WEEK-END FIELD EXCURSION TO SOUTHERN EAST ANGLIA

Leader: J. Rose — May 3–5th 1985

A party of 26 members gathered at the Graham Court Hotel in Ipswich, on the evening of Friday 3rd May, to review the field programme for the coming two days and discuss the themes to be considered during the excursion. Mr. Rose began by reporting that, after a day checking the sites, most sections were in reasonable condition, all problems of access had been arranged and it would be possible to examine all aspects of the Pleistocene geology of south-west Suffolk. He then outlined the main topics to be considered:

(i) Early Pleistocene marine and estuarine sediments. These provide evidence for shallow marine submergence across the region. Within them are the first traces of glaciation in the British Isles.

(ii) Middle Pleistocene river deposits and palaeosols. The river deposits were laid down when the Thames drained north-eastwards across the region. The palaeosols developed on the terrace surfaces and retain detailed evidence of both temperate, and severe periglacial, climatic conditions.

(iii) Middle Pleistocene glacigenic deposits. These were formed when the Anglian glaciers covered the region, and represent a wide range of glacial and glacifluvial depositional environments. It was at this time that the relief of East Anglia was changed fundamentally from a series of river terraces formed by the river Thames draining north-eastward, to a radial pattern of drainage parallel with the ice-flow paths.

(iv) Late Pleistocene river deposits. These are restricted to the valley bottoms and provide evidence for the last processes effectively to shape the landforms of the region.

The location of sites studied during the field excursion is given on Figure 1. A summary of the stratigraphic units observed during the excursion is given on Table 1. Although the sites visited during the field meeting are restricted to south-east and east Suffolk, they are typical of southern East Anglia as a whole and reflect the geology of the wider region. During the excursion transport was provided by the Birkbeck College Minibus and members' cars.

On the morning of Saturday 4th May the party travelled north to examine the Early and Middle Pleistocene marine and estuarine deposits.

The first stop was at the famous section at *Neutral Farm, Butley (TM 372511)* where a small, fresh exposure in the now overgrown quarry showed a typical example of Red Crag that is dated to the Pre-Ludhamian Stage at the very base of the Pleistocene (Beck *et al.*, 1972). These deposits are considered to have formed by tidal currents flowing towards the south-west (Dixon, 1979), and are typical of the Red Crag Formation (Zalasiewicz and Mathers, 1985).

Members were able to examine, and collect from, some 3 m of shelly sands with well developed, large-scale cross-set structures. This deposit merged upwards into more horizontally bedded, less fossiliferous, sands. In a small channel at the top of the section it was possible to see a sandy gravel with quartz and quartzite pebbles typical of the Kesgrave Sands and Gravels. It was pointed out that these far-travelled materials are rare in the marine deposits and provide conspicuous lithological evidence for the change from the marine environment of Lower Pleistocene times to the fluvial environment which dominated the Middle Pleistocene.

As usual, good exposures existed at *Chillesford Churchyard Pit (TM 382534)*, and members were able to examine Chillesford Crag and Chillesford Clay, and have a first sight of Lowestoft Till. Zalasiewicz and Mathers (1985) consider both the crag and clay to be facies of the Chillesford Sand Member of the Norwich Crag Formation. The Chillesford Crag represents intertidal shell beds with occasional silty clay laminations and the Chillesford Clay is interpreted as lagoonal sediment. The age of the Chillesford beds is problematical, originally having been correlated with the Pastonian temperate stage (West and Norton, 1974), and currently related to the

Bramertonian temperate stage (Funnell *et al.*, 1979). However, the upper part of the succession reveals sub-arctic marine fauna which may represent the cold Pre-Pastonian a Stage (West and Norton, 1974). The Lowestoft Till is representative of the Anglian Glaciation.

At the base of the succession members were able to see the Chillesford Crag which consisted of brown sands with abraded shells and occasional worm tubes (Norton, 1977). It was possible also to examine the silty clay layers from which Professor West had collected the temperate pollen, which formed the basis of the biostratigraphical interpretation. Further up the succession *Mya truncata* could be seen in a position of life in a brown silty sand. Unfortunately these shells could be collected only with difficulty because of their soft condition. Above this silty sand, members were able to see traces of a laminated, grey, silty clay which represents the Chillesford Clay. The Lowestoft Till was the uppermost unit to be observed. This consisted of an oxidized brown stony clay with chalk and flint clasts. In places it is altered, by decalcification from the surface, to dark brown 'lobe-like' structures, relatively rich in clay and free of chalk.

From Chillesford, the party headed east and south to Orford, then southwestwards to *The Cliff* at *Gedgrave (TM 397486)*. This small, and largely overgrown, section is located on the side of a ridge of Coralline Crag, and is a beautiful locality next to the banks of the Butley River. The Coralline Crag is important because it represents the uppermost unit of the Tertiary in Britain, and this site is important because the beds are not lithified, as are several other exposures of Coralline Crag, and can therefore be examined in more detail. The units at this section consist of the lower shelly sand and the upper Bryozoa rock (Baden-Powell and West, 1960). Also of importance, is the fact that the present topographic ridge is inherited from a feature that existed at the time of deposition of the Red Crag, and influenced contemporary patterns of current flow and locally formed a substrate upon which the Red Crag was deposited (Zalasiewicz and Mathers, 1985).

After a little excavation, members were able to examine the shelly sand unit and collect well preserved fauna including *Pseudamussium gerardi, Chlamys tigerina, Chlamys opercularis* and *Arctica islandica*. Some time was also given to speculating on the nature of the offshore relief at the time the Red Crag was deposited.

On the short journey back to Orford, where the party adjourned for lunch at the quayside, attention was drawn to the fine, large-scale cross-sets in the Bryozoa Rock in the badly overgrown pit at Richmond Farm, Gedgrave (TM 413493).

After lunch, during which many sheltered from the rain in the adjacent public house, the party headed further north through Saxmundam, to *Easton Bavents cliffs (TM 518787)*, just north of Southwold. This site is of considerable importance in being the stratotype for the Baventian cold stage and providing the first trace of glaciation in the British Isles (Funnell and West, 1962). It also provides evidence of the Antian temperate stage (Norton and Beck, 1972; Funnell and West, 1977). The section is capped by the Westleton Beds.

On the occasion of this visit the length of coastal section which has received most attention (see West, 1977) had not been affected by coastal erosion for some time, and was badly obscured by fallen material. However, the section of cliff, just to the south, below the truncated road from Easton Bavents Farm, proved to have been extensively eroded very recently and showed excellent exposures of the Baventian laminated clays. Unfortunately along this section no trace of the Antian shelly sands could be seen.

In order to see the full section, the party visited the documented site and after a little effort removed sufficient spoil to see all the lithological units, including the shelly sands at the base of the section. Although it was possible to see the lithological units attention was drawn to the fact that much of the interpretation is based on the analysis of evidence such as pollen, foraminifera and heavy minerals that can only be seen under the microscope. However, the significance of each of the units in the section was explained and discussed. Typically, the shelly sand unit contains a derived sublittoral fauna representative of a marine Boreal region and a rich arboreal pollen assemblage which includes *Tsuga*, and provides the basis of correlation with the Antian Stage. Pollen from the upper part of the shelly sands suggest a deterioration of climate and allocation to the first zone of the Baventian Stage (Lu 4a of Ludham; West and Norton, 1974). The overlying laminated clays are interpreted as estuarine sediments formed during a lowering of relative sea-level and as the full development of the Baventian cold stage. The discovery of far travelled, fresh, heavy minerals such as alkaline amphiboles, which were hitherto not common in East Anglia are taken as evidence for the presence of an ice sheet in the region bringing freshly quarried minerals from source areas in metamorphic provinces such as Scotland or Scandinavia. Heavily weathered, oxidized and cryoturbated gravels could be observed above the Baventian silty clays, and represent the Westleton beds at this site.

The final site of the day was to *Quay Lane Pit, Reydon (TM 484776)* to see well developed sections of Westleton Beds, that are so extensively developed throughout this region (Hey, 1967). The Westleton Beds are interpreted as beach-plain deposits similar to those forming at Dungeness at the present day. Although difficult

to date, they have been allocated, on the basis of stratigraphical position and enclosed fossils, to the Bramertonian temperate stage.

At Quay Lane Pit, very good exposures showed the well sorted, well rounded gravels, composed almost entirely of flint. Large scale cross-set structures, believed to have formed as the gravel units were deposited as a beach, were also visible. Members were also able to see the chatter marks on the surface of the rounded flints, which are considered to be the product of wave battering during transport in the shoreline environment. Unfortunately, no fossils were discovered and the party arrived too late to see the fragments of ivory from a elephant tusk, that had kindly been put aside by the quarry manager.

The party then headed south to Ipswich, pausing at Blythborough to visit the magnificent church. After a leisurely meal at the Graham Court Hotel (and elsewhere), the opportunity was taken to discuss the day's observations, and attempts were made to place them in their wider geological perspective.

On Sunday 5th May the party headed towards Clayden in the Gipping Valley to study, in particular, Middle Pleistocene palaeosols and glacigenic deposits and Late Pleistocene river deposits.

The first site to be examined was *Mason's Pit, Great Blakenham (TM 115499)*, which in many ways can be considered one of the most important Quaternary sites in Britain (Rose *et al.*, 1978; Allen 1984). Because of the range and abundance of evidence the whole morning was spent at this locality. Indeed the visit had to be terminated because of the need for lunch to coincide with opening hours in the local public house!

Pleistocene deposits at Great Blakenham overlie Chalk and begin with a thin lag of Red Crag. This is followed by up to 11 m of Creeting Sands and College Farm Silty-clays which are Early Pleistocene shallow marine deposits whose precise age is, as yet, unknown (Allen, 1984). At the top of the College Farm Silts are remnants of the Baylham Common Member of the Kesgrave Sands and Gravel Formation, representing sediment laid down when the river Thames drained north-eastwards across the region (Rose *et al.*, 1976, Rose and Allen, 1977). These were probably deposited during Pre-Pastonian time (Rose, 1983; Allen 1984). Developed in these river deposits, which have the form of a low relief terrace, are the complex Valley Farm Soil, which is characterised by temperate-climate pedogenic features and extends in age from the Pre-Pastonian to the Cromerian (Kemp, 1985a), and the Barham Soil, which is characterized by periglacial soil features and is early Anglian in age (Rose, Allen, *et al.*, 1985). In places the Barham Soil includes fragments of the Barham Coversand, which is a windbown deposit formed just before the Anglian glaciers overrode the region and deposited the final unit, namely the Lowestoft Till. This forms an extensive sheet across the region (Perrin *et al.*, 1979). Several lithofacies of Lowestoft Till can be recognised at Great Blackenham including lodgement till, and basal meltout till (Allen, 1984). Additionally the till forms complex structures (Rose *et al.*, 1978) and may be associated with discontinuous bodies of outwash sand and gravels, formed beneath or in front of the Anglian ice, known as the Sandy Lane Gravels (Allen, 1984).

With so much to examine the party concentrated on those features that were best developed. In the Creeting Formation attention was drawn to the large-scale trough cross-set structures, and small scale flaser bedding. Although in other places members were able to study the massive, well sorted, white sands which are so typical of the Creeting Sands Member. Attention was also given to a dark, organic zone within these sands from which pollen had been obtained indicating woodland vegetation typical of temperate parts of the Pleistocene, but incapable, as yet, of being allocated to any particular stage (Allen, 1984).

On the occasion of the visit the Baylham Common Gravels were poorly exposed, but in the fragments that could be studied it was possible to see the high concentrations of quartz and quartzite (typically up to 30%) transported from the Bunter Pebble Beds (Kidderminster Conglomerate) of the west Midlands by a much larger ancestral river Thames. Although the Baylham Common Gravels were not well exposed on this occasion, sections showing the Valley Farm and Barham Palaeosols were superb. The bright red colour (10R 4/8) and high clay content of the Valley Farm Soil were most impressive, whereas the massive sand wedges with vertical laminations, and involutions were the most striking features of the Barham Soil. In places these structures were glacitectonically deformed, showing simple unidirectional folds or even nappe structures. It was suggested that the red colour of the Valley Farm Soil in due to haematite formed in the soil during humid, warm temperate weathering condition (Kemp, 1985b), and the sand wedges in the Barham Soil are due to intense thermal contraction, which fractured the ground into a polygonal pattern. These factures were then infilled with wind-blown sand indicating intense, if local, aridity typical of polar desert conditions (Rose, Allen, *et al.*, 1985).

In the Lowestoft Till it was possible to see a massive, very dark grey (5YR 3/1) unit, with chalk and flint clasts dominating. Also found associated with this unit were clasts of granite, dolerite, red chalk, Mesozoic shale and massive septaria (up to 1 m diameter). It was suggested, as a result of detailed study by Peter Allen, that much of this till was deposited by the lodgement process at the base of the glacier. Locally, in a basal position, the till took on a banded form, relatively low in clay and silt, but with a similar assemblage of the smaller clasts.

After much discussion it was agreed that this was a basal meltout unit, formed by the release of debris held in the basal parts of the ice sheet.

Finally, at Great Blakenham attemtion was given to a large structure in which the till relaces the palaeosols and Creeting Formation and rests directly on the Chalk. The relationship was found to be most complex because, at the boundary, the palaeosols layer is folded over the Creeting Formation with normal faults developed to accommodate the displacement, indicating that the sands have been eroded from beneath the soil. The palaeosols disappear at the base of the fold. After much discussion it was suggested that sub-glacial meltwater had eroded and removed the Creeting Formation and cut a channel into the top of the Chalk, but it was difficult to understand why the palaeosol layer had not also been destroyed, and it was agreed that there was considerble scope for further work at this site.

After lunch the party made the short journey to *Barham, Sandy Lane Pit (TM 133515)*, which was the original site where the revision of the Middle Pleistocene stratigraphy of southern East Anglia began, and has been designated the stratotype for several of the stratigraphic members. The full succession recorded at this site, from the base upwards, is given below.

Stage	Stratigraphic Names	
Anglian	Lowestoft Formation	Barham Till Member Sandy Lane Gravels Member Barham Sands and Gravels Member
		Barham Loess Barham Coversand Barham Soil
Cromerian to Pre-Pastonian	Valley Farm Soil Kesgrave Formation	Westland Green Sands and Gravels Member

At the present time, the original pit, where most of the discoveries were made, is badly overground, and the party visited the current excavation to the west side of the track (TM 135515), where it was possible to see the Westland Green Member of the Kesgrave Sands and Gravels, traces of the palaeosols, the Barham Sands and Gravels and the Barham Member of the Lowestoft Till. The fine, large scale, trough cross-sets that could be seen in the Westland Green Gravels were interpreted as channel and channel infill structures formed in the braided channel of the Thames when it drained across the region. Attention was given to the large proportion of far travelled quartz and quartzite pebbles, but despite a careful search only a few of the volcanic rocks, which have been traced to source areas in north Wales, could be discovered. It was pointed out that this large component of far travelled material has been taken as evidence for a much larger catchment for the river Thames and the presence of glacier ice in the upper parts of that catchment (Hey, 1976; 1980). It was suggested that, if this is the case, it provides evidence for one of the earliest glaciations in the British Isles (although much later than that indicated at Easton Bavents). Evidence of the palaeosols at this quarry took the form a zone of clay enrichment, and a fine ice-wedge cast, but in most places the palaeosol had been eroded by the rivers that deposited the overlying Barham Sands and Gravels. These Barham Sands and Gravels could be recognised by their brown colour, their small scale, planar, cross-set structures, and the presence of relatively soft rocks such as shale clasts or Jurassic fossils [see Rose and Allen (1977) for a comparison of the lithologies of the Barham and Kesgrave Sands and Gravels, and Allen (1984) for detailed lithological descriptions of these units]. Finally, at this section and at a surviving part of the original pit, the party studied the till lithology, observing the banding that has been attributed to flow deposition, and the impressive decalcification lobes representing differential weathering by surface processes. Mention was made of the fact that the glaciers which deposited the Lowestoft Till and associated sediments, were responsible for changing the whole landscape of East Anglia. Prior to the glaciation the relief and drainage was dominated by the north-eastward flowing river Thames and its terraces, but after the Anglian Glaciation the relief was formed of glacial deposits with a radial drainage pattern parallel to the direction of ice flow (Rose, Boardman *et al.*, 1985). It is this radial pattern that determines the position and direction of the present East Anglian rivers. The discovery of a skull sticking out of one of the sections which had been cut through a Saxon cemetery (now deconsecrated), also provided a little excitement.

Because of the shortage of time, it was not possible to visit Clayden Church Pit (TM 133498) (although Messrs Aram and Rowley did make a visit after the rest of the party had departed), and the party made its way to *Bramford (TM 123487)* to examine Late Pleistocene river gravels. At the time of this visit members were able to see the large extent of coarse-grained, predominantly flint gravels that infill the base of the Gipping Valley, and are typical of so many other valleys in lowland Britain. These gravels are overlain by either peat or clay mud. Work done at Sproughton, just down the valley from Bramford (Rose *et al.*, 1980), has indicated that the gravels were deposited by meandering and braided snow-melt rivers in a periglacial climate during the very short climatic deterioration that occurred between about 11,000 and 9,500 yrs., BP. These deposits infil a deep channel cut between 11,300 and 11,000 yrs., BP.

This period of erosion and incision is the last time that the landscape of regions like southern East Anglia changed significantly. Since that time, until the landscape was modified by the influence of man, there had been little change because of the protection offered the dense vegetation cover, and this is reflected by the fine-grained, organic sediments that have been deposited as floodplain sediments above the Lateglacial gravels.

After an unsuccessful search for the flint implements that are known to rest on the surface of the gravels, the meeting drew to a close. Members returned to their vehicles and the party dispersed.

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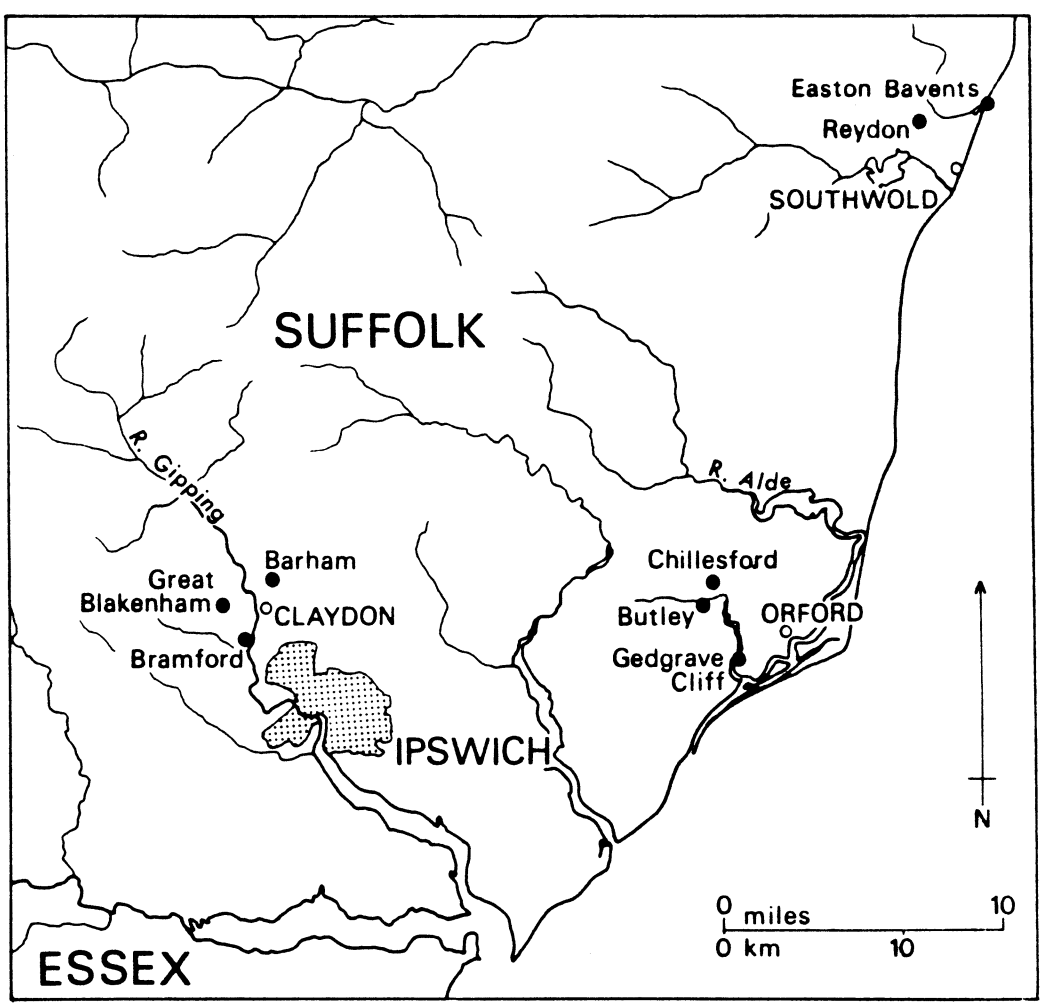

Fig.1. Location of sites visited.

Butley Neutral Farm	*Chillesford Churchyard Pit*	*Gedgrave Cliff*	*Easton Bavents Cliffs*	*Reydon Quay Lane Pit*	*Great Blakenham*	*Barham Sandy Lane Pit*	*Bramford Valley Bottom*	*Environment*	*Stage Name* PLEISTOCENE
							peat	temperate	Flandrian
							gravels	cold	Devensian
	Lowestoft Till				Lowestoft Till Sandy Lane Gravels Barham Coversand Barham Soil	Lowestoft Till (Barham Member) Barham Gravels Barham Coversand Barham Soil		glacial and periglacial	Anglian
					Valley Farm Soil	Valley Farm Soil		warm, temperate	Cromerian to Pre-Pastonian
Kesgrave Gravels					Kesgrave Gravels (Baylham Common Member)	Kesgrave Gravels (Westland Green Member)		periglacial	Beestonian to Pre-Pastonian
	Chillesford Clay				College Farm Silts*			temperate cold	Pre-Pastonian Pre-Pastonian a
	Chillesford Crag		Westleton Beds	Westleton Beds	Creeting Sands*			temperate	Bramertonian
			estuarine clay					cold/glacial	Baventian
			shelly sand					temperate	Antian
Red Crag					Red Crag			cold	Pre-Ludhamian
		Coral-line Crag						warm temperate	PLIOCENE

Table 1. Stratigraphic successions observed at the sites visited along with the environment at their time of formation and their age. * = correlation and age not yet demonstrated, but the position in the charts is the most likely at the present stage of knowledge.