THE POST-GLACIAL LACUSTRINE DEPOSITS OF SINFIN MOOR, SOUTH DERBYSHIRE

by

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Summary

Lacustrine deposits are found occupying a shallow depression in the region of Sinfin Moor, south of Derby. The stratigraphy and faunal assemblages of the lake deposits are described. A pollen analysis of marginal peat deposits has been attempted and it is suggested that peat accumulation began late in Zone VII B or in Zone VIII. It is thought that clay deposition was initiated in early Post-glacial times, from the evidence of sparse pollen found at the base of the clays. There is some evidence to suggest that the depression is a solution hollow.

Introduction

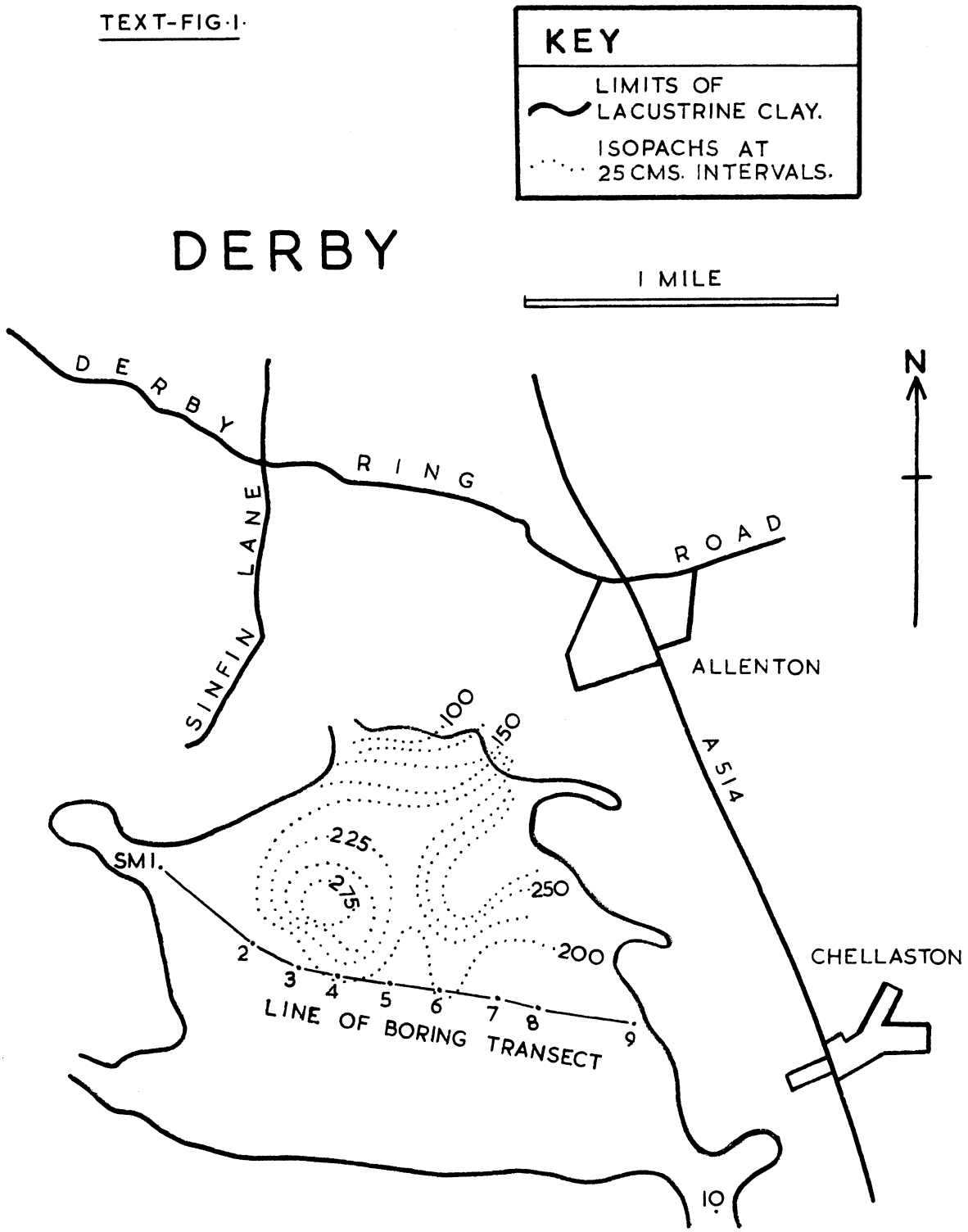
Sinfin Moor, an extensive area of flat pasture land covering an area of some 800 acres, is situated about three miles south of Derby and one mile west of Chellaston (Text-fig. 1). It is shown on the One-inch Geological Survey Map (Sheet 141) as the largest of a group of three areas of lacustrine clay north of the River Trent, in an area bounded to the west by the River Dove and to the east by the River Derwent.

Morphologically similar depressions (i.e. wide shallow basins) occupied by lacustrine sediments occur in the Trent valley to the east, notably at Gotham in Nottinghamshire, but time was not available to make an appraisal of these features, valuable as a comparison would have been.

In 1767 P. P. Burdett recorded Sinfin Moor as an area of ill-drained marshland on a map of the district; and in 1794 Thomas Brown described the geology and pedology of Derbyshire in some detail. Arnold-Bemrose and Deeley (1896) are the only authors known to have investigated the stratigraphy of Sinfin Moor, although their paper is primarily concerned with a description of presumed (? Eemian) interglacial deposits found a few hundred yards east of Sinfin Moor at Allenton. Here they recorded Elephas, Hippopotamus and Rhinoceras laying above the Allenton gravels in fluviatile clays and covered by 'trail', (i.e. solifluction debris). However a single excavation on Sinfin Moor is also recorded, which established the lacustrine origin of the sediments.

Swinnerton (1948) indicates that ice-scouring may have been responsible for some depressions backing high-level gravels north and south of the Trent. The high-level gravels shown have a relationship similar to that between the Hilton Terrace gravels and the Sinfin Moor depression. Also the Hilton Terraces are demonstrably of fluvio-glacial origin in this area,

TEXT-FIG·1·



SINFIN MOOR — THICKNESS OF SUPERFICIAL DEPOSITS IN NORTHERN SECTOR

everything in their lithologies indicating that they are outwash aggradation terraces of the Eastern Glaciation. Swinnerton also notes the survival of a Post-glacial lake until recent times in Nottingham and the existence of lacustrine deposits and peat, often covered by alluvium, on the terrace gravels. Nevertheless Sinfin Moor was found to be floored by a shallow, horizontal platform, and scouring was therefore discounted as an important factor in initiating the depression (Text-fig. 1).

Clayton (1953, 1955) discusses the geomorphology and denudation chronology of the Derby - Nottingham district; and Straw (1963) gives a useful account of the lower and middle Trent. The suggestion by Clayton that the higher gravels of this area are normal aggradation gravels is not borne out by the numerous reports of masses of included boulder-clay in the gravels of the Hilton terraces, notably at the Willington workings (SK 287288). Straw examined the Beeston Terrace, found to the south and east of Sinfin Moor, as did Posnansky (1960), but no general agreement upon the age of this or the closely associated Allenton gravels has been reached.

Johnson (1965), working in the west Pennines, records a lacustrine feature where peat is found overlying Chara-marl and grey silt in a succession very reminiscent of the Sinfin Moor profile. The present study describes the stratigraphy and palaeontology of Sinfin Moor.

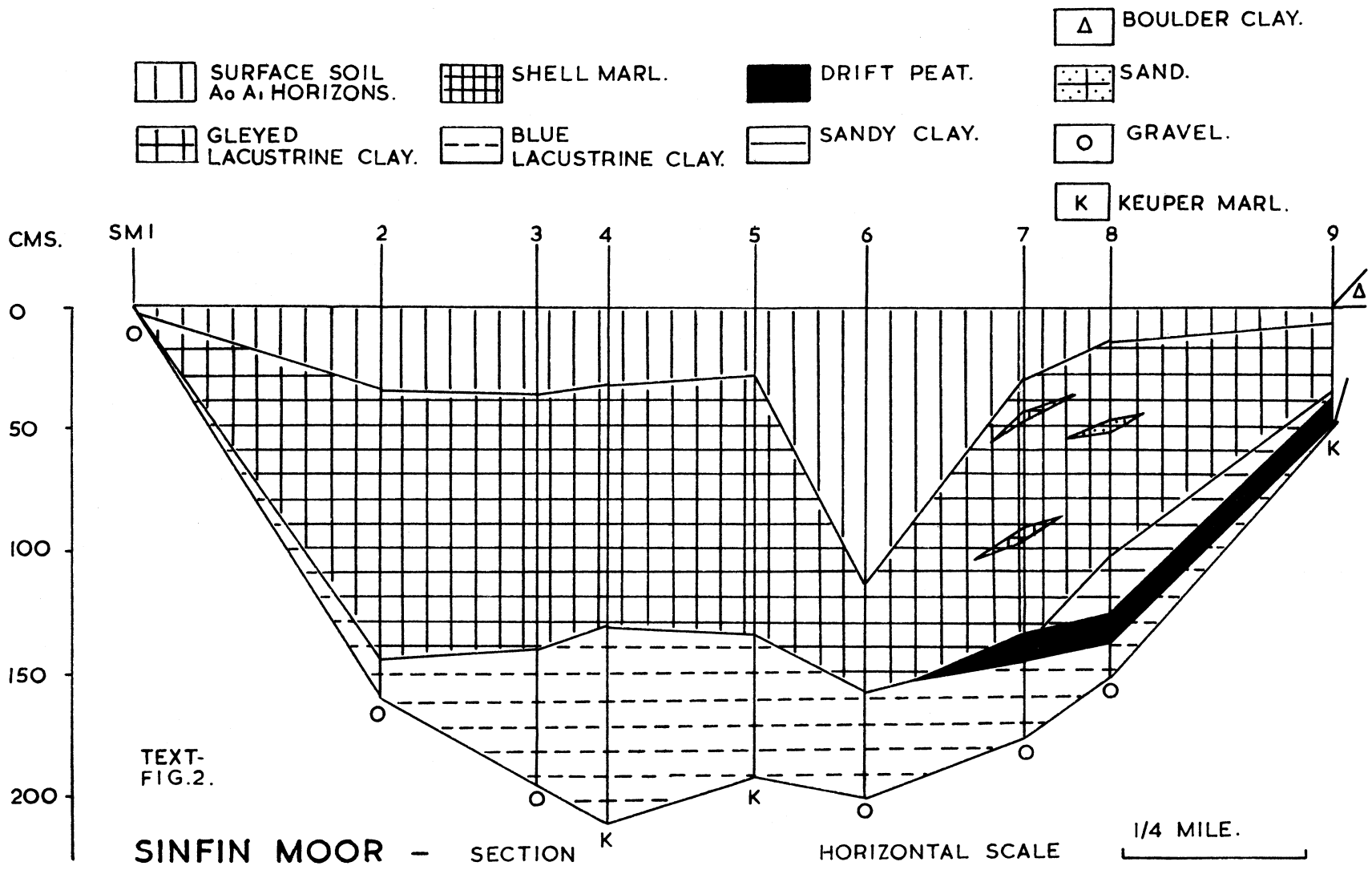
Stratigraphy

A boring transect was taken across the centre of Sinfin Moor in an east-west direction, using a Hiller borer. Borings indicated that lacustrine deposits at all sites were less than 225 cms. thick, but deep borehole data showed that this is exceeded to the north of the transect by about 50 cms.

The stratigraphy was found to be superficially simple, consisting in a typical profile of a surface soil with a humus and A-1 horizon developed above lacustrine clay - gleyed in its upper part and calcareous, blue or grey, below the summer water-table. Coarser sands and clays occur marginally, interbedded with drift-peat which has in all probability been derived from re-worked highly humified peats found poorly developed along the south-eastern margin of the depression, (Text-fig. 2).

Lenses of sand and shell-marl are interspersed in the clays but are only well developed in the gley, where they are stained by ferrous and ferric oxide aggregations. Little of their original structure remains and there is a conspicuous lack of recognisable fossil shells. These lenses could be interpreted as representing shallow pools in which high populations of molluscs and crustaceans were accumulated during periods of drought, or, if the lenses are elongated parallel to the shore, they could be littoral accumulations during low water periods. It is thought that a wide shallow lake such as this would have been subject to almost complete drying out when intense evaporation was active for a long duration. Hard nodules of calcium carbonate are found in the shell-marl, but their origin is not known. From the available evidence it seems that periods of drying out were of short duration and sedimentation in the lake was not significantly affected.

Pebbles were rare in the gley but an admixture of coarse material, pebbles and boulders, was found in the upper layers close to the eastern boundary of lacustrine deposits, and indicates that basin infilling was primarily active from the east, as suggested by the geomorphological evidence of four remnant stream courses entering the depression from the east. The streams draining off the calcareous boulder-clays around Chellaston would have supplied ample calcium bicarbonate into the lake for the rapid colonization by Chara and the molluscans and crustacean fauna found in the clays.


SURFACE SOIL
Ao A1 HORIZONS.
SHELL MARL.
DRIFT PEAT.
BOULDER CLAY.
SAND.
GLEYED
LACUSTRINE CLAY.
BLUE
LACUSTRINE CLAY.
SANDY CLAY.
GRAVEL.
KEUPER MARL.
CMS.
0
50
100
150
200
SM1
2
3
4
5
6
7
8
9
O
K
Δ
TEXT-
FIG.2.
SINFIN MOOR – SECTION
HORIZONTAL SCALE
1/4 MILE.

In several of the bores drifted vegetation was found in the blue clays, probably at more than one level, but known in one case to pre-date the drift-peat. The marginal peats were found to have their greatest thickness in the south-eastern part of the Moor. At site SM 10 (SK 37442934), 115 cms. of highly humified peat (H.9-10) is developed above 131 cms. of blue lacustrine clay. 5 cms. of alluvium or inwashed boulder-clay covers 5 cms. of soil above the peat. The peat is calcareous for about 15 cms. above the clay-peat transition and contained molluscan remains. The succeeding 100 cms. of peat are decalcified and structureless. An attenuated extension of this peat is found for 500 yards north of SM 10, but is always found deeply buried below alluvium or transported boulder-clay; and consequently the relationship between the marginal peat and the standard section (Text-fig. 2) is obscured.

Faunal Remains

Counts were made on faunal remains in the clays and peats at two sites, SM 3 and SM 10. The purpose of the counts was to gain an insight into the ecological history of the lake and to aid dating of the deposits. Samples of clay were taken at various levels at SM 3 and 1 cm. above the clay/peat transition at SM 10. About 20 grammes of clay were taken from each level and disaggregated by boiling in water, and further treated with hydrogen peroxide, which it was found did not harm significantly the ostracod tests present. After sieving the species were segregated using a binocular microscope. The peat from site SM 10 was disaggregated by boiling in dilute sodium carbonate solution and, after filtering, the shells were extracted individually from the matrix.

At site SM 3, molluscs from the clay were counted until the total gastropods plus $\frac{1}{2}$ the total lamellibranch valves amounted to 100, at each sampling level. 200 ostracod valves were also counted at each sampling level. The results were expressed as percentages (Text-fig. 3). Ostracods were found to predominate in the counts, being far more numerous in absolute terms than the molluscan species. The restricted numbers of molluscan species might at first be taken to indicate their slow introduction and establishment, but the high ostracod values do not support this view. It is probable that periodic drying out of the lake would allow ostracods to flourish because of their ability to withstand extremely adverse conditions, and would cause molluscan populations to disappear under very severe circumstances. Recolonization of a re-formed lake would be rapid by the ostracods buried in the lake muds, and with decreased competition their initial advantage would be further accentuated. Molluscs would be slow to re-establish themselves, being wholly dependant on external introductions. As indicators of temperature the ostracods are of little use: the factors limiting their expansion are more likely to be water pH, salinity, competition and food supply. The occurrence of the gastropod Planorbis laevis Alder is tentatively taken to indicate cooler phases in the history of the lake, as the modern range of this species is restricted to northern Britain.

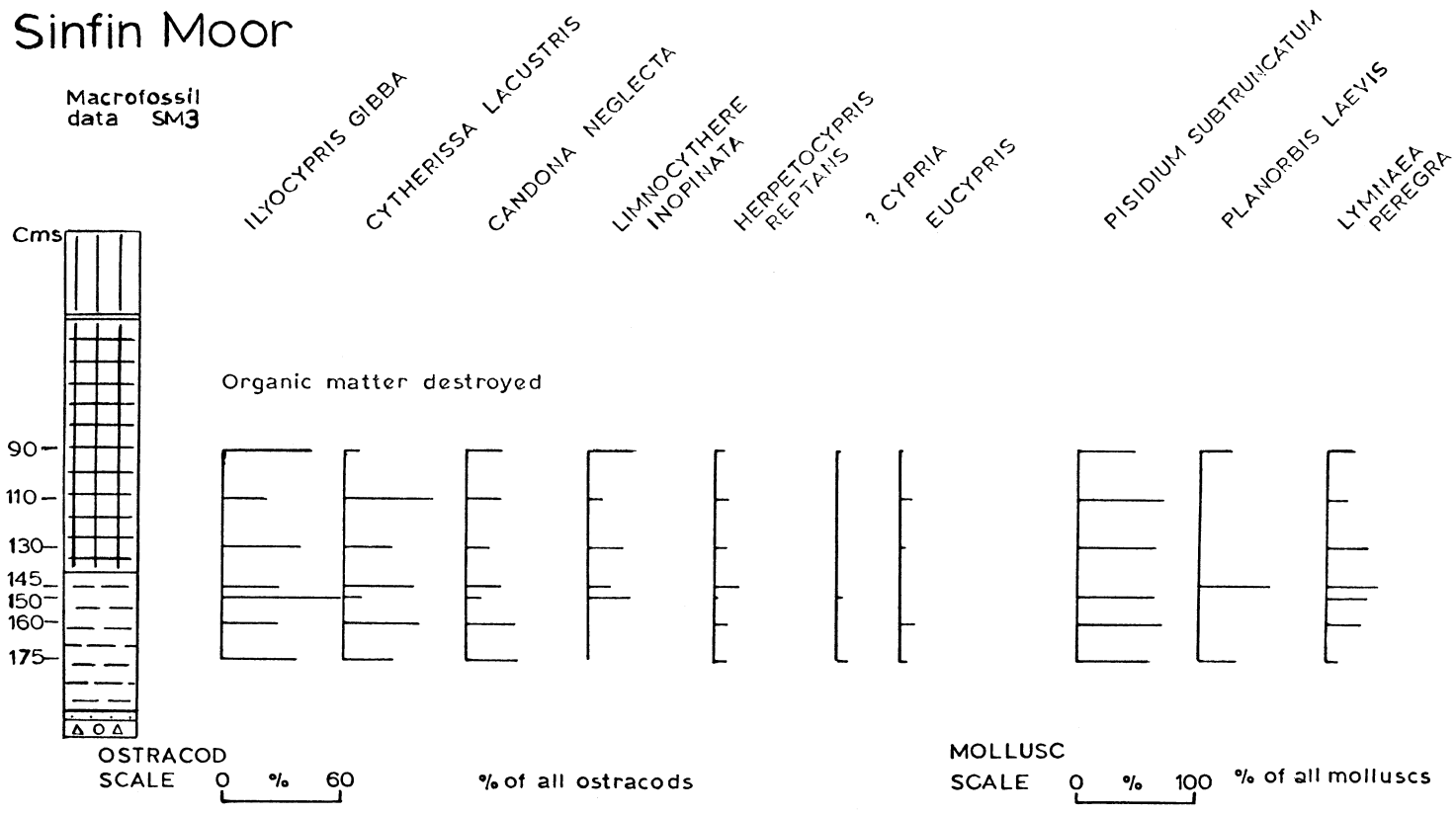
At site SM 10, 100 molluscs were counted and the species present shown as a percentage of the total (Text-fig. 4). The count showed that the basal peat was probably telmatic, as terrestial and lacustrine gastropods are found together, indicating fluctuating water levels during peat accumulation. No sampling was possible above 1 cm. as shell material had been wholly or partly destroyed.

The species recorded at the above sites are given in Table 1.

Pollen Analysis

Pollen analysis of the lacustrine clays of site SM 3 was attempted in order to provide a correlation with the faunal succession, but this proved impracticable. After repeated HF treatment

Sinfin Moor



TEXT-FIG.3.

TABLE 1

Fauna from sites SM 3 and SM 10

Species	Site	Habitat
Lymnaea peregra (Müller)	SM3	Lacustrine
Pisidium spp. juv.	"	"
Pisidium subtruncatum Malm	"	"
Planorbis laevis Alder	"	"
Herpetocypris reptans (Baird)	"	"
Candona neglecta Sars	"	"
Ilyocypris gibba (Ramdohr)	"	"
Limnocythere inopinata (Baird)	"	"
Cytherissa lacustris (Sars)	"	"
?Cypria sp.	"	"
Eucypris sp.	"	"
Planorbis sp.	SM10	"
Lymnaea sp.	"	"
Cepaea nemoralis (L)	"	Terrestial
Acanthinula lamellata (Jeffreys)	"	"
Oxychilus cellarius (Müller)	"	"
Discus rotundatus (Müller)	"	"
Hygromia sp.	"	"
Retinella c.f. pura (Alder)	"	"
Retinella sp.	"	"
Vertiginidae	"	"
Enidae	"	"

of the clay insufficient pollen was found to count.

At SM 10 sparse pollen was found in the basal clays, but very little in the clays above this level. For the sake of completeness the pollen count from the base of the section is given: Betula 6%; Cyperaceae 10%; Empetrum 4%; Pinus 4%; Gramineae 60%; Lycopodium-type 2%; Polygonum 2%; Rumex 2%; Salix 2%; derived spores 4%; others 4%. The spectrum is indicative of open-ground conditions, and one is tempted to regard this as a probable Late- or early Post-glacial accumulation, but it would be unwise to place too much importance upon such a limited count, i.e. 50 grains. The sample was taken at 246 cms. but the pollen diagram proper begins at 115 cms. (Text-fig. 5). Macroscopic remains were found in the clays just below the peat and include seeds of Potamogeton sp. and oospores of Chara sp.

Pollen-analysis of the peat was undertaken following the methods outlined by Faegri and Iversen (1950). The diagram indicates that the peat accumulated sometime during Zones VII B and VIII; and most likely it is a post-Iron Age accumulation, this interpretation being based upon the AP/NAP ratio, the high proportion of weed species, and Pteridium values. Five general phases A-E are shown on the pollen diagram, indicating periods of disforestation and spread of

TEXT-
FIG.4.

Sinfin Moor :

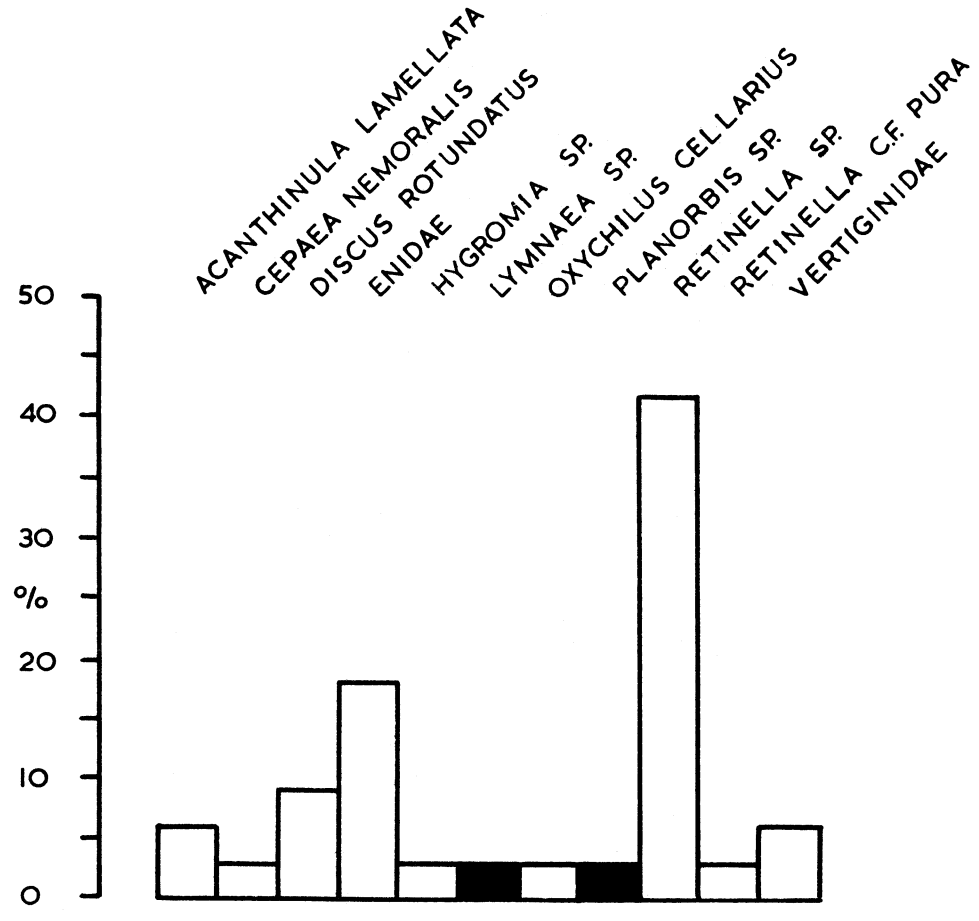
SUB-FOSSIL GASTROPODA FROM I CM.

ABOVE CLAY/ PEAT TRANSITION AT

SM IO SHOWING SPECIES RATIOS.

SHADED – LACUSTRINE FORMS

BLANK – TERRESTIAL FORMS



heliophytes alternating with periods of tree-regeneration. There is insufficient evidence to correlate these phases with known historical vegetational changes.

The high values recorded for Tilia and Taraxacum can be attributed partly to differential destruction. However, the survival of Fraxinus pollen in the peat points to the fact that corrosion of the grains was not too far advanced; and the values recorded are thought to represent fairly accurately the actual representation of these species in the growing flora. From the stratigraphy it was clear that fluctuations in the water-table within the peat had allowed aerobic conditions to become established and some aerobiosis to take place. The declining Alnus frequencies are probably associated in phase E with the enclosure of Sinfin Moor in 1804 and the draining of the Moor in 1828.

The conidia of fungi occur in large quantities throughout the peat profile. The majority are well preserved and withstand acetolysis well. They belong to the Class Oomycetes, which are a group of aquatic and non-aquatic fungi. The most commonly observed species is Bremia lactucae, a form which is parasitic on the Compositae. The occurrence of this species, and others in the Family Peronosporaceae, is taken as further evidence for high percentages of Compositae in the flora at or near the lake during the phases shown on the pollen diagram.

A single pollen count was made on drift-peat from the base of this deposit at SM 8. The pollen spectrum, based on a count of 300 grains, gives Betula 5%; Ulmus 1%; Quercus 9%; Tilia 1%; Alnus 5%; Coryloid 3%; Salix 4%; Graminae 18%; Cyperaceae 12%; Plantago 3%; Ranunculus 2%; Compositae 3%; Caryophyllaceae 2%; Potamogeton 32%. The pollen has clearly come from several sources, (1) from pondweeds (Potamogeton) deposited in situ, (2) from marginal peat deposits and (3) from contemporaneously deposited aerial pollen. The count is therefore of limited value for dating purposes, but the deposit cannot be Late-glacial and is unlikely to be very early in the Post-glacial. It could be derived from marginal peats similar in age to those found at SM 10.

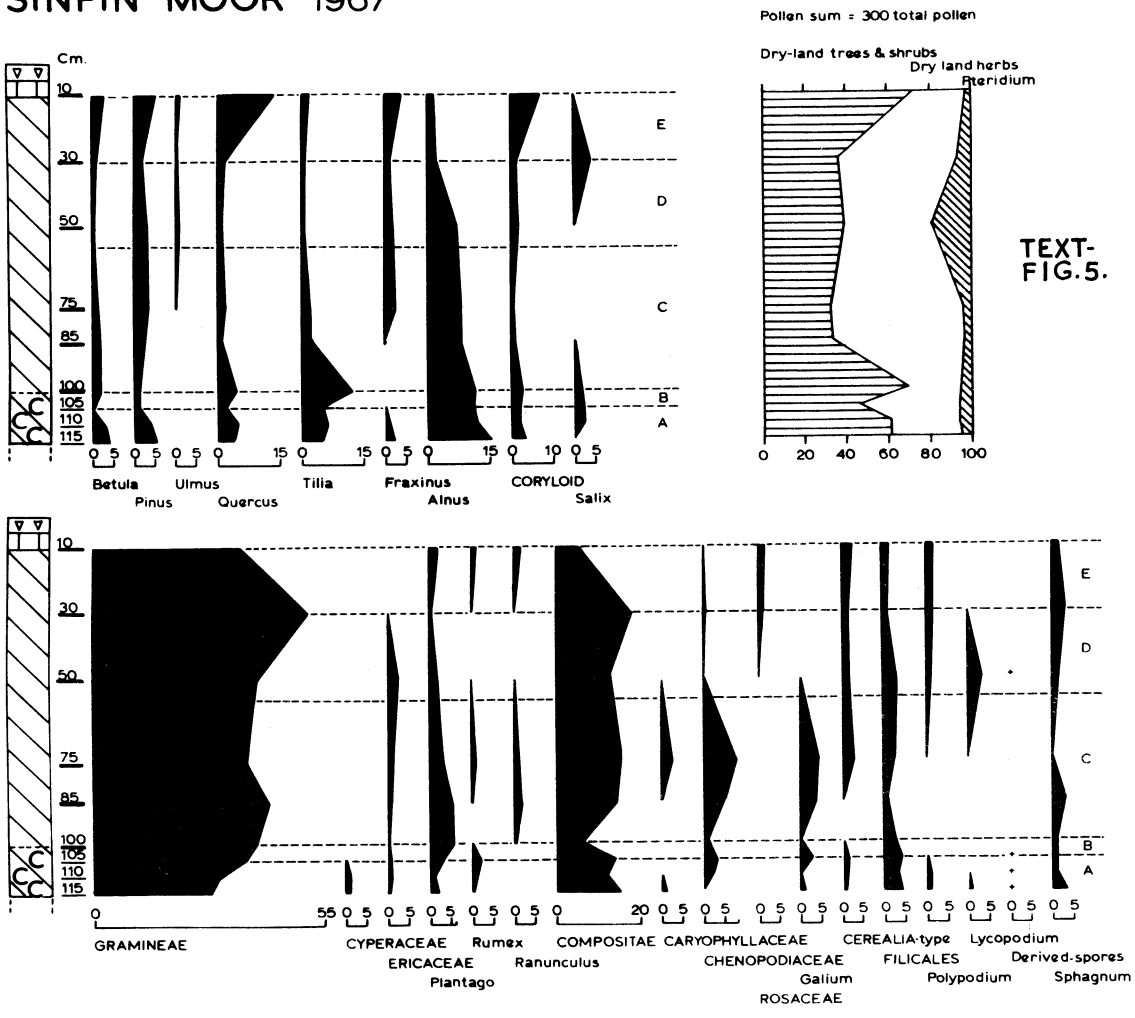
The Lake Depression

The boring transect and deep borehole data showed that Keuper Marl is found below the lacustrine deposits at SM 4, 5 and 9, with gravel below the clays at other sites. Deep borehole records, kindly afforded by Rolls Royce Ltd., indicate that the gravels attain a maximum thickness of 120 cms. at SK 35503102. These gravels are thought to be remnant patches left after incomplete removal of glacial outwash gravels prior to the deposition of the lake deposits, because of their position between the Chalky boulder-clay to the north and the Hilton terraces to the south. The borehole records also showed that gypsum is only rarely encountered in the Keuper Marl below the lacustrine deposits. At Chellaston (SK 386302), quarrying has revealed at least ten bands of gypsum in almost horizontally bedded Keuper Marl. Bemrose and Deeley (1896, p. 508) first suggested the possibility that the Sinfin Moor depression owed its existence to the removal of a soluble bed in the Keuper, but they considered this an unlikely origin. Dr. T.D. Ford has also drawn my attention to possible lacustrine hollows at the south end of the Fauld Gypsum Mine workings, near Tutbury (SK 182284). Borings at this site encountered unspecified superficial deposits replacing the expected gypsum. Enemy bombing during the last war revealed gypsum near Lea Farm (SK 357308) at a depth of ten feet, but the general absence of this mineral indicates that solution may have played a part in the creation of the depression.

General Conclusions

Deposits, predominantly clays and sands, found occupying the shallow Sinfin Moor depression have a lacustrine origin. Marginal deposits indicate the contemporaneous development

SINFIN MOOR 1967



TEXT-FIG.5.

of a hydrosere, with clays containing Potamogeton succeeded by telmatic and probably terrestial peats. A drift-peat found interbedded with the lake clays is thought to derive from re-working of marginal peats during periods of fluctuating lake level. Periods of low lake level are also indicated by shell-marls and high ostracod populations in the unaltered clays.

Infilling of the lake was probably most active from the east, as coarse material was found in the gley near the eastern boundary of the lacustrine deposits associated with four remnant stream courses.

Accumulation in the depression probably began in Late-glacial or early Post-glacial times, with peat development initiated sometime during Zones VII B or VIII.

The absence of gypsum in the Keuper Marl below Sinfin Moor suggests that the lacustrine deposits occupy a solution hollow.

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