Flamborough Head, September/October 2022
led by Paul Hildreth (YGS)

Flamborough Head is a prominent headland on the east coast of Yorkshire comprised of Late Cretaceous rocks (Chalk Group) overlain by varying thicknesses of glacial sediments. The cliffs rise from a 'low' of approximately 40m at Flamborough Head to an impressive sheer drop of 135m to the north at Buckton close to Bempton RSPB reserve, where one of only two of the UK's mainland breeding colonies of gannets are to be found. In places the top of the chalk is cut by pre-Devensian age valleys which bring Pleistocene deposits down to present sea level. The chalk is horizontally parallel bedded in the main, but there are dramatic examples in places of east-west belts of deformation and intense folding.

Friday morning, having parked at the Car Park at the 'end' of Flamborough Head we headed south-east along a clifftop pathway toward High Stacks. The characteristic landforms associated with a chalk headland are well displayed from this path, including a presumed collapsed blowhole where a cross section of the stratigraphy shows a vertical chalk profile topped by a concave cover of Boulder Clay, and gravelly Devensian (17 - 20Ka) Skipsea Till and isolated stack of chalk.

At Selwicks Bay the chalk cliffs and foreshore are formed by the flint-bearing Burnham Chalk Formation, overlain by the flintless Flamborough Chalk Formation. The main feature of geological interest on reaching the foreshore and the West Cliff of Selwicks Bay is a zone of intense deformation that runs E-W through the bay; representing part of the Howardian-Flamborough Fault Belt.

Small embayment's along the south cliff represent collapsed blow holes and at the north-east corner of the bay, a large 'cut' into North Cliff is called Molk Hole. At the entrance to Molk Hole near the foot of the cliff the highest flint band (High Stacks Flint) of the Yorkshire Flint is exposed, marking the top of the Burnham Formation.

At North Landing the flint-rich Vale House Flint Member of the Burnham Chalk Formation is present in the east cliff face, as is the North Ormesby Marl. This is overlain by a further flint layer (Ludborough Flint) that is known to extend as far as Grimes Graves in the Transitional Province.

The Chalk Tower at Flamborough was built as a private lighthouse in 1674 by Sir John Layton as a business venture, the intention being that passing ships would pay a "voluntary tax" to pay for it's upkeep and provide the warning "fires" at the top of the tower, however, the "voluntary" taxes were not forthcoming, and the towers use as a lighthouse was short lived.

It was subsequently used as a telegraph station. The structure was listed, Grade II*, in 1949.

Saturday, we convened at the main car park at Danes Dyke, a local nature reserve on Flamborough Head, which provided one of the few access points to the south coast of the headland. Our route was along the beach to Sewerby, focusing on the Quaternary geology and the Flamborough Chalk Formation, which are broadly equivalent to the Newhaven and Culver Chalk in the Southern Chalk Province, being Late Santonian and Campanian in age (c. 83 to 75mya). At Danes Dyke the chalk has been tectonically and periglacially deformed and a paleo valley has been cut below beach level. This natural feature has, in part, been filled by Quaternary deposits which have been incised by a small steam.

The 1.5-mile section of Flamborough Chalk Formation from Danes Dyke to Sewerby exposes the youngest chalk along the coast at Farmborough. This includes the interesting zones of *marsupites testudinarius* which is a planktonic crinoid (left) and bivalve *sphenoceramus lingua* (right).

At Sewerby Rocks, just over half-way to Sewerby Steps, and within the lingua zone, is the Flamborough Sponge Bed. This is a 10m thick unit with occasional exceptional fossil preservation. Examples of calcretes are seen on the wave cut platform as fallen blocks from the chalk gravel beds between the Flamborough Chalk Formation and the Skipsea Till. Typically, calcretes are formed on calcareous materials as a result of climatic fluctuations in arid and semiarid regions. Calcite is dissolved in groundwater and, under drying conditions, is precipitated as the water evaporates at the surface.

The northern end of Holderness and the start of Flamborough Head is marked by the

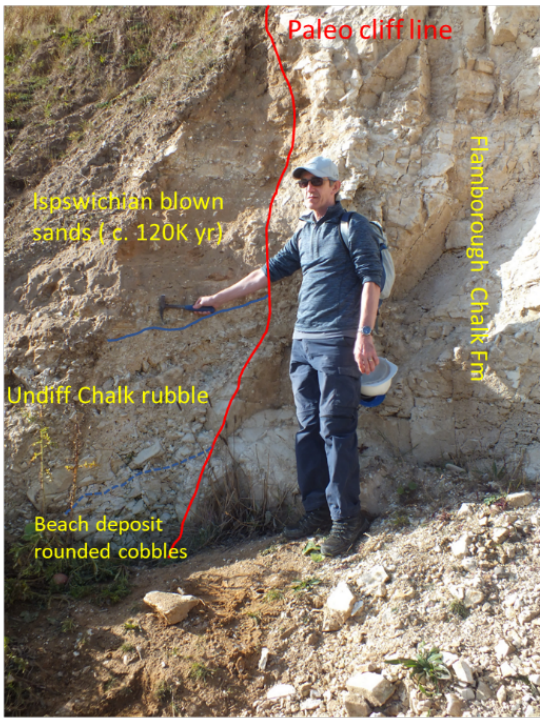


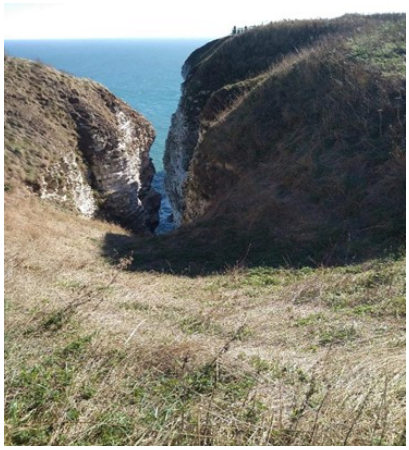
Photo 5 Sewerby Buried Cliff

site of Sewerby Buried Cliff which from here turns inland towards Driffield and can be traced as a topographic feature to Hessle, on the north bank of the Humber and then into Lincolnshire, west of Grimsby and southwards to Louth.

In this section the chalk cliffs terminate against interglacial beach shingle, glacial blown sand of the (Ipswichian MIS 5e 120kyr), periglacial head and glacial tills (Devensian MIS2 20kyr). A Pleistocene cliff face carved into Chalk.

The periglacial deposits (blown sand and periglacial head slope deposits mark an early phase of a cold period of the Devensian (last glaciation). As conditions became colder, ice spread over the area about 20kyr depositing the Skipsea Till.

Sunday morning, started at Bempton Cliffs RSPB reserve. The cliffs here are vertical and more than 100m tall. The birds nest on ledges caused by the weathering back of the marl seams and by protruding layers of hard flint which dip down inland so that eggs do not roll off into the sea. A very safe nesting site but precarious looking to the human eye.



Bempton is a great place to look back in time. Standing on the 80 mya Burnham chalk at Bartlett Nab we looked across Filey Bay to Filey Brigg. This reef-like promontory is made of Upper Jurassic lime-rich sandstones which are 135 mya. We then examined a 'geo'. This vertical slit in the cliff was probably produced when air was forced along weaknesses in the rock by the power of the sea. Water can be forced up to the top of the cliff in exceptional circumstances hence the name 'blowhole' is also used for these features. The roof of this 'geo' has collapsed to expose the now eroded inlet.

Our walk along the top of the cliff end with a truly astonishing view of the deformation of the chalk layers. This is believed to have been caused by the reactivation of some faults in the Howardian-Flamborough fault complex which delineates the southern edge of the Cleveland Basin.

At Thornwick Bay the enormous thickness of Skipsea till was such a contrast to Bempton Cliffs. Its erosion produced a marked change in slope half to three quarters of the way up the cliffs. Great and Little Thornwick Bays are cut into the Welton and Burnham chalk, whose boundary we had studied at North Landing previously. In both bays the poorly fossiliferous chalk is mainly in the *Terebratulina lata* Zone of the Turonian. This

ill-defined biozone can be finely divided lithologically.

We made our descent into Little Thornwick Bay via some extremely dilapidated steps cut into a paleovalley filled with till. The views were fantastic. Having admired the deeply eroded clefts of the Barton Marls at the foot of the cliff we were introduced to the Ferruginous Flint band about 3m above the highest marl.

This is up to 15cm thick and is a highly distinctive carious tabular flint with reddish-brown weathering patches. It can be followed around Thornwick Nab into Great Thornwick Bay and forms one of the best marker bands. A second good marker band is the Melton Ross Marl which formed a prominent groove at the top of the cliff. Little Thornwick west wall FF=ferruginous flint MR=Melton.

Before leaving Little Thornwick Bay, we examined a possible slip strike fault evidenced by some slickensides seen in line with the paleovalley and Little Thornwick Bay. This made a change from lithostratigraphy. We made our way around Thornwick Nab where it was a relief to recognise the Ravendale Flint.

However, we were not finished with chalk lithostratigraphy by any means, and we were invited to study the Welton chalk succession between the Ferruginous Flint band and the Melton Ross Marl. Between these two markers lay two *Thalassinoides* layers. The lower was nodular, while the upper band was semi-tabular where the *Thalassinoides* had coalesced into sheets of flint up to a metre across. Still higher in the succession, between the Melton Ross Marl and the Ravendale Flint, we could make out the Deepdale Flint band followed by the Upper and Lower Deepdale Marls. Only the Beacon Hill Marl then separated us from the hugely recognisable Ravendale Flint and thus the start of the Burnham chalk. The lithographic succession of Thornwick Bay was then completed by the Triple Tabular Flints.