# Ugley Park Quarry

[TL 519 280]

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## Highlights

Ugley Park Quarry is important for demonstrating the stratigraphical relations of the glacial and glaciofluvial deposits formed during the later part of the glaciation of the Vale of St Albans, and for correlating these with the fluvial sequences in the Thames catchment. It offers a rare opportunity for the study of ice-proximal glaciofluvial deposits.

## Introduction

Ugley Park Quarry is the most north-easterly of the sites described in this chapter, being situated virtually on the interfluve between the catchments of the River Stort (a tributary of the Lea) and of the Cam or Granta (part of the Great Ouse system, draining to the Wash). The quarry is excavated in Pleistocene sediments that fill a valley cut through Reading and Thanet Beds (Palaeogene) into Chalk. This particular valley-fill lies to the west of the subglacially formed Stort–Cam tunnel valley (Woodland, 1970), which traverses the East Anglian chalklands from north to south. The valley at Ugley has been interpreted as a glaciofluvial spillway (Hopson, 1981). The fluvial sediments that now fill this valley, at elevations of 80–100 m O.D., were deposited by north-bank tributaries of the Thames shortly after its diversion from the Vale of St Albans, at a time when the ice sheets of the Anglian glaciation persisted in the vicinity. These ice sheets supplied outwash to the river system and, intermittently, advanced across the gravel floodplains, depositing the tills that are interbedded with the fluviatile sequence.

The significance of the site accrues partly from its geographical position on the modern watershed between the Thames system and the drainage of the Wash basin; it thus provides a link between the fluvial and glaciofluvial sediments of the Middle Thames/Vale of St Albans and the equivalent glacial deposits of central-southern East Anglia. The main value of the site is that it demonstrates more clearly than elsewhere the stratigraphical relations between the late Anglian sediments of both these areas.

## Description

Ugley Park Quarry consists of separate east and west pits, of which the latter has been partly infilled. The floor of the west pit formerly exposed the junction between the Upper Chalk and the overlying Palaeogene, here represented by the Thanet Beds (with the characteristic Bullhead Bed at the base, at 80.5 m O.D.). The Thanet Beds and the succeeding Reading Beds formed the floor of the eastern part of the west pit, but have not been seen in the east pit, as the full Pleistocene sequence there has not been worked. London Clay is not seen, but occurs 300 m east of the east pit, below till. Silty sand and clay that have been interpreted as Palaeogene in age appear in the eastern face of the east pit but, as discussed later, are probably not *in situ.*

Attention was drawn to the deposits at Ugley Park Quarry by Hopson (1981) and they were discussed briefly by Wilson and Lake (1983). The latter authors recognized two Pleistocene sedimentary beds: up to 10 m of poorly sorted chalky flint-gravels succeeded by up to 6 m of chalky till. The chalky gravel has been attributed to a proximal glacial origin and is thought to be the infilling of a north–south aligned channel parallel to, but 1.5 km to the west of, the Stort–Cam tunnel valley (Hopson, 1981). Wilson and Lake (1983, p. 78) noted that, in the north-east part of the east pit, the chalky till contained 'intercalations of silts with laminated beds, and irregular silty sands with complex convoluted structures and lenticles of firm olive grey clay'. They asserted that the lenticles of clay were derived from soft Palaeogene bedrock.

Cheshire (1986a) recognized a further lithostratigraphical unit in the east pit. This unit, a stiff, dark grey chalky till, does not outcrop in the eastern face, the face that has received the most attention, and appears not to have been recognized

earlier. Boreholes in the quarry floor have revealed that an additional gravel unit occurs beneath the till, although in places the latter rests directly upon Reading Beds. This basal gravel is poorly sorted and contains cobbles of flint and Chalk.

The full sequence is therefore as follows:

| | | Maximum thickness west pit/east pit |
|---|---|---|
| 4. Chalky till, brown/yellow-brown | (Westmill Till) | 2.0 m/3.0 m |
| 3. Chalky gravel and sand, cross-bedded | (Ugley Gravel) | 9.5 m/4.6 m |
| 2. Chalky till, dark grey | (Ugley Till) | —/6.9 m |
| 1. Clayey, siltysandy gravel | | —/>3.7 m |

The Ugley Till occurs only in the east pit, where the top 2 m has been exposed. It is stiff, massive, compact and apparently structureless. The particle size, acid solubility, and small-clast composition are similar to those of the Westmill Till, both at this site and at Westmill Quarry.

Fabric data from the Ugley Till reveals statistically significant preferred orientations suggestive of lodgement by ice moving from the north-west or north-north-west.

The Ugley Gravel lies in a channel with its base at about 85 m O.D. It overlaps the Ugley Till at elevations of between 88 m and 94 m O.D. in the east pit. The maximum thickness is seen in the west pit, where the gravel reaches 9.5 m; it thickens as the top of the Ugley Till descends eastwards across the east pit. The orientations of large-scale trough and tabular cross-bedding in the chalky gravel and sand in the west pit suggest southward palaeocurrents. These structures also suggest deposition in a braided river with fluctuating energy conditions. Similarly, southward palaeocurrents are indicated by structures in chalky sand in the east pit. The gravel in the east face of the east pit incorporates a till-derived debris flow and massive matrix-supported gravel in its lowest three metres. This is succeeded by a thin buff silty clay and up to 1.4 m of cross-bedded coarse chalky sand.

The Ugley Gravel has a clast composition that differs markedly from other gravels in the Thames system (Bridgland, 1980, 1983a, 1986b; Cheshire, 1986a; Bridgland *et al.,* 1990; (Table 3.2)). In particular, it has a very low proportion of rounded flint pebbles reworked from the Palaeogene; this can be as low as 1–2%, but is highly variable. The gravel also contains abundant Chalk and exotic limestones (mainly Jurassic), the calcareous fraction sometimes approaching half the total count. Another significant constituent of the gravel is *Rhaxella* chert, at up to 1.5% (including calcareous *Rhaxella*-bearing rocks). Clasts of this rock are believed to have been introduced in quantity into the London Basin for the first time by Anglian ice. Exotic rocks that are characteristic components of Thames deposits are relatively scarce in the Ugley Gravel, particularly in comparison with the pre-diversion Thames formations. The extremely calcareous Ugley Gravel contains the highest proportion of Chalk recorded in any fluvial deposit yet studied in Hertfordshire and Essex and has been taken as a standard for Anglian Stage ice-proximal outwash (Bridgland, 1980, 1986b; Bridgland *et al.,* 1990; (Table 5.1)).

Resting upon the eroded but generally even surface of the Ugley Gravel in both pits is the Westmill Till. This brown to yellowish-brown, very chalky till increases in thickness northeastward, reaching 8.6 m at The Hall, Ugley [TL 521 285]. Its particle-size distribution is remarkably uniform both vertically and laterally and, in common with the same till at Westmill Quarry, it contains little medium-grade sand in comparison with the Ware and Stortford Tills. The small-clast composition includes relatively high proportions of flint and *Rhaxella* chert; quartz is less abundant and the acid-soluble content higher than in the Ware and Stortford Tills. Fabric analysis indicates ice-movement from due north.

The thickness of chalky Westmill Till is reduced to about 1 m in the north-eastern part of the east pit, where the lower part of this member contains a large body of silty medium-fine sand. This sand, which contains faint cross-bedding, appears similar to Palaeogene bedrock sediment, but lies 12 m above the maximum height at which Palaeogene strata are known to occur in this part of the quarry. However, in small pits at the base of the face, the silty sand was seen to overlie coarse chalky sand of the Ugley Gravel. This silty sand is probably the same material observed by Wilson and Lake (1983) in the

north-eastern part of the site. Streaks and small lenses of chalky till occur in the upper 0.5 m of this sand body, which is thought to represent a large raft (at least 15 m across) of Palaeogene sediment transported, possibly as a frozen block, by the Westmill Till ice.

## Interpretation

The sections at Ugley Park Quarry record the only known sequence that demonstrates conclusively the stratigraphical relations of the Ugley Gravel and the Ugley Till. The Chalk-rich Ugley Gravel can be traced, mainly through borehole records, down the Stort valley to the modern Lea valley, where it can be correlated with that part of the Westmill Upper Gravel occurring above 68 m O.D. at Westmill Quarry. Gibbard (1974, 1977) showed that the carbonate content of the Westmill Upper Gravel increases significantly at that elevation within the Westmill sequence, in conjunction with a change in palaeocurrent direction (see above, Westmill). This higher carbonate content (principally Chalk) has been recorded by Cheshire (1981, 1986a) in the upper part of the Westmill Upper Gravel at other sites in eastern Hertfordshire and western Essex, the largest calcareous component occurring at Ugley Park Quarry. The latter site was therefore selected as the type locality for the upper division of the Westmill Upper Gravel, the Ugley Gravel. The thickness and Chalk-content of the Ugley Gravel is considerably reduced in the area between the type site and Westmill. The lower part of the Westmill Upper Gravel was redefined by Cheshire (1986a) as the Hoddesdon Gravel (type locality: Cock Lane Quarry, Hoddesdon, [TL 354 077]).

The Ugley Till, unit 2 at Ugley Park Quarry, is absent at Westmill. However, at the former Foxholes Quarry [TL 340 123] and [TL 342 125], south of Hertford, a till with particle-size, small-clast lithology and carbonate properties identical to the lower till at Ugley occurs below a Chalk-rich gravel that is correlated with the Ugley Gravel (see above, Westmill). At this site, the Ugley Till had a highly significant fabric orientation, suggesting lodgement from the north-east. Cheshire (1986a) considered that the Ugley Till at Foxholes Quarry was deposited near the ice margin, implying that it represents the least extensive of the four glacial advances that affected the Hertfordshire/western Essex region.

In previous schemes for Anglian glacial stratigraphy in this area, only two glacial advances were recognized. West and Donner (1956) and Clayton and Brown (1958) advocated the separation of upper and lower tills over a wide area of southern East Anglia on the basis of distinctive fabric orientations. According to these authors, fabrics from lower tills were indicative of ice-movement from the north-west and those from upper tills from the north. Gibbard (1977) agreed that tills in the wider region can be separated by their fabric properties and also recognized two advances in Hertfordshire, those associated with his Ware and Eastend Green Tills. At Quendon, 3 km north of Ugley Park Quarry, Baker (1977) identified a lower till, which he named the Quendon Till, in a similar sequence to that found at Ugley. The Quendon Till is 1.8–7.6 m thick, dark grey and has a preferred fabric orientation indicating ice-movement from the north-west, similar to the Ugley Till, to which it is quite possibly equivalent. However, Baker and Jones (1980) equated the Quendon Till with the Ware Till of Gibbard (1977) and the Maldon Till of Clayton (1957), on the basis that it is the lower of the two tills that were recognized over a wide area at that time. Baker and Jones cited evidence (after Baker, 1977), from proglacial varves in lacustrine sediments, implying that, between the deposition of their lower and upper tills, the ice front retreated to the Newport area in northern Essex and stabilized there for a minimum period of 5400 years.

Cheshire (1986a) has shown that tills in the south Hertfordshire/western Essex area possess distinctive petrographical properties, which, with the use of similarity indices, enable correlation from site to site. These methods show that the distinctive Ware Till signature may be traced from site to site towards Ugley, but cannot be recognized in the Ugley Till. Thus the Ugley Till cannot be equated with the Ware Till, despite having a fabric orientation that indicates ice advance from the north-west or north-northwest. Although the Ware Till, Stortford Till and Westmill Till may be differentiated from each other by their petrographical properties, the Westmill Till and Ugley Till are petrographically similar. They may, however, be differentiated by their stratigraphical positions respectively above or below the Ugley Gravel.

At Westmill Quarry, the Westmill Till shows a preferred fabric orientation that, coupled with structural discontinuities related to ice-movement, indicates lodgement from the north-east; this contrasts with the northerly origin of the same till at Ugley. This general pattern, which is reproduced to a greater or lesser extent in sediments deposited by each of the four ice advances into the Vale of St Albans, may be interpreted as the result of ice repeatedly approaching the Thames

Basin from the north or the north-north-west, as proposed by Perrin *et al.* (1979). As the ice crossed the Chalk escarpment and entered the former valley of the Thames, it spread out to the south-west in Hertfordshire, to the south-east in Essex and Suffolk (Allen, 1983), and southwards in central Essex (Allen *et al.,* 1991).

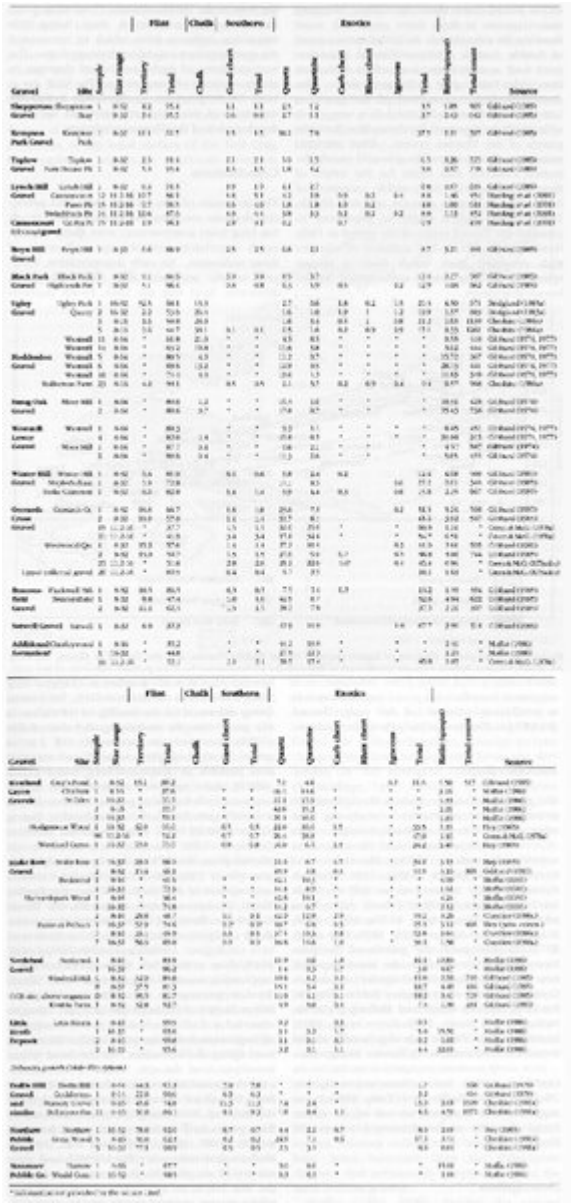
Samples of the gravel detected in boreholes below the Ugley Till were not available for analysis of petrographical properties, but the material is probably equivalent to the Hoddes-don Gravel, the lower, less calcareous division of the Westmill Upper Gravel. This unit, like the Ugley Gravel, can be traced down the Lower Lea valley as far as Bullscross Farm (Cheshire, 1983c, 1986a; see above, Westmill). Thus all the sediments at Ugley Park Quarry were deposited after the Thames had been diverted from its Vale of St Albans course, in what had already become the catchment of the River Lea.

The sequence at Ugley Park Quarry shows the stratigraphical relations of the later Anglian glacial and glaciofluvial deposits in the northern part of the Thames Basin. It complements the site at Westmill, in which the Ugley Till is missing from the sequence. The Ugley Park Quarry site also provides the best exposure of the chalky Ugley Gravel outwash. Thus both Westmill and Ugley can be regarded as key Anglian sites, each exhibiting part of a complex sequence.

## Conclusions

The complex sequence of sands, gravels and till (boulder clay) at Ugley Park Quarry is important for showing that, during the cold Anglian Stage of the Quaternary Ice Age (about 450,000 years ago), the Thames catchment was repeatedly invaded by ice moving from the north or north-north-west. The evidence from Ugley is critical, in conjunction with that from Westmill, in demonstrating that there were at least four of these Anglian glacial advances, each of which deposited characteristic tills. Gravels and sands, found between and underneath the tills at Ugley, were deposited by meltwater streams flowing from the ice sheets and feeding the newly formed River Lea system.

**References**



*(Table 3.2) Clast-lithological data (in percentage of total count) from the Middle Thames and Vale of St Albans (compiled from various sources). The data concentrates on key sites, GCR sites and localities mentioned in the text. Note that many different size ranges are included and that these yield strikingly different data (this can be observed where results from different fractions from the same deposits have been analysed). As in (Table 4.2), (Table 5.1) and (Table 5.3), the igneous category includes metamorphic rocks (very rarely encountered) and the quartzite category includes durable sandstones. The Tertiary flint category comprises rounded pebbles (sometimes subsequently broken) reworked from the Palaeogene (see glossary with (Table 4.2)).*

| Central and northern Essex | | Eastern Essex | |
|---|---|---|---|
| Deposits of local rivers | | Deposits of local rivers | East Essex Gravel Group |
| | | Low-level East Essex Gravel Subgroup | |
| Anglian glacial deposits | | | |
| Low-level Kesgrave Subgroup | Kesgrave Sands and Gravels Group | High-level East Essex Gravel Subgroup | |
| High-level Kesgrave Subgroup | | | |

*(Table 5.1) Lithostratigraphy of fluvial gravels in Essex.*