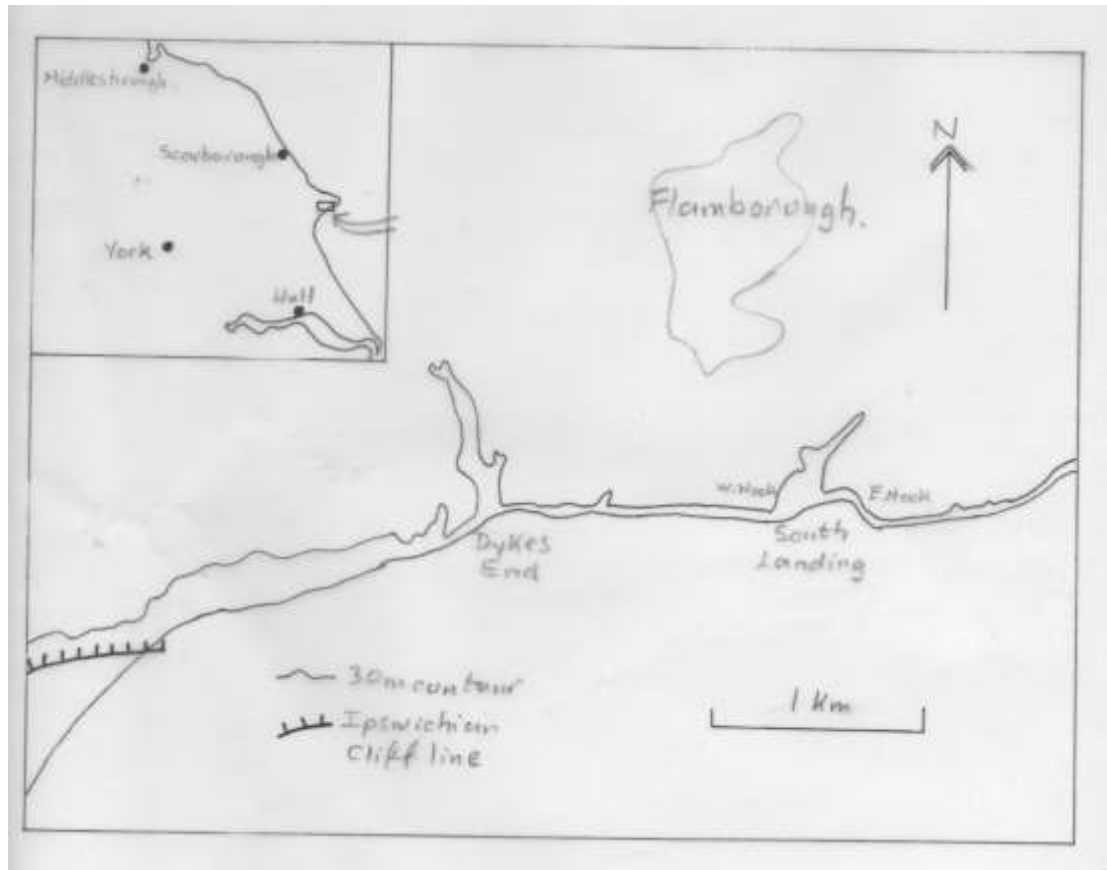


**Contribution to the report of the
Flamborough Quaternary Research Group
Unfinished work by Derek Gobbett, 7th December 2010**

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Introduction

The three sites lie on the south side of Flamborough Head at the north end of Bridlington Bay. Dykes End and South Landing lie in south-trending palaeo-valleys where these intersect the modern coast line (Fig.1).

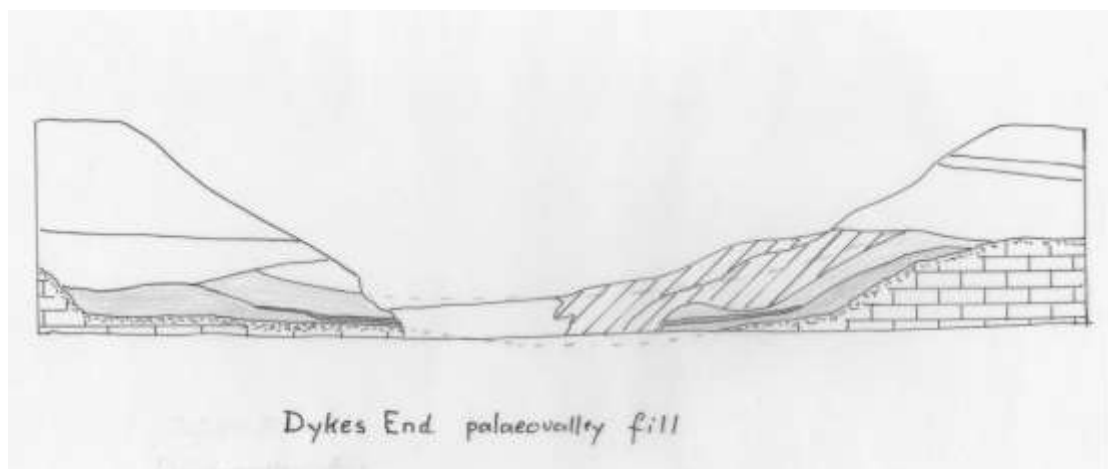


The drift deposits of Flamborough Head were investigated by a number of geologists in the nineteenth century, notably by Daykins (1880) and Lamplugh (1890,1891). Daykins (1880) sketched the section on the west side of Dykes End recognising “fine chalkwash, in twisted laminae, overlain by sand” between the Chalk and the lowest boulder clay and he recorded coarse chalk gravels overlying the chalk at South Landing. Lamplugh (1891) described the drift seen in the coastal sections between Bridlington and Filey and recognised the existence of palaeo-valleys. He sketched the cliff sections at Sewerby, Dykes End and the

west side of South Landing and noted the contortions in the top of the Chalk at Dykes End considering these to be caused by “ice pressure” He also described and figured details of the east side of South Landing (Lamplugh 1890).

Dykes End

The cliff section at Dykes end cuts through a south-trending palaeo-valley eroded in the chalk. This valley has steep (20° - 30°) sides and a flat floor about 125 m wide, typical of many dry valleys in the chalk. It was completely filled and overtopped by mainly glaciogene late Pleistocene deposits, but post-glacial erosion has re-excavated its centre which is now occupied by a narrow steep-sided, modern valley which is normally dry.(Fig. 2).



The Chalk bedrock belongs to the Flamborough Formation and generally dips gently westward at $1-2^{\circ}$. Its top is brecciated and locally the uppermost metre displays thrusts and folds which could have been caused by cryoturbation. However these structures have been identified by Starmer (1995, p.221) as one of several concordant shear zones formed by bedding-parallel slip associated with movements within the Howardian Flamborough Fault Zone. In the brecciated chalk are a few erratic boulders of a well-cemented sandstone possibly of Carboniferous origin and remanié from an earlier glacial period.

Overlying the Chalk is the Dykes End Silty Gravel, a poorly-sorted angular to sub-rounded chalk gravel with a silt-rich matrix and discrete thin silty interlayers. It is banked up against the palaeo-valley side. and shows some crude bedding inclined at $15^{\circ} - 20^{\circ}$ towards the valley floor. The greatest thickness preserved is about 2.5m. On the west side of the valley it thins to 0.3m downslope and appears to be terraced.

This is interpreted as a solifluction/gelifluction deposit. The silty interlayers are dominated by coarse silt (63%) typical of loess.

This is overlain by up to 2m of finely laminated silty clay coarsening upwards to laminated and ripple cross laminated fine to medium sand. This deposit is probably glaciolacustrine. The laminated silty clays are restricted to the floor of the palaeo-valley and thin towards the valley sides. They may be interpreted as rhythmites produced by seasonal deposition in a lake which occupied the valley when its drainage was blocked either by ice or moraine.

The sand is abruptly followed by a till layer 2-3m thick and the whole succession is truncated by an erosion surface and a deposit of chalk- rich diamicton and a glaciogene sequence which forms the major part of the valley fill.

South Landing

The southwest trending palaeo-valley at South Landing has similar features to that at Dykes End but the modern coastline curves across it and cuts it more obliquely.

South Landing East

From East Nook to Quay Hole the cliff trends NW and the brecciated top of the chalk bedrock slopes down to the NW to reach OD near Quay Hole. Directly overlying the chalk poorly sorted gravels and sands, mainly of chalk, display clinoforms dipping NW at varying angles up to 22° , the dips increasing upwards and also to the SE. We refer to these as the East Nook Gravels. The clinoforms appear to be abruptly truncated by a coarse gravel about 0.5m thick which resemble the Quay Hole Gravels exposed east of Quay Hole. There is a sharp erosive top to this unit overlain by about 2m of sand followed by glaciogene gravels and diamictons including a raft of dark till with lenses of shelly sand similar to the Basement till of Dimlington. This raft is possibly referred to by (refs)

South Landing Central

Between Quay Hole and the centre of the modern valley the chalk bedrock lies at or below OD and is covered by the modern beach so that the base of the drift is not seen. The modern sea cliff exposes Quay Hole Gravels, here some 8m thick. These are generally coarser than the East Nook Gravels and contain erratic clasts representing ~5.4% of the total. They are crudely bedded and show some hint of upwards coarsening units but these primary structures are probably obscured by later cryoturbation. The gravels have the appearance of a debris flow which moved down the valley and blocked it. They are sharply truncated by glaciogene sediments dominated by diamictons. In part of the section the gravels appear to extend higher up the cliff possibly due to being ice rafted.

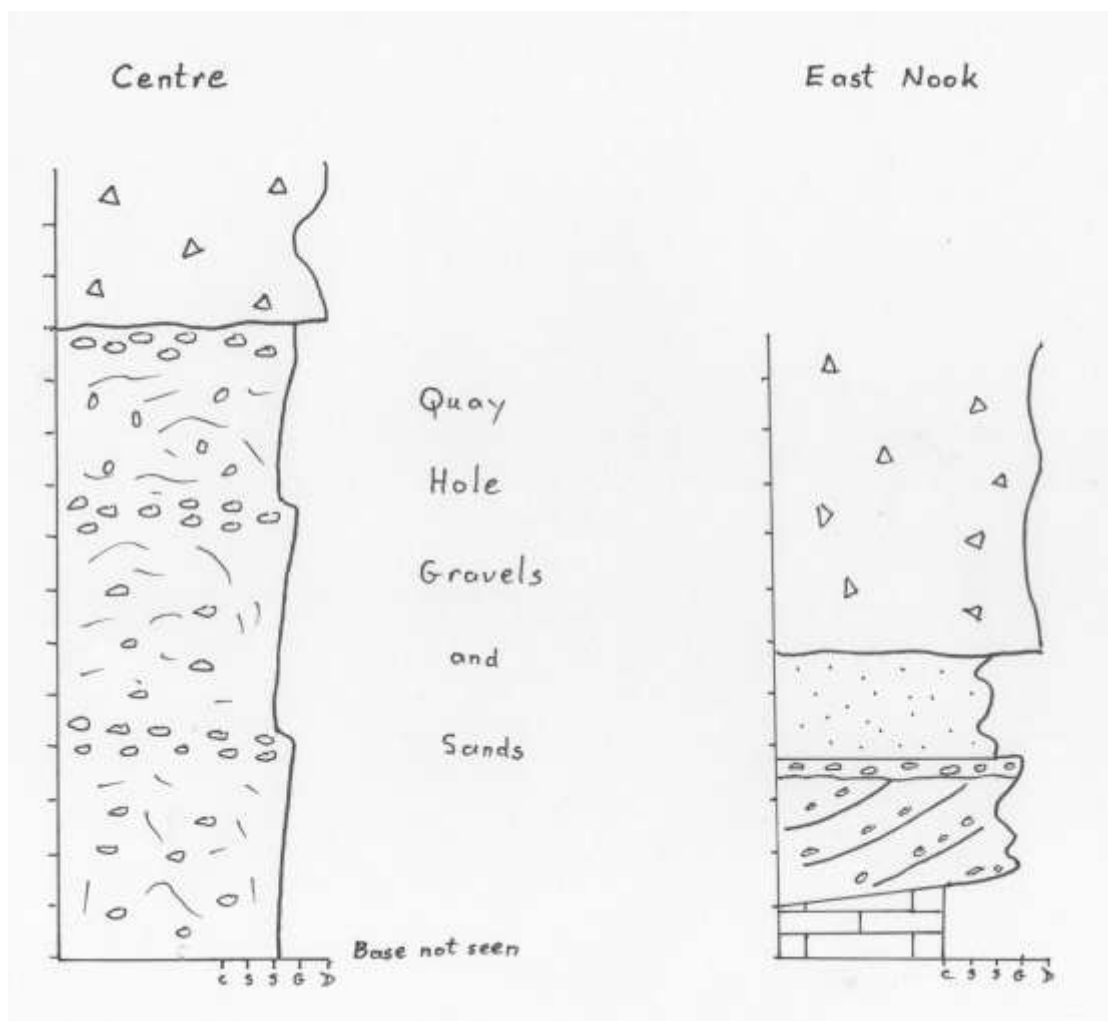
South Landing West

At West Nook a steep cliff is cut into the chalk bedrock, at the base of which lies a sub-horizontal platform of chalk about 2m above the modern shore platform. Above the chalk is a 3m layer of gravel with a fine to coarse sand matrix, the West

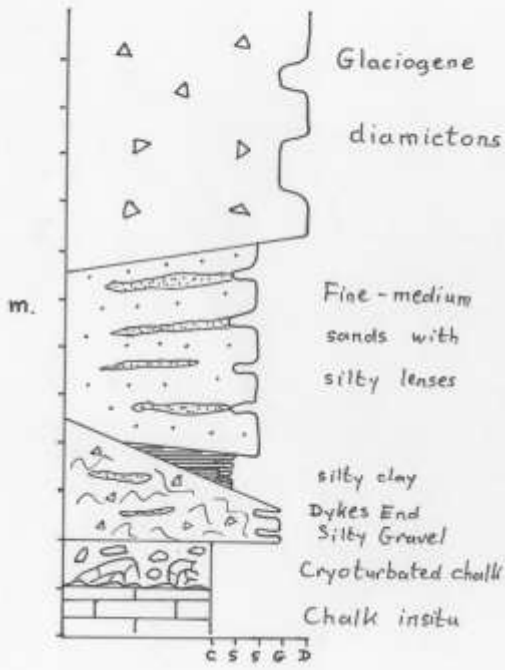
Nook Gravels and Sands. This gravel is composed of angular chalk clasts with about 30% erratics comprising a diverse suite of sedimentary, igneous and metamorphic rocks. Some of the clasts appear to be imbricated although this may be due to cryoturbation and there is a more clearly cryoturbated horizon near the top of the unit. Clast size tends to diminish upwards. Within the gravel are lenses of coarse sand showing small scale trough cross bedding.

The top 60 cm of the gravel are cemented by carbonate/calcite to form a conspicuous ledge in the cliff and large blocks of this layer lie fallen on the beach. This cemented layer has more angular chalk clasts some of which appear to have been broken *in situ* by frost action and the cracks filled with sand.

The West Nook Gravels and Sands are overlain by laminated sands and silty clays probably of glaciolacustrine origin. Above is a relatively poorly exposed glaciogene assemblage of diamictons, gravels and sands.



Dykes End



West Nook

