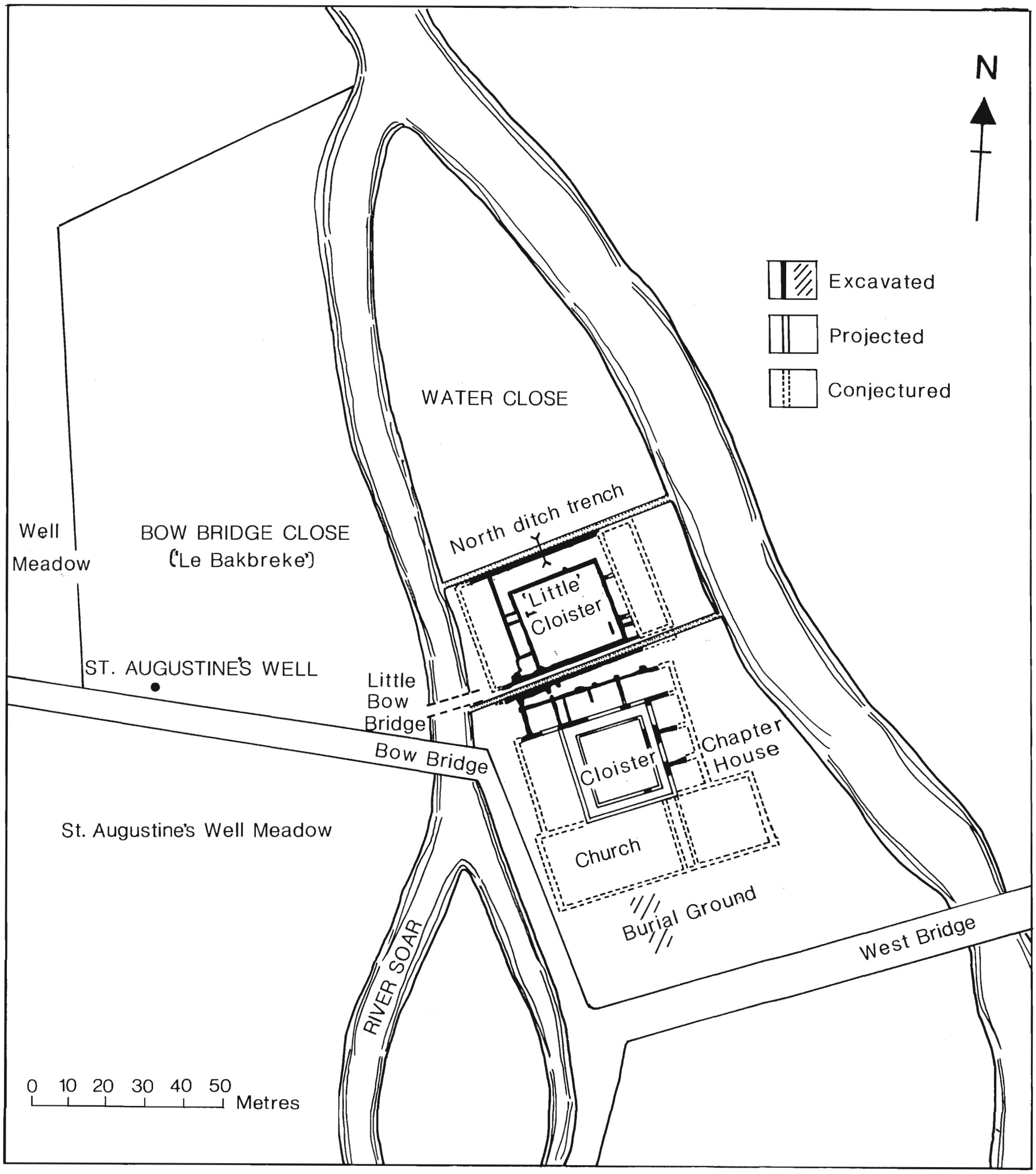

Fig. 2 Austin Friars excavations, showing the north ditch trench (after P. Clay 1981)

TABLE 1

Insect remains. Identifications H.K. Kenward.

Species	Preferred Habit
Coleoptera	
(Carabidae)	
Agonum sp.	Waterside and damp places
Elaphrus riparius	Waterside and damp places
Trechus secalis	Waterside and damp places
(Dytiscidae)	
Agabus bipustulatus	Slow flowing/quiet water
(Gyrinidae)	
Gyrinus sp.	Slow flowing/quiet water
Cercyron sp.	Waterside/damp places
(Hydrophilidae)	
Helophorus sp.	Slow flowing/quiet water
Hydraena sp.?p.	Slow flowing/quiet water
Hydrobius fuscipes	Slow flowing/quiet water
Ochthebius spp.	Slow flowing/quiet water
(Staphylinidae)	
Aleocharinae	Non specific
Anotylus rugosus	Non specific
Arpedium bracypterum	Sub arctic
Carpelimus elongatulus	Waterside
Platystethus arenarius	Foul matter
Stenus spp.	Non specific
(Helodidae)	
Cyphon sp.	Waterside
Drusilla canaliculata	Ants nests
(Scarabaeidae)	
Aphodius spp.	Dung
Clambus spp.	Rotting matter
(Chrysomelidae)	
Donaciinae	Waterside
(Halticinae)	
Halticinae	Non specific
(Curculionidae)	
Apion sp.	Various herbs
Notaris aethiops	Waterside and northern species
Notaris sp.	Waterside
Otiorhynchus ovatus	Open ground, sparse vegetation
Phyllobius or Polydrusus sp.	Various trees and shrubs
Sitona sp.	Papilionaceae — mostly shrubs and herbs
Agabinae indet.	Slow and quiet water
Elminthidae	Running water
Metabletus sp.	Rotting matter
Saldidae	Waterside
(Crustacea)	
Daphnia	Slow and quiet water
(Hemiptera)	
Gerris sp.	Slow and quiet water

TABLE 2
Fruit and seeds (identifications SAH and J.A. Greig)

Species	Subsamples										
	A	B	C	D	E	F	G	H	I	J	K
Ajuga reptans (n)	—	—	—	—	—	—	1	1	1	2	—
Berula erecta (s)	4	11	15	10	12	17	4	6	12	4	6
Carex sp. (s)	—	—	—	—	—	3	—	—	3	—	—
Carex disticha (s)	—	—	—	—	—	2	7	3	—	—	—
Carex rostrata (s)	1	—	3	—	2	1	2	8	2	—	—
Chenopodium sp. (s)	—	—	—	—	—	—	1	—	3	—	—
Cirsium sp. (fr)	—	—	—	—	—	—	2	—	—	—	—
Conium maculatum (s)	—	—	—	—	—	—	—	—	4	—	—
Epilobium sp. (s)	—	—	1	—	—	—	—	—	—	—	3
Galium cruciata (fr)	—	—	—	—	—	—	—	3	6	—	—
Hippuris vulgaris (fr)	—	—	—	—	1	—	—	—	2	3	—
Juncus sp. (fr)	—	—	—	—	—	—	—	1	—	—	—
Lycopus europaeus (fr)	18	8	29	31	45	14	50	22	53	18	30
Mentha sp. (fr)	—	—	2	—	—	—	—	—	—	—	—
Potomogeton natans (fr)	—	—	—	2	—	—	3	—	—	—	—
Ranunculus-Batratium sp. (fr)	—	—	—	—	—	—	—	—	3	—	—
Ranunculus scleratus (fr)	—	—	1	—	—	3	3	—	4	—	—
Rumex sp. (s)	1	—	3	1	—	1	—	2	1	—	—
Scirpus lacustris (fr)	39	59	200	89	67	48	23	50	20	98	62
Stachys sp. (s)	—	—	3	—	—	—	—	—	—	—	1
Stellari media (s)	—	—	—	—	—	—	—	3	—	—	—
Teucrium sp. (fr)	—	—	—	—	—	—	—	—	—	—	1
Typha sp. (s)	—	—	6	5	2	2	12	3	8	4	7
Urtica dioca (fr)	—	—	2	1	1	—	—	2	—	2	—
Chara sp.	—	—	—	—	—	—	—	—	—	3	—

fr = fruit, s = seed, n = nut

The preliminary identification of the seeds was carried out by SAH with Dr James Greig performing further investigations and confirming the initial results. Results are shown in Table (2) and the common name and preferred habitat in Table (3).

Macroplant remains retained on the 5 mm sieve were examined and definite identifications made of *Scirpus scirpus* and *Hippuris vulgaris;* both species also being evidenced by their seeds. A tentative identification of some small twigs as *Corylus* (hazel) or possible *Alnus* (Alder) and a *Salix* (willow) was made, and the samples contained many herb-type root systems and shoots of *Calluna* (heather).

Analysis of the pollen samples was carried out by Dr Kevin Edwards. Not much pollen was recovered but all was from sedge (Cyperaceae), no other species being present.

3 SPECIES IDENTIFIED, AND THEIR HABITATS

A breakdown of the insect and plant species identified is given in Tables (1-3). The insect assemblages indicate several generalised, but easily defined, habitat types, notably slow or quietly-flowing water, waterside and damp places and terrestrial habitats. A quantitative study of the numbers and frequency of the species identified might produce a more detailed

TABLE 3
Plant common names and habitats

Common Name	Habitat
Bugle	Woodland, damp meadow and pasture
Narrow-leaved Water Parsnip	Ditches, ponds, fens, marsh
Sedge	Widespread
Brown Sedge	Meadows and marshes
Beaked Sedge	Wet, peaty places, bogs and marshes
Goosefoot	Marshes, waste places
Thistle sp.	Widespread
Hemlock	Damp places, open woods, stream banks
Willow Herb	Open places
Crosswort	Hedgebanks, shrubby places
Marestail	Still or quiet water
Rush family	Wet ground, waterside, marsh bogs
Gypsy Wort	Wet ground and marshes
Mint	Wet habitats
Broad-leaved Pond Weed	Still or quiet water
Water Crowfoot	Shallow water
Celery-leaved Water Crowfoot	Still or quiet water
Sorrel sp.	Widespread
Bulrush	Margins of lakes and ponds
Herb	Waste places, open habitats
Chickweed	Waste places, cultivated ground
Germanda sp.	Widespread
Reedmace	Slow flowing shallow water
Stinging nettle	Waste places and hedges
Freshwater algae	Still or quiet water

picture but such a project is not logistically feasible at present. The slow-flowing or quiet water insects come mainly from the actively-swimming Hydrophilidae such as *Helophorus* sp., *Hydraena* sp., and *Ochthebius* spp. (Table 1). The presence of *Hydrobius fuscipes* indicates stagnant water and is supported by the surface swimmers *Gyrinus* sp. (whirligig beetle) and *Gerris* sp. (pondskater) which prefer open, stagnant water. The presence of Elminthidae, on the other hand, alone suggests running water and water beetles such as *Agabus bipustulatus* and *Daphnia* (water flea) indicate that the water body was open in aspect. The presence of aquatic plants is deduced since these are necessary to support the Hydrophilidae. A second group of beetles, not true aquatics, still requires a waterside habitat. Most live on plants to be found at the edges of water, for example Donaciinae (Table 1) which lives on emergent aquatic vegetation such as reeds, rooted at the bottom of a river or pond. Other species (*Notaris* sp., *Notaris aethiops*, *Agonum* sp., *Trechus secalis*, *Carpelimus elongata*, *Cyphon* and *Elaphrus riparis*) indicate vegetation. The latter, however, prefers an open habitat with plenty of sunlight. The presence of waterside *Cercyron* and *Arpedium brachypterum* indicates an accumulation of the decayed vegetable matter on which they feed. *Notaris aethiops* and *Arpedium brachypterum* are of particular interest since they indicate cold-stage temperatures. The third group of beetles, slightly more varied in their habitat requirements, are all terrestrial. One component part is associated with foul rotting matter; *Platysthenus arenarius*, for example, is a member of the Staphylinidae, a chiefly carniverous group that live on Arthropod microfauna. *Clambus* sp. and *Aphodius* sp. also inhabit rotting matter but the latter may be found in the dung of large herbivorous mammals although it also occurs in accummulations of highly rotted vegetation (Coope and Brophy 1972.112). A second part of this terrestrial group, for example *Otiorynchus ovatus,* is characteristic of open ground with sparse vegetation but these beetles can exploit many species of plant. *Sitona* sp. are more specific, feeding on Papilionaceae. *Phyllobius* and *Polydrusus* are associated with trees and shrubs and *Apion* with various herb types. *Drusilla canaliculata* is associated with ant nests and other habitats and, indeed, an ant was found in this deposit. A final group of beetles, the eurotypes, do not reflect a specific habitat since they exploit a wide range of species. *Anotylus rugosus,* for example, is found in both terrestrial and waterside habitats.

The fruit and seed assemblages were also grouped into habitat types: slow flowing or quiet water, waterside and marshy habitats, open areas and waste places. A breakdown of the numbers represented from these habitats is shown in Table (2). There is no obvious change in the time factor between the top, middle and base of the deposit. The first, aquatic group, includes species such as *Potomogeton natans* which likes stagnant water in lakes, ponds or slow rivers. It is found in shallow water (less than 1m deep), with its narrower leaves submerged and broader ones floating on the top of the water. *Ranunculus-Batrachium* sp. and *Chara* sp., the freshwater algae, again prefer quiet, shallow water. Plants which are rooted but emerge from the surface, such as *Typha* sp., *Ranunculus scleratus* and *Hippuris vulgaris* (Table 2) are found in very similar conditions. Within this group of plants found in waterside habitats two subgroups may be distinguished, those which grow half-submerged in water and those which prefer wet, marshy conditions. The largest numbers of seeds occurs from plants within the first category, notably *Scirpus lacustris* which, together with *Barula erecta,* is found on the margins of rivers, lakes and ponds where there is abundant silt. *Lycopus europaeus* and *Juncus* sp. are also waterside plants which like very wet ground. The marshy habitat is represented by the sedges *Carex* sp. *Carex rostrata* is found in wet peaty places with a consistently high water level while *Carex disticha* prefers wet, marshy open areas. *Mentha* sp. is a herb which is found in wet marshy habitats. Some terrestrial species of plants were found which prefer open habitats. *Epilobium* sp., flourishes in open habitats, as do *Galium cruciata, Stachys* sp. and *Rumex* sp. *Urtica dioica* (nettle), *Chenopodium* sp. (goosefoot) and *Stellaria media* (chickweed) live on waste ground. There are, in addition, two species which do not fit in to any particular group, *Ajuga reptans* (which indicates damp grassland or woods) and *Conium maculatum* (hemlock) which is found in grasslands, damp places and near water.

The macroplant remains were not sufficiently conclusive to be divided up into groups, but did indicate preferred habitats. Leaves and shoots from *Scirpus lacustris* and *Hippuris vulgaris* support the evidence obtained from the seed identification, indicating slow-flowing water, and the remains of 'herb type' root systems identified in the macroplants support the evidence of the 'herb type' seeds. A tentative identification was made of *Corylus,* which indicates open ground, and *Alnus,* which likes low-lying swampy habitats near lakes. *Salix* type shrubs again prefer open ground and *Calluna* (heather) is found on heaths, moors, bogs and open woods. The identification of Cyperaceae pollen was supported by the recovery of *Carex* sp. and *Scirpus lacustris* seeds although the lack of any other pollen species is unusual. This could indicate a local wetland fauna dominated completely by sedge or, more prosaically, the selective destruction of other pollen types. No firm conclusions should therefore be drawn from the pollen evidence.

4 CONCLUSIONS

4.1 *Palaeoenvironment*

In the interpretation of the information obtained during the course of this work it was assumed that all the habitats co-existed and did not succeed one another, as discussed by Osborne (1972.358) in relation to his work at Church Stretton. Both insects and plants indicated the presence of a body of open, shallow water, possibly stagnant, or at least very slow flowing. The dominance of the Hydrophilidae seems to suggest an adequate growth of aquatic plants but not in sufficient numbers to affect the open nature of the water. The number of plants present which required a high organic matter content with a floor of silt or mud suggested a cut-off pool or meander. The presence of the Elminthidae, which prefer fast-flowing water, at first appears to be contradictory but it may represent a background flora or species introduced by flood water; indicating an event, rather than a habitat (Osborne 1979). The large group of waterside insects and plants seems to have been living in a marshy area around the pool or lake with a profuse growth of sub-aquatic plants such as *Scirpus lacustris* and *Typha* sp. in the very shallow water at the edge, together with *Carex* sp., and *Lycopus europaeus.* The only evidence of amphibian life from these samples was the femur of a frog or toad (kindly identified by T. O'Connell), whose original owner presumably lived in the marshes. The nature of the area surrounding the water was more difficult to determine. Plant evidence produced positive indications of open ground although the numbers of seeds are quite small. Some, like *Epilobium* sp. are colonisers of open ground which are quickly shaded out by higher vegetation (Osborne 1972) where there is little competition, and the presence of open ground is confirmed by the insect remains, notably *Sitona* sp. and *Otiorhyncus ovatus* which exploit a wide range of herb plants. The habitat of the beetle *Aphodius* is more difficult to determine; if it was living in highly-rotted plant matter no problem exists since this would have been present in quantity at the marshy edges of the pool, but its alternative habitat, the dung of large herbivorous mammals, produces more difficulties since no grassland pollen was recovered. The identification of *Ajuga reptans* and *Conium maculatum* does not agree with the other evidence; the former being a woodland plant while the latter is more usually associated with cultivated ground of Roman date. Earlier occurrences have, however, been noted, as far back as the Cromerian (Godwin 1975).

On balance the evidence therefore suggests a cut-off pool with marshy edges, situated in an area of open ground which is sparsely vegetated with herbs and light-demanding shrubs. The presence of trees is suggested but not conclusively demonstrated but it is possible that they were not found in the immediate vicinity of the site, or that they were confined to isolated groups.

4.2 *Climate*

The palaeoenvironment at Austin Friars represents a stage in an assemblage of flora and fauna, arrested in its natural development, known as a hydroseral progression. This succession relies on climatic and physical conditions and at Austin Friars the normal sequence of development from freshwater pool to climax forest has been retarded. Climate plays a fundamental role in establishing the geographical ranges and communities structures of flora and fauna. Insects, in particular, are especially sensitive to climatic change (Coope 1975, 1977) although plants are similarly affected but can generally tolerate a wider variation in temperatures.

The identification of *Notaris aethiops* and *Arpedium brachypterum* provided crucial climatic evidence since both species indicate near tundra-like temperatures. The former is currently restricted to northern Europe and Siberia while the latter presently occupies boreo-montane habitats. A tundra-like climate would preclude the presence of any save scrubby trees, which has already been suggested from the floral evidence,and such a climate would preserve the hydrophytic conditions evidenced from the peat. The majority of the aquatic flora identified can withstand near tundra temperatures, as can many of the compact shrubs. Four of the species (*Ajuga reptans, Berula erecta, Lycopus europaeus* and *Typha* sp.) today have a restricted northern range in Scandinavia and fossil recoveries of *Lycopus* indicate that these species were present in a climate no more severe than that of southern Finland.

4.3 *Mode of deposition*

The peat apparently accumulated in an area of stagnant water somewhere in the vicinity of the present day river Soar. The preservation of the organic material was good, largely due to the overlying anaerobic blue clay. The wet and cold conditions responsible for the peat formation retarded the hydroseral progression to a middle development phase, but the peat bed seemed to have been subject to periodic flooding, as indicated by the presence of terrestrial insect species from the surrounding area. The peat was stratified immediately above an angular river gravel, laid down in fast flowing water, and the change in depositional conditions may be the result of an alteration in the course of the river, perhaps the formation of a cutoff meander. The fossil assemblage does not give any suggestion of the length of time involved, although the peat could have been deposited over quite a short period, rapidly capped by clay and associated with a sudden change in climatic conditions. Alternatively, it could represent a short episode in a long and stable environment (Nigel Pears, pers. comm.). The thick clay deposit indicates another change in depositional conditions, almost certainly further flooding. An almost exact parallel for this sequence was observed by MLS from a peat bed at New Shide Bridge, Isle of Wight, although that was considerably later in date (Shackley 1976).

4.4 *Date*

A radiocarbon date of 9920±100 bp or 7960 bc places the deposit at the beginning of the Post Glacial in the pre-Boreal stage (10-9000 bp, Godwin 1975). The nature of the environment suggested from the biological material, including its combination of apparently contradictory factors, is characteristic of Late Glacial conditions. The Austin Friars vegetation assemblage is of Zone 111 type; dominated by aquatic and marsh plants which reflect the abundance of open lakes and fens in the fresh and uneven landscape left behind the retreating ice sheets and thawing soils. A further, interesting, characteristic of Zone 111 is low pollen recovery. At Austin Friars sedge species are overrepresented. The weeds, indicators of open space and bare soil surfaces, are again consistent with Zone 111 vegetation patterns. Both insect and plant evidence confirms a cool climate, with diverse elements existing together as part of rapid vegetation change and increasing persistence and expansion of established species and vigorous extension of newer ones (Godwin 1975). Osborne (1972) and Coope and Brophy (1972) have demonstrated the rapidity of Late Glacial climatic changes and Osborne (1980) has recently studied a series of dated insect faunas between the Late and Post Glacial periods over a span of nearly 300 years, from 12 165-9000 bp. The area round his site changed from being open marshland to a more aquatic environment of open water and reeds, with an accompanying climatic swing from cool temperate through arctic severity back to temperate. The date of the transition, when the predominantly arctic fauna had been reduced to only one northern species with an increasing number of aquatic species, was 9970±100 bp but an earlier sample, dated 10025±100 bp was identified as Late Glacial Zone 111, with a full arctic fauna (Osborne 1980). The rapidity of environmental changes at this time means that the suggested palaeo-environment and proposed Zone 111 position claimed for Austin Friars may be fully reconciled. The transition between Late Glacial and early Post Glacial phases was not abrupt and as more sites are being identified the boundary is becoming less significant. Austin Friars is a perfectly acceptable Post Glacial site, deposited at the very end of surviving Late Glacial conditions, and it is quite possible that the increase in warmth associated with the Post Glacial played a part in the formation of the peat deposit by causing severe flooding in what is now the Soar valley.

ACKNOWLEDGEMENTS
We are most grateful to the following individuals: Mr Terry Pearce (Leicester Museums Archaeological Unit) who realised the significance of the peat deposit and took the samples; Mr Patrick Clay (Leicester Museums Archaeological Unit) who brought the deposit to our attention; Dr Harry Kenward (University of York), who identified the insect remains; Dr James Greig (University of Birmingham) who made a confirmatory identification of the seed assemblage, and Dr Kevin Edwards (University of Birmingham) who carried out the pollen analysis. Further advice and assistance came from Mr Tony Gouldwell (Environmental Archaeology Laboratory, University of Leicester), Ms Jean Mellor (Leicester Museums Service) and Dr Nigel Pears (University of Leicester). Illustrations are the work of Lorna Smith.

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