EXCURSION REPORT

QUATERNARY TERRACE SEDIMENTS OF THE MIDDLE TRENT BASIN

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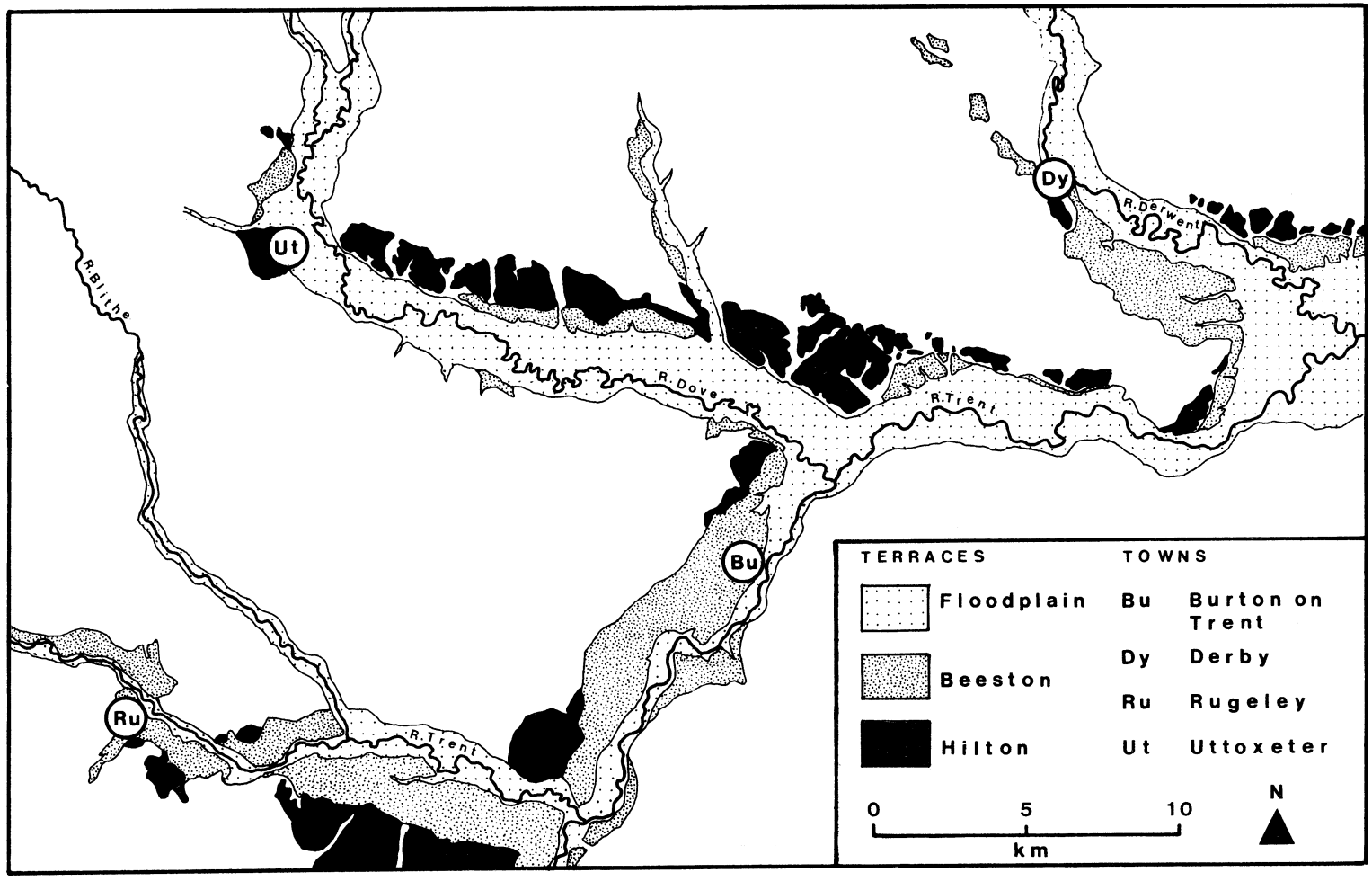
Introduction

The River Trent is a principal river of the English Midlands. It transects the Triassic lowlands of southern Derbyshire and Nottinghamshire in a wide valley flanked by terraces. The terraces comprise discountinuous patches of sand and gravel with relatively level surfaces. They form prominent morphological features at heights of up to 90 ft above the modern floodplain. Following the work of Clayton (1953) three major terraces are generally recognised, text-fig.1, although some of these are locally composite. Traditionally the terraces have been interpreted as representing the remnants of former floodplains which were left behind when the river was forced to cut down to a new level following successive episodes of rejuvenation. In this way, each terrace has been regarded as a single morphostratigraphic unit capable of being dated on the basis of its relative height above sea level. However, considerable disagreement has persisted over the age, origin and even the number of terraces. Recent evidence suggests that the terrace stratigraphy is far from simple (Jones and Derbyshire, 1977). The purpose of this field excursion was to give members of the Society an opportunity to assess some of the evidence for themselves through the examination of temporary sections in the terrace sediments provided by current industrial workings. By this means, it was hoped to demonstrate the amount of useful information that may be obtained from the careful monitoring of gravel workings over a period of time. Since all industrial excavations are necessarily destructive to the surface morphology and sub-surface geology, it is vital that as much information as possible is recorded at the time of excavation. The excursion leaders wished to emphasise that there was a pressing need for more extensive site documentation of this type.

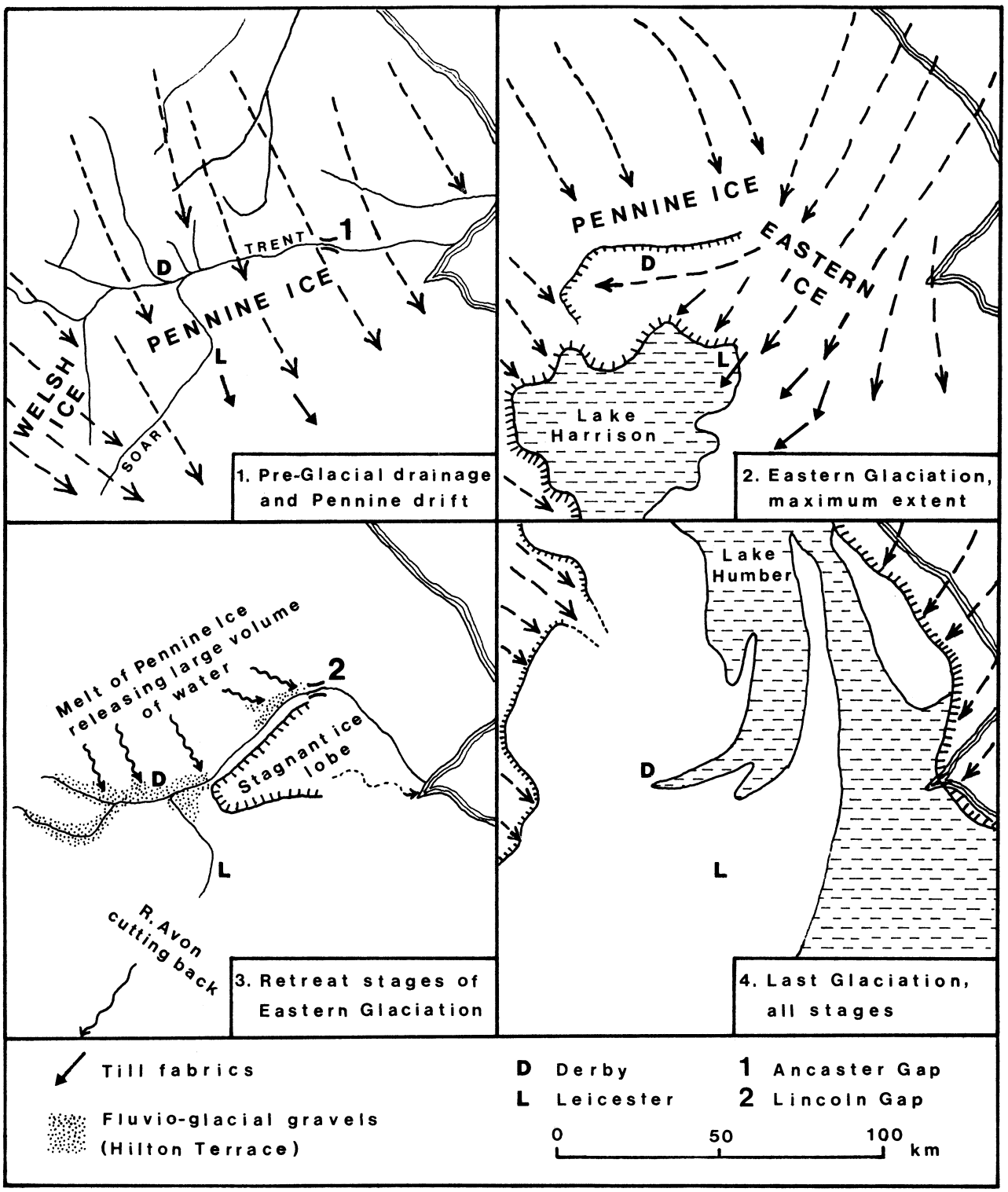
Quaternary evolution of the River Trent

The circuitous and often anomalous route followed by the River Trent between the south-western Pennines and the Humber reflects the complex history of environmental change during the last 2 million years. Although the river's early development is obscure and somewhat speculative, it is clear that the final evolutionary stages are intimately associated with the sequence of late Quaternary glaciations.

The penultimate (Wolstonian) glaciation appears to have caused considerable derangement of Midland's drainage. According to Posnansky (1960) and Straw (1963), the former valley of the River Trent between Long Eaton (SK 5033) and the Wash was deeply gouged by the advancing ice and, during deglaciation, the gouged area was occupied by a large stagnant ice lobe. The Trent was thus unable to re-establish its earlier course across the Vale of Belvoir, and supplemented by meltwater from the decaying ice sheets, eroded a new valley along the north-western edge of the ice lobe, text-fig.2. This route was maintained after the ice melted and now takes the form of an anomalous NE-SW 'trench' aligned obliquely across the Keuper Marl dip slope between Nottingham and Newark. During the melting process, vast quantities of sediment were washed from the ice fronts to form extensive sand and gravel spreads. As the rivers cut down into their valleys these spreads were left as high level terraces. They are particularly prominent on the north side of the River Dove near its confluence with the Trent, where they constitute the composite Hilton Terrace, text-fig.1.



Text-fig. 1: Distribution of 'river terraces' in the Middle Trent Basin.



Text-fig. 2: Glacial chronology of the Middle Trent Basin (after M. Posnansky 1960)

During the ensuing Ipswichian interglacial, temperate conditions prevailed. As a result, river gravels containing a fauna indicative of warm climatic conditions were deposited. At Derby, in 1973, temporary excavations into these gravels revealed the remains of hippopotamus, elephant, rhinoceros, brown bear, red deer, hyaena and bison (Jones & Stanley, 1975). Similar faunal assemblages have been discovered in excavations at Trafalgar Square in London and at other Ipswichian sites in southern Britain.

The Ipswichian interglacial was succeeded by the Devensian cold stage. Ice sheets were mainly restricted to northern Britain, but the English Midlands were subjected to severe periglacial conditions. At this time considerable modification of earlier deposits took place, both by cryoturbation (disturbances related to freezing ground) and as a result of solifluction (mass movement of material downslope). Furthermore, significant changes of sea level caused substantial down-cutting by the rivers. This probably accelerated the erosion of neighbouring upland areas and led to the formation of river terraces in a much degraded landscape.

Comparatively little dissection has taken place in post-Devensian (Holocene) times. The most notable development has been the deposition of alluvium on the floodplains of the modern river valleys. At the present day the River Trent is a rather sluggish stream. Only in periods of flood does it possess sufficient energy to transport coarse detritus. Consequently, deposition of the thick and extensive sheets of gravel which lie beneath the floodplain must have largely occurred when the river was in a more active and higher energy condition; possibly towards the close of the Devensian glacial episode (approximately 10,000 years ago) when the melting of ice sheets and permafrost would have produced a greatly increased discharge. Since that time the river has continually eroded and progressively re-worked these deposits while meandering across its floodplain. Periodic overbank flooding has been responsible for the surficial spreads of alluvium which now obscure the gravels. Much of the alluvium may be derived from soil washed off the interfluves into the valleys as a result of man's clearance of the forests during historical times.

Excursion details

1. Chellaston Quarry (SK 385301)

Inside the quarry, Mr. Jones outlined the general sequence of Quaternary events in the Middle Trent area. The party then had an opportunity to examine the bedrock geology (Keuper Marl) and overlying glacial drift. The former represents the substrate over which the River Trent now flows, while the latter illustrates the material from which the terrace sediments have been largely derived.

The Keuper Marl comprises a sequence of reddish brown mudstones and siltstones with several beds of gypsum. This formation has been examined at other localities on previous excursions by the Society (see, for example, Taylor & Houldsworth, 1973). However, many of the party were intrigued by the variability of the gypsum present at Chellaston, and specimens of alabaster, satin spar and selenite were avidly collected. Attention was drawn to solution marks on the surfaces of gypsum nodules, and it was suggested that selective sub-surface solution of gypsum horizons could be the explanation of various topographic depressions in Keuper Marl areas.

The glacial drift dates from the penultimate (Wolstonian) glaciation and rests on an irregular surface of Keuper Marl. The south-eastern face of the quarry showed a 10 m thick section of drift. This consisted of a basal clayey gravel containing fragments of red mudstone, and an overlying complex of tills containing lenses of sand, sandy gravel and relatively stone-free clays. The tills contained erratics of both northern (Carboniferous) and eastern (Mesozoic) derivation, and some time was spent discussing the implications of this varied suite with respect to the glacial chronology of the region. A particularly notable feature of the erratic suite was the remarkable abundance of derived fossils, and various members of the party collected specimens of bivalves (*Gryphaea*, *Cardinia*, *Lima*, *Nuculana*),

amonites (*Dactilyoceras*, *Amaltheus*, *Schlotheimia*), corals (*Montlivaltia*, *Syringopora*, *Lithostrotion*), crinoids (*Pentacrinus*) and belemnites. Mr. Jones mentioned that the quarry was the last surviving brick-pit in Derby and regretted that it was scheduled to close in September 1977.

2. Etwall Gravel Pit (SK 275300)

Here the party examined gravels ascribed to the Hilton Terrace which reaches its maximum development in this area. The terrace feature had already been noted on the north side of the Swarkestone-Willington road en-route from Chellaston. The Hilton Gravels represent the highest (oldest?) terrace sediments along the River Trent. Previous conflicting views have attributed them either to normal fluvial aggradation (Clayton, 1953) or to glacifluvial deposition (Stevenson & Mitchell, 1955). As a partial compromise Posnansky (1960) suggested that the Hilton deposits represented 'outwash aggradation terraces' initiated during the retreat stages of the Wolstonian glaciation and completed during the ensuing Ipswichian interglacial.

The gravels were poorly stratified and highly disturbed in a form suggestive of severe periglacial disruption. They made a strong contrast with the the lower-lying terrace and floodplain sediments. It was mentioned that lumps of 'boulder clay' had been recorded in the Hilton gravels during earlier excavations (Posnansky, 1960). Members of the excursion examined a discontinuous surficial layer of pebbly clay and there was much discussion (particularly amongst the leaders) whether this constituted a till or a solifluction earth. The problem was unresolved. Nevertheless it was noted that the apparently simple planar surface of the terrace is misleading since it obscures a complex internal structure.

The party then proceeded via Willington and Repton to Ingleby which is situated on the southern bluff line of the Trent valley. Lunch was taken at the John Thompson Inn, Ingleby, SK 354269, in warm sunshine and pleasant surroundings.

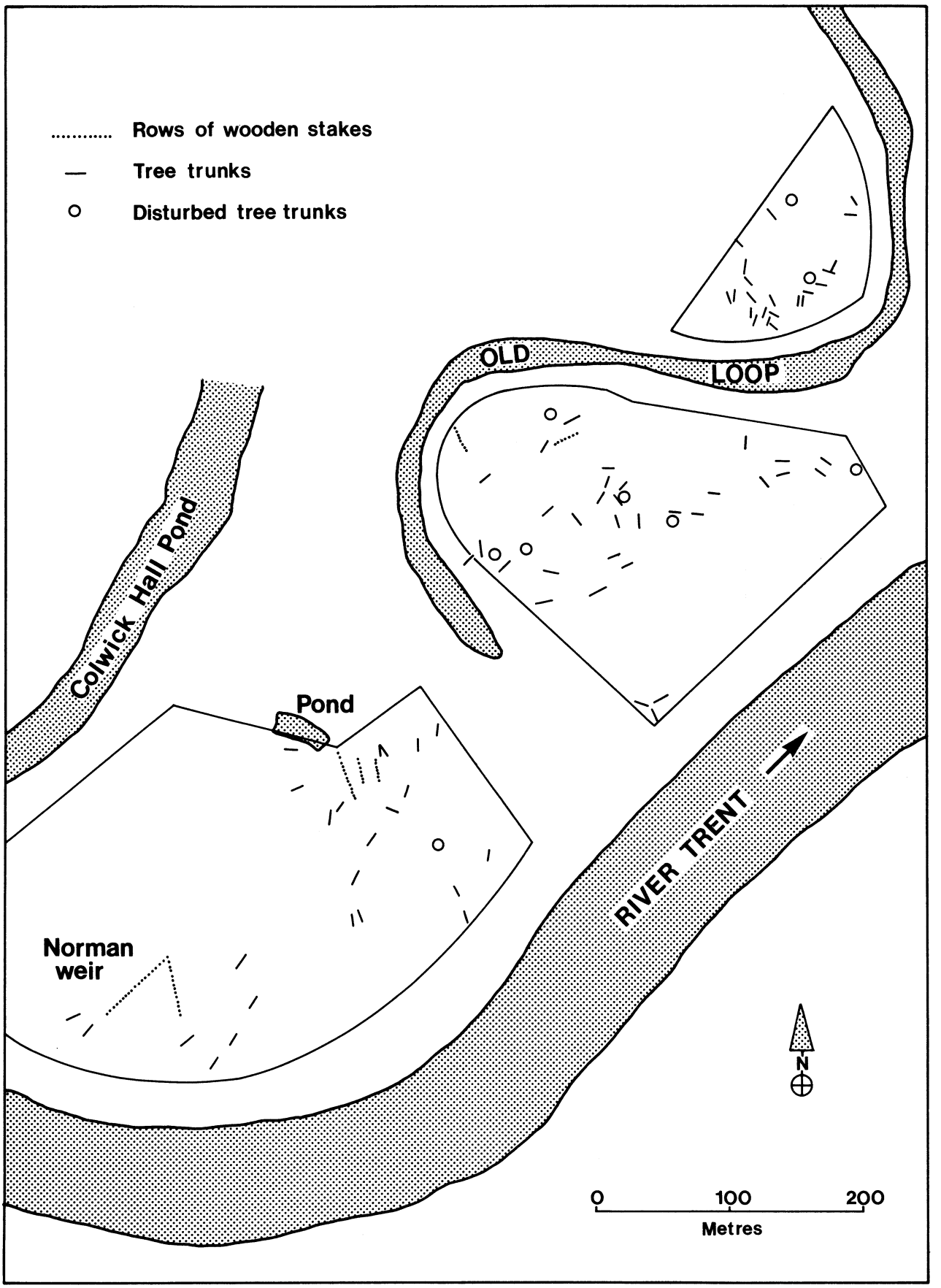
3. River Trent, Ingleby (SK 356270)

After lunch the modern floodplain of the River Trent was viewed from a vantage point on the Ingleby-Swarkestone road. Dr. Cummins briefly outlined the process of fluvial sedimentation and, in particular, discussed the activities of the meandering River Trent. The party's attention was drawn to the active erosion taking place on the outside of a large meander loop, and to point bar deposition occurring on the inside. Recent overbank flooding had added a thin layer of silt and clay to the surface of the floodplain.

The coach and following vehicles then travelled via Swarkestone and Chellaston towards Borrowash, SK 4134. This involved a transect of the Allenton Terrace of the lower Derwent Valley, which is a correlative of the Beeston Terrace of the River Trent. Unfortunately, no exposures in this terrace were available for examination. Previous excavations at Allenton, SK 3732, and Boulton Moor, SK 3831, had revealed Ipswichian mammalian remains (Jones & Stanley, 1975). Before the coach departed from Ingleby, members of the excursion had an opportunity to examine some of the mammalian remains in a "roadside display" provided by Mr. M.F. Stanley of Derby Museum.

4. Church Wilne Gravel Pit (SK 449318)

The route from Borrowash to Church Wilne took the party over representatives of all three terrace features on the northern side of the Derwent valley. Church Wilne lies on the floodplain of the River Derwent near to the confluence with the River Trent. Floodplain sediments and subjacent glacial deposits were examined. The former consisted of brown silty alluvium (1.0 m) overlying coarse sandy gravels (1.5 - 2.0 m) with large-scale cross-bedding. A black organic silty clay occurring beneath the alluvium and occupying a wide sinuous channel in the gravels was interpreted as being an infill of an old meander cut-off. Fragments of Mediaeval pottery, obtained from the clay, indicated that the channel had been active within historical times. Thin lenses of dark organic silt at the base of the gravels have recently yielded a radiocarbon date of 10,320 ± 160 BP (Birm-818).



Text-fig. 3: Distribution of tree trunks and wooden structures found in Colwick gravel pits, Nottingham.

The glacial deposits fill a deep buried channel beneath the floodplain sediments. They form a complex assemblage of tills, gravels, silts and clays, and are probably of Wolstonian age. Unfortunately, because of high groundwater levels, these deposits were not readily accessible on the day of the visit.

5. Colwick Gravel Pits (SK 604388)

Colwick was reached via Long Eaton, Beeston and Nottingham. This route followed the anomalous SW-NE valley of the River Trent. Gravel pits adjacent to the river were examined by walking from the Holme Sluice Road to Colwick Hall. Most of the older workings are now flooded but the southern pit was dry at the time of the visit. The floodplain deposits seen here were similar to those at Church Wilne. However, an interesting feature of this locality was the presence of large flat-lying tree trunks, and members of the excursion examined several of these *in situ* on the floor of the pit.

Dr. Salisbury explained that over 90 trunks had been recorded at Colwick, and the majority of these were oak. They were all tall, straight, forest-grown trees, often with the roots and branch stumps attached. The virtual absence of sap wood suggested that the trees had been dead for some time before deposition. The trunks occurred mainly in the lower 3.0 m of coarse, cross-stratified gravels. In plan, they formed a broad meandering band in which their long axes tended to lie parallel to the river valley, text-fig.3. In general, their roots pointed upstream. It was thus concluded that the trunks were water borne, before being emplaced in the bed-load deposits of an earlier meander of the River Trent (cf. Cummins & Rundle, 1969). Dr. Salisbury speculated that, since oaks were intolerant of flood water, a stand of these trees had been killed and eventually swept away during a period of particularly severe flooding. He briefly described the dendrochronological work which he is currently carrying out on the trunks, and stated that this might eventually provide evidence for the rate of movement of meanders.

Mr. Fox outlined the archaeological attractions of the site. In 1973 a unique Norman fish weir had been excavated which yielded a radiocarbon date of 1105 A.D. ± 70 (HAR-846). It stood in the lowest 2 m of gravel and 200 m away from the modern course of the Trent. Fragments of a similar structure were available for examination by the party. Members were also shown an impressive collection of archaeological objects recovered from the pits. These ranged in age from Neolithic to 18th Century, and served to emphasise the fact that constant re-working of the floodplain deposits has been taking place throughout Holocene times. As a consequence, the depth and position of movable artifacts now bears little relationship to chronology.

The excursion ended with some members finding difficulty in tearing themselves away from the archaeological remains provided by Dr. Salisbury and Mr. Fox. A vote of thanks was made to all four leaders and the coach then returned to Nottingham and Derby.

Acknowledgements

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