Shippersea Bay

[NZ 443 453]

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Introduction

Shippersea Bay, Easington in Durham, is of great importance for its potential in unravelling the Late Quaternary stratigraphy of north-east England and for reconstructing former sea levels. It is the site of the Easington raised beach, which is interglacial but there has been much discussion as to which interglacial age it relates to and hence much debate about the chronology of the associated glacial succession, both above and below the beach (Bowen *et al.,* 1991; Bridgland, 1999; Bridgland and Austin, 1999; Jones and Keen, 1993; Tooley, 1984, 1985; Trechmann, 1931, 1952; Smith, D.B. *et al.,* 1973; Woolacott, 1920, 1922). The GCR site is within the existing SSSI from Hart Warren to Hawthorn Dene, which has been designated as such for its Quaternary importance, and Thomas (1999) defined the Easington Formation from this location.

Description

Shippersea Bay is about 300 m long and bounded to the north and south by relatively resistant Magnesian Limestone headlands (Figure 4.16). The cliffs forming the back of the bay are also composed of Magnesian Limestone, bevelled to a height of 27 m OD (Smith and Francis, 1967), although the exact height of the platform has been suggested as anywhere between 18 and 32 m OD (Figure 4.17). This rock platform is capped by 4 m of sand and gravel regarded by Woolacott (1922) and Trechmann (1931) as the Easington raised beach. It is composed of sand and gravel, some beds of which are calcreted. The lowest metre of beach consists of poorly cemented coarse sand and fine gravel that pass into coarser gravels, which are highly cemented in the uppermost 2.5 m. This was reported by Woolacott (1922) to be overlain by soft sand containing shell fragments. Shells and shell fragments are abundant in the lower parts of this succession but seem to be less abundant in the calcreted beds. The lateral extent of the raised beach is in doubt and it is not always easy to differentiate from glacial gravels, but Smith and Francis (1967) suggest that it is post-dates the Lower Boulder Clay and pre-dates the Upper Boulder Clay.

The shells within the gravels (Woolacott, 1920, 1922; Bowen *et al.,* 1991) indicate a temperate marine origin (Table 4.4). Some of the gravels are bored by marine molluscs and annelid worms (Woolacott, 1920, 1922; Trechmann, 1931). In addition the land snail (*Helix* species) has been recorded and Woolacott recorded several species of foraminifera and ostracods. Woolacott (1920) noted that many rodent's bones had been found a little further to the south in the gravel. The gravels are bedded ((Figure 4.18) and (Figure 4.19)), with a clean sandy matrix and they lack the variably shaped, often angular, gravel that is characteristic of the glacial gravels (Bridgland and Austin, 1999). Bowen *et al.* (1991) give a detailed a description of the main beach exposure, where they recognized eight separate beds. Most are horizontally stratified, with no clear palaeocurrent evidence from limited cross-stratification and imbrication, although a southward and eastward transport was recorded at some levels. As in many modern beach gravels, a small proportion of pebbles and cobbles at all levels are steeply inclined or vertical (Bowen *et al.,* 1991). These authors confirmed Woolacott's (1922) observation that Magnesian Limestone is progressively diluted up through the succession and that non-local gravels include andesites from the Cheviots, Borrowdale Volcanics from the Lake District and Whin Sill dolerite. Trechmann (1952) indicated that halleflinta, rhomb porphyry and garnet-hornblende schist from Scandinavia were present.

Interpretation

Woolacott's original interpretation of the gravels as a raised beach has generally been accepted, but his view that it was a Late-glacial or a post-glacial beach was disputed by Lamplugh (quoted by Woolacott (1922) and Trechmann (1931, 1952)). The presence of exotic clasts in the raised beach indicates that at least one major glacial had affected the area prior to the formation of the beach, and it is overlain by a glacial succession. The Scandinavian rocks must have been derived from the glacial advance represented by the lowermost diamicton at Warren House Gill, indicating a later origin for the beach. Trechmann (1931, 1952) favoured an interglacial age, which, given the temperate fauna, was effectively proved by a ^{14}C minimum age of greater than 38 000 years BP from shells (Smith and Francis, 1967). Smith, D.B. *et al.* (1973) and Jones and Keen (1993) suggested an Ipswichian affinity, although its altitude is more suggestive of an older interglacial, particularly in comparison with known Ipswichian beaches to the south, such as Sewerby. However, a 'late interglacial age' shortly before the last glaciation was favoured by Baden-Powell (in litt. to Smith, 1965, 1966), with a slight preference for the Ipswichian, although he was concerned at the apparent absence of *Corbicula.* This age is unlikely to be the case (Tooley, 1984, 1985) as West (1972, 1980) concluded that the minimum elevation of sea level was probably +7.5 m OD in this interglacial and the maximum in late Hoxnian times was at least +23 m OD. However, its current elevation may be a response to post-Ipswichian tectonic movement (Shotton, 1981), although there is no real evidence for this.

(Table 4.4) Shell list from the Easington raised beach (based on Woolacott, 1920, 1922).

Species	
Littorina littorea	common
Littorina obtusata	common
Littorina rudis	
Patella vulgata	common
Nucella lapillus	
Cliona sp.	
Polydora sp.	
Saxicava sp.	
Buccinum undatum	
Arctica islandica	
Mytilus edulis	
Pecten sp.	
Rhynchonella psittacea	
Helix sp.	

Bowen *et al.* (1991) and Thomas (1999) correlated the beach with Oxygen Isotope Stage 7, with a reworked fauna from Oxygen Isotope Stage 9, and both Lunn (1995) and Hughes *et al.* (1998) suggested that the beach is Ilfordian in age, about 200 000 years old. This was based on the amino acid analyses of the shells, which had suggested that the beach be correlated with Oxygen Isotope Stage 7 (Bowen *et al.,* 1991), although two shell populations were identified amongst the analyses of *Patella vulgata.* An older one with a mean amino acid D/L ratio of 0.228 ± 0.12 (n = 5) and a younger population, with a ratio of 0.174 ± 0.01 (n = 5). The older population is interpreted as being reworked from deposits dating to a previous higher sea level, which Bowen *et al.* (1991) attributed to Oxygen Isotope Stage 9. They regarded the younger population as indigenous to the Easington raised beach and correlated with Oxygen Isotope Stage 7.

No comparable raised beach deposits have been found in north-east England, but there is a widespread gently sloping platform cut into the Magnesian Limestone in coastal districts to the north, at least as far as South Shields. The extent of this platform, the landward edge of which abuts against an inferred exhumed cliffline at about +31 m OD, strongly suggests it is marine in origin and possibly correlated with the Easington raised beach (Bowen *et al.,* 1991; Smith, 1994).

The relationship between the Easington raised beach and the marine sediments at Speeton (Austin and Evans, 1999) and Kirmington (Bridgland and Thomas, 1999) is unknown. Wilson (1991) provided a useful synthesis for the argument for the age of the Speeton Shell Bed and concludes that it was deposited during Oxygen Isotope Stage 7. However, Bowen and Sykes (1991) argue against the validity of Wilson's amino acid ratio data owing to the fact that she used museum shell collections coated in resin. Nevertheless, the material analysed by Bowen and Sykes (1991) shows a standard deviation of 17% from the mean and the lowest amino acid ratio of 0.0154 hints at an Ipswichian date. This is the conclusion reached by Knudsen and Sjerup (1988) when they analysed the amino acid ratios of foraminifera from the Speeton Shell Bed.

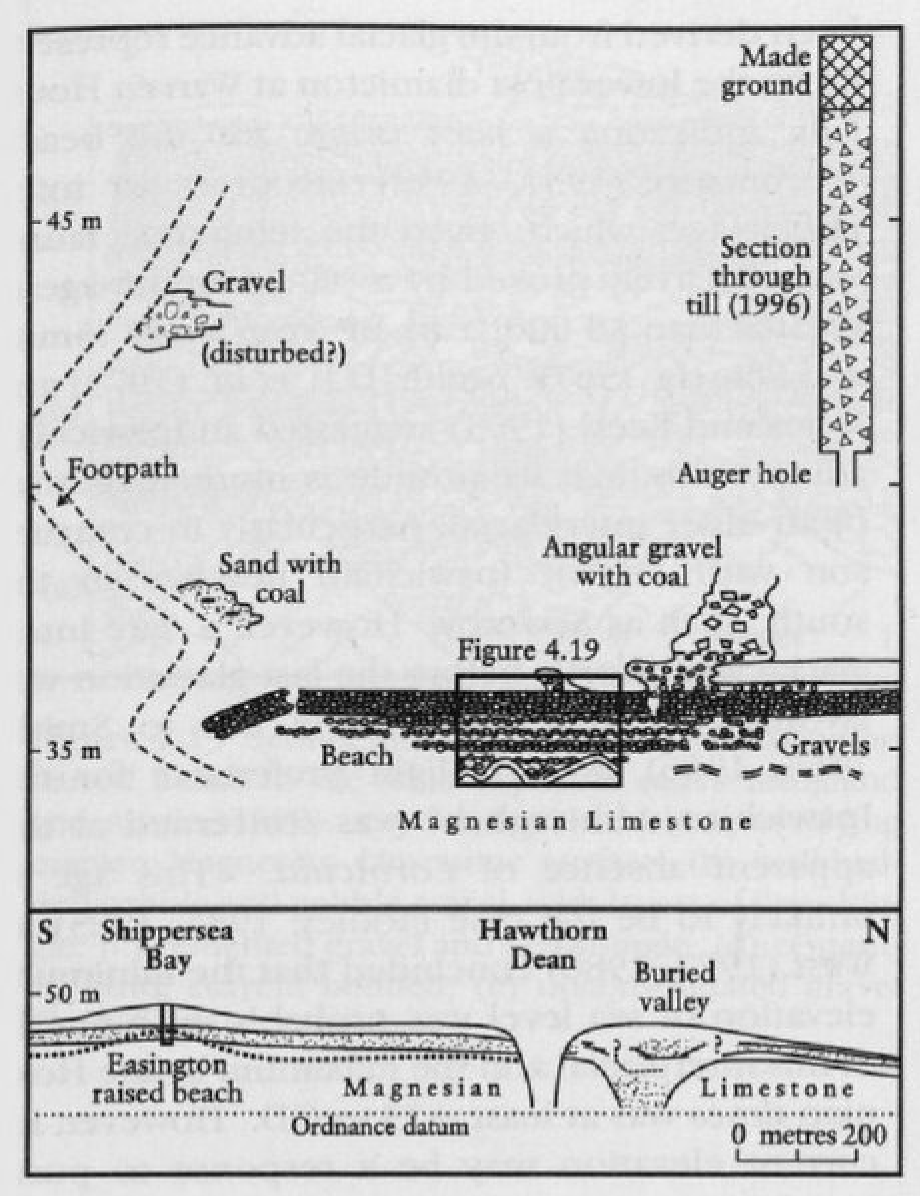
At Kirmington most authors have suggested a Hoxnian age for the deposits (Watts, 1959; Boylan, 1966b; Catt and Penny, 1966; Smith, D.B. *et al.,* 1973), but Bridgland and Thomas (1999) suggest that the transgression that deposited the marine gravels corresponds to Oxygen Isotope Stage 11. According to evidence from mammalian biostratigraphy (Schreve, 1997) this is the true age of the type Hoxnian deposits. However, there seems no doubt that the raised beach deposits at Sewerby are Ipswichian. Thus it appears that the Easington beach may well be of an age between the Kirmington deposit and Sewerby and equivalent to the Speeton Shell Bed.

Overlying the raised beach are diamictons and gravels of glacial origin thought to be of Late Devensian age. These deposits are widespread as a capping to the cliffs in this area and are well represented within the infills of pre-glacial or subglacial valleys that intersect the coast. However, because the contacts between the beach and these deposits are obscured, there has been a serious problem in distinguishing the deposits of different glaciations within the infills of these valleys, some of which are likely to be of considerable age. Smith and Francis (1967) intimated that the beach gravels had been incorporated into the upper division of their glacial Middle Sands by reworking, a view that might raise questions about the whole basis for pre-Devensian glacial sediments of the Durham coast, were it not for the unlikelihood that such an extensive raft of interglacial sediment could have been transported and deposited horizontally, with no sign of disturbance (Bridgland and Austin, 1999). It is evident though that there are extensive gravels that lack shells cropping out at a similar level within the coastal exposures. These are part of the glacial sequence and the determination of their stratigraphical relationship with the raised beach becomes of considerable importance. It seems probable that they are younger and related to Late Devensian glacio-fluvial sandur sedimentation during advances and retreats of the coastal ice.

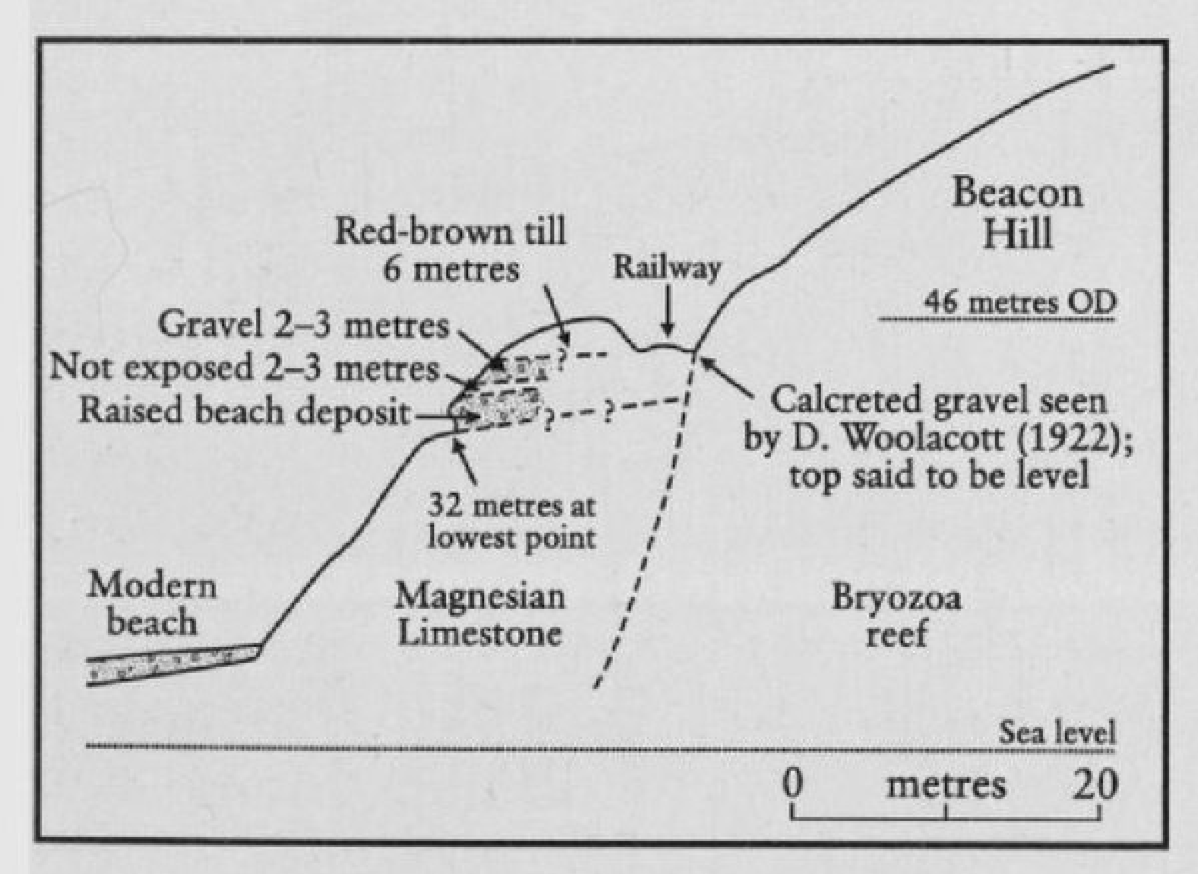
Conclusions

Although there are some problems associated with the stratigraphy and dating of the Easington raised beach it seems probable that the beach is related to a high interglacial sea level in Oxygen Isotope Stage 7 and that it is *in situ.* It is likely to be older than the Warren House Till, which is believed to be as old as Oxygen Isotope Stage 6 (Francis, 1970; Thomas, 1999) and older than the East Durham and Wear Formations (Thomas, 1999), which are Late Devensian and glacial in origin.

References



(Figure 4.16) Sections in the cliffs north of Easington. The upper part shows Shippersea Bay exposures since 1996, examined by Bridgland and Austin (1999). The location of (Figure 4.19) is noted. Below shows the sections based on observations and records of former exposures described by Smith and Francis (1967). Their Middle Sands and Gravels (stippled) separate Lower and Upper Boulder Clays (no ornamentation). The stratigraphical location of the Easington raised beach is noted (after Bridgland and Austin, 1999).

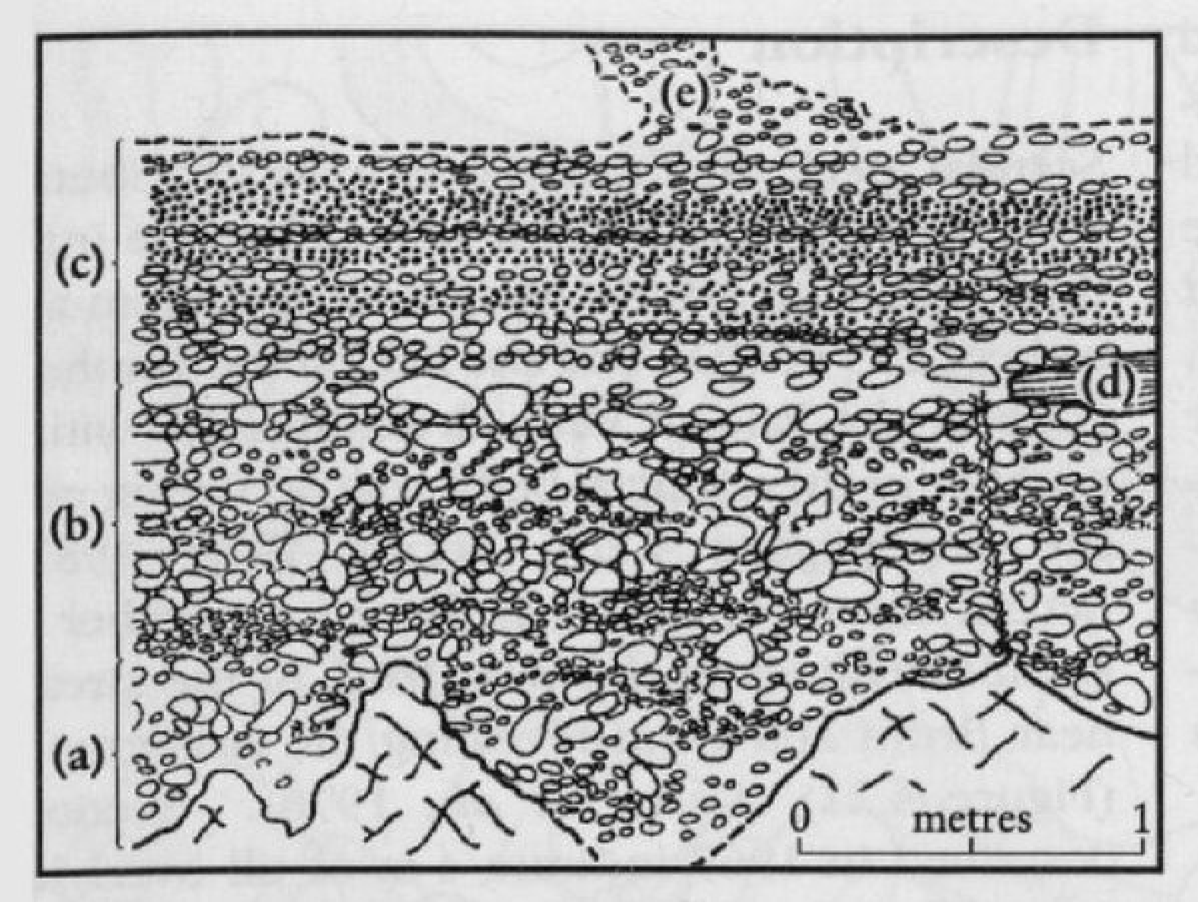


(Figure 4.17) Diagrammatic section of the Easington raised beach and associated deposits (after Woolacott, 1922; Bowen et al., 1991).

Species	
Littorina littorea	common
Littorina obtusata	common
Littorina rudis	
Patella vulgata	common
Nucella lapillus	
Cliona sp.	
Polydora sp.	
Saxicava sp.	
Buccinum undatum	
Arctica islandica	
Mytilus edulis	
Pecten sp.	
Rhynchonella psittacea	
Helix sp.	

(Table 4.4) Shell list from the Easington raised beach (based on Woolacott, 1920, 1922).

(Figure 4.18) Easington raised beach, April 2000. (Photo: D. Huddart.)



(Figure 4.19) Sedimentological detail of the Easington Raised Beach in the main exposure (after Bridgland and Austin, 1999). (a) Sand with cobbles, overlying uneven Magnesian Limestone surface; (b) well-bedded cobble and pebble gravel, with layers of fine shingle; (c) cemented gravel and pea-shingle; (d) cemented sand, current bedded; (e) unconsolidated gravel and shingle.