Field excursion to the Isle of Portland on the 5th January, 2016

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The purpose of the field excursion was to examine aspects of the sedimentology, and palaeontology above and below the Portland–Purbeck transition at a number of locations. There was also an opportunity to see the raised beaches on the west and east sides of Portland Bill, as well as some of the cryoturbation structures. The Mesolithic site at Culverwell was also visited.

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Introduction

After the Annual Conference of the Ussher Society at the Rembrandt Hotel in Weymouth, Tony Brown, Alan Holiday and Geoffrey Walton, led a field excursion to the Isle of Portland on the 5th January, 2016. The island is formed of gently folded, hard, well-jointed Purbeck and Portland limestones, overlying the Kimmeridge Clay Formation, on the northern flank of the Shambles Syncline. Jointing reflects the axes of the syncline and the NNE–SSW fault pattern of the Purbeck Anticline. This controls the pattern, distribution and size of the frequent landslides that occur on Portland (Brunsden *et al.*, 1996). The landslides occur predominantly in the winter months, after heavy rainfall, and are related to the overall evolution of the landscape which has been driven by the processes of lateral spreading, loading, clay extrusion and erosional unloading (Brunsden *et al.*, 1996).

Chesil Beach

The first stop on the excursion was at The Heights, from where there is a spectacular first view (Fig. 1) of the longest beach-barrier system in Europe (29 km): see May (2003). It is thought to have developed in the early Holocene as a beach-barrier which then rolled inland (as sea level rose) connecting to Portland and making it appear to be a tombolo: perhaps this is a common process of tombolo formation?. The beach is composed of flint, chert and quartzites (probably from the Budleigh Salterton Pebble Beds), forming a ridge up to 14.7 m above mean high water (*c.* 18 m OD), and the pebble size increasing from west to east as a result of an increase in wave energy in the long-shore direction which prevents deposition of fine gravels and sands. It impounds a brackish water lake called the Fleet and has periodically been breached by large storms. Recent research, using ground penetration radar, has revealed the internal structure of the barrier and proposed a three-stage model of beach evolution (Bennett *et al.*, 2009). In this model the beach began as a long narrow barrier beach which moved back towards the higher ground as sea level rose in the early Holocene. In phase two the beach grew up and bulked out, probably due to a slowing down of the rate of relative sea level rise and erosion of periglacial debris at the base of the cliffs to the west. In phase three the beach humped (prograded) and moved back out towards the sea, again after relative sea level had attained (approximately) its present height around 6000 BP. Evidence of the old land-surface and coastal lagoon over which the beach developed can be seen in blocks of peat ripped up from the sediments in front of the beach and deposited on it by large storms. If relative sea level continues to rise, it is quite likely that sediment supply will not keep pace and it will breach again in the near future.

King Barrow Quarry

After discussions of the processes involved in the formation of Chesil Beach, and also the current – and future – management of the barrier the party walked the short distance to **King Barrow Quarry**. Here the stratigraphy and palaeoenvironmental setting of the Portland and Purbeck limestones were described. Of particular interest are the fossil algal 'burrs' around the tree trunks in the fossil forest of the lowermost Purbeck beds (Figs 2, 3). These structures are now thought to be the product of cyanobacteria and may more probably be regarded as thrombolites comparable to those seen in the modern Lake Thetis, Western Australia (see, for example, Grey *et al.*, 1990). These are similar to the coeval exposures seen to the east of Lulworth Cove, but more easily accessed.

The lowest horizon readily accessible is the Roach (top of the Portland Stone) which are highly fossiliferous, including *Aptyxiella* (a high-spired gastropod) and *Laevitrigonia* (an highly ornamented bivalve) mostly with moldic preservation. The environment of formation was marine, as the sediment is oolitic (Townson, 1975). Moving up the sequence into the Lulworth Formation of the Purbeck Beds, relative sea level fell and a non-marine environment was established with, adjacent to low-lying land, sabkhas, lagoons, hypersaline lakes and freshwater lakes being developed. Conifer trees grew on the land surface (Francis, 1983a, b, 1996) and, when increased water levels flooded the area, the trees died off and the trunks were surrounded by algal 'burrs'. No tree remains are visible at Kingbarrow but a fine example of a silicified tree trunk can be seen in the grounds of the Heights Hotel nearby (see cover photograph).