Field excursion to examine the geology and coastal landforms of the Charmouth to Lyme Regis area, 3rd January, 2001

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Introduction

The aim of the field excursion was to demonstrate the more important geological features that have controlled the development of the landforms in the coastal zone between Charmouth and Lyme Regis, and to illustrate some of the results of recent geological studies that have been designed to reach an understanding of the processes involved. The visit was, in part, complementary to the description of the work carried out to try to provide the data required to design remedial works that will save Lyme Regis from the twin threats of landslip and marine erosion (Gallois and Davis, 2001).

When the fieldtrip was first planned in Autumn 2000, the intention was to traverse the beach from Charmouth to Seven Rock Point, west of Lyme Regis, to examine the stratigraphy and structure of the Jurassic rocks exposed in the cliffs, foreshore and Black Ven, and the landslips and marine-erosion features adjacent to Lyme Regis. A number of unusual events combined immediately prior to the visit to make this impracticable. First, the unusually high rainfall in the early winter had reactivated many of the landslips along the coast. A major landslip at Cain's Folly [SY 376 928] one week before the visit led the police to close the beach and coastal path for several miles eastwards from Charmouth, and to advise extreme caution on the beaches and landslipped areas west of Charmouth. Second, south-westerly gales in December had transported much of the beach shingle offshore with the result that beach levels were up to 3 m lower than normal, albeit with better geological exposure in the intertidal zone. Third, strong winds on the day before the visit had produced a heavy swell that carried the sea to the foot of cliffs that would usually be accessible. The field party therefore spent the morning at Charmouth and then travelled by car to Lyme Regis for lunch and the afternoon.

Charmouth and Black Ven

The group followed the coastal path from Sea Lane car park [SY 365 931] at Charmouth, in places skirting around the edge of recent landslip activity, to a National Trust viewpoint [SY 357 934] on the eastern edge of the Tertiary plateau, adjacent to the Roman Charmouth-Lyme Regis road. This locality provides splendid views eastwards along the Dorset coastline and northwards inland to the Vale of Marshwood and beyond. The westerly overstep of the Gault and Upper Greensand across the easterly dipping Lower and Middle Jurassic rocks, the Tertiary planation surface, and extensive active landslipping are clearly displayed in the cliffs below Stonebarrow Hill and Golden Cap. Inland, the topographical expression of the same geology can be

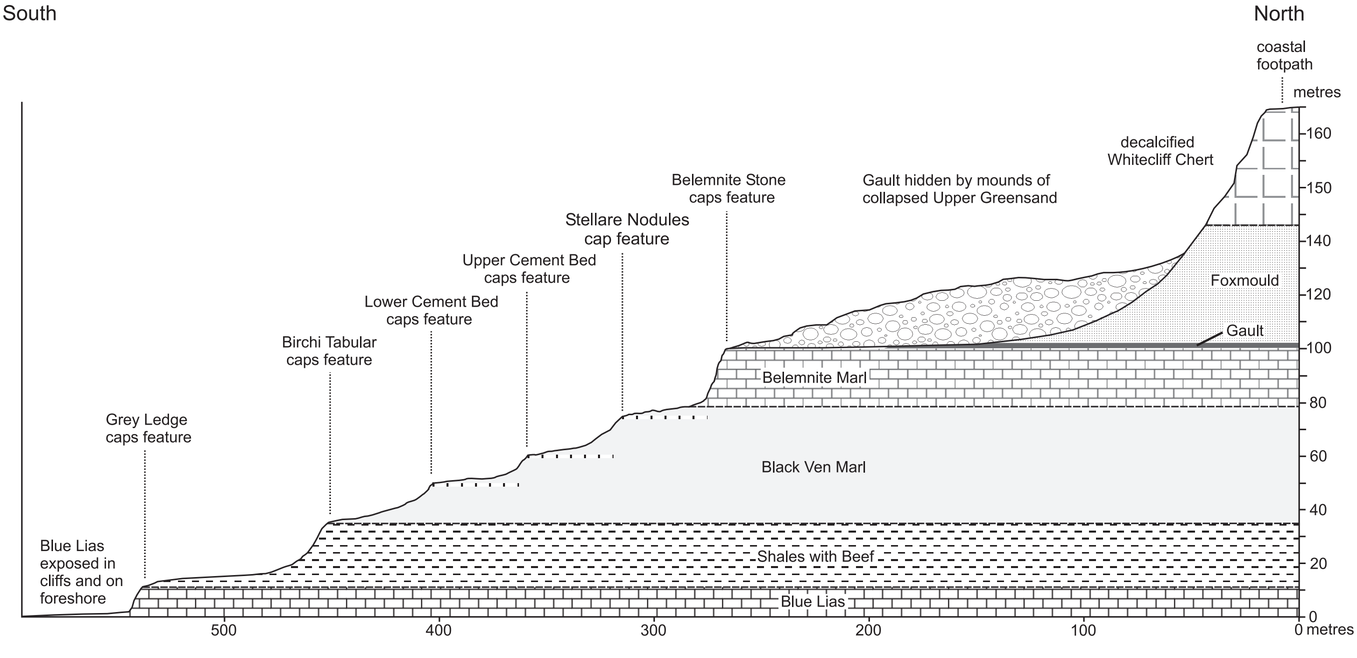

Figure 1. *Simplified geological section through the central part of the Black Ven landslip showing the relationship of the topography to thin beds of limestone within the Charmouth Mudstone Formation.*

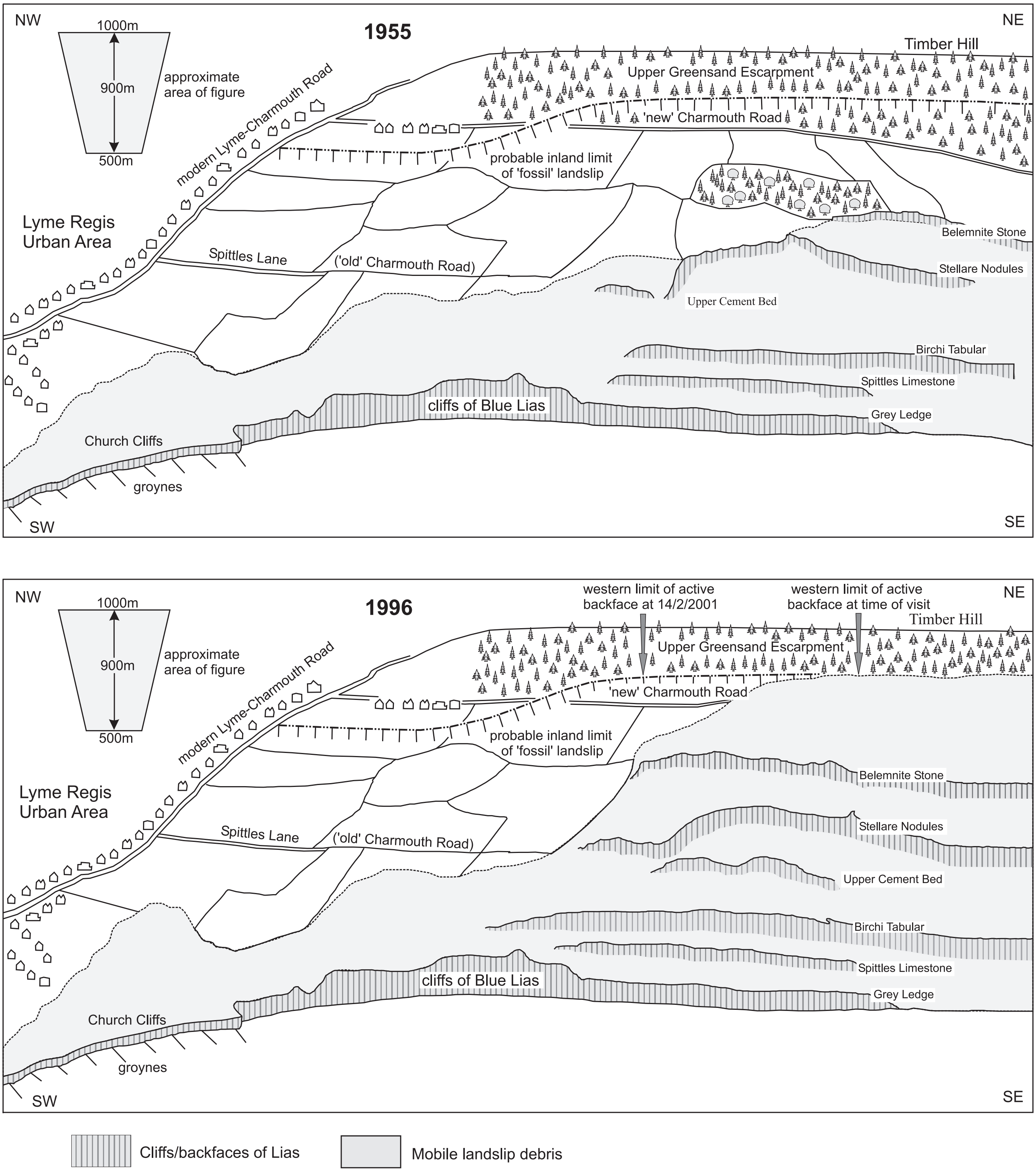

Figure 2. *Sketch diagrams of the western part of the Black Ven-Spittles 'fossil' landslip showing the reactivation between 1955 and 1996. Based on oblique air photographs; uncorrected for parallax.*

seen in the dissected Tertiary plateau, the Cretaceous escarpments and the undulose landslipped hillsides that run northwards from the coast.

To the west, the same viewpoint overlooks the great amphitheatre of the Black Ven-Spittles landslip. The subsidiary failure mechanisms within the landslip were well displayed at the time of the visit. A steady stream of collapsed masses of weathered sand and chert from the Upper Greensand Formation (Whitecliff Chert Member) fell from the backface of the landslip, and intermittent streams of sand from the lower part of the Upper Greensand (Foxmould Member) flowed over the terrace-like escarpments that are capped by thin (mostly <0.5 m thick) limestone beds within the Shales with Beef, Black Ven Marl and Belemnite Marl members of the Jurassic Charmouth Mudstone Formation (Figure 1). The principal failure mechanism, mass movement along shear surfaces in the Gault Formation beneath the Upper Greensand, has rarely been observed because of the almost permanent complete cover of collapsed Upper Greensand debris.

The Black Ven-Spittles landslip has been described as the largest active coastal landslip in Europe (Brunsden, 1969). The area that is currently active consists of an upper bench of about

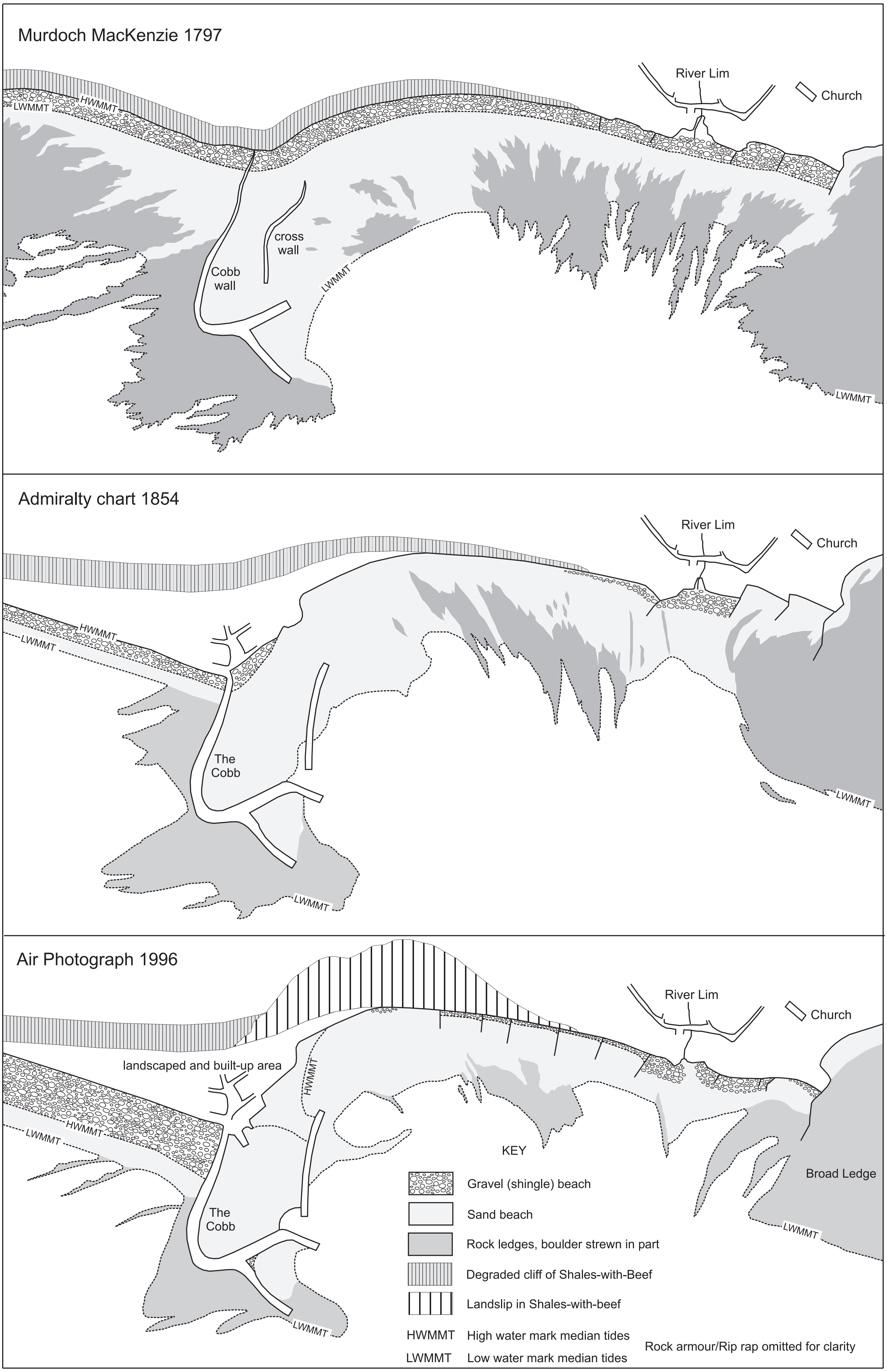

Figure 3. *Changes in the intertidal area adjacent to The Cobb over the last 200 years.*

0.2 km² of collapsed Upper Greensand that overlies a thin (1 to 2 m thick) bed of Gault. Below this and extending to the sea, about 0.4 km² of mudflows and collapse-debris derived from the Charmouth Mudstone and Upper Greensand rest on a series of benches between steep faces of Charmouth Mudstone (e.g. Conway, 1974). Both parts of the currently active area are within a larger landslip complex that was probably formed in the late Pleistocene in a periglacial climate when it was subjected to successive periods of freezing and thawing of a deep permafrost layer. The Holocene rise in sea level has caused active erosion of the toe of the 'fossil' landslip, which has become progressively reactivated as erosion has proceeded. There is historical evidence to show that the rate of reactivation has increased in the past 200 years, and it has been suggested that this may in part be the result of increased marine erosion due to sea defence works and quarrying on the foreshore at Lyme Regis.

The party walked westwards, close to the backface of the landslip, to a point on the golf course at Timber Hill [SY 350 934] near the western limit of the active face, taking care to stay on the landward side of a long line of tension cracks that presaged further retreat of the backface. Westwards from this point, the Upper Greensand in the backface was at that time vegetated by scrub and trees that became thicker and more mature in a westerly direction. Six weeks after the visit, on February 14th 2001, a failure occurred for a distance of c. 200 m along the tension cracks that had been observed on the visit, and new tension cracks developed for another 250 m to the west. This was the longest single reactivation of the Upper Greensand backface yet recorded, and it may prove to be the most significant because it could regenerate a large area in the western part of the 'fossil' landslip complex, adjacent to the Lyme Regis urban area (Figure 2).

The traverse of the backface of the landslip also afforded good views of what remains of the 'new' Lyme Regis to Charmouth road. This ran along the foot of the then wooded and stable Upper Greensand backface, presumably to avoid the extra climb up to the Tertiary plateau. The 'new' road was opened in 1825 as a replacement for the 'old' road which had run eastwards through the lower part of the landslip from what is now Spittles Lane [SY 344 927] (Figure 2). The 'new' road was damaged by landslipping within three years of its opening and, after many repairs, was eventually replaced by the modern road, which runs inland to avoid the landslip, in 1880 (Woodward and Ussher, 1911, p. 80). The 'new' road was finally closed to traffic in 1924. All that remains of it are a short section within the Devil's Bellows road cutting [SY 357 933] at the eastern end and about 300 m at the western end [SY 346 932], much of which consists of a tarmac switchback cut by deep fissures. In contrast, the Roman Road was not breached until 1995 when a particularly large section of Upper Greensand backface collapsed after an unusually wet autumn. Being on the Tertiary plateau, it could have been moved inland at little cost if that had been required.

Lyme Regis

After lunch at the Cobb Arms, Lyme Regis, the party walked through sheets of sea spray to the point on the outer wall of The Cobb [SY 3402 9142] made famous by Meryl Streep in *The French Lieutenant's Woman*. There, the geographical conditions that made the site so favourable for a harbour were described with the help of seismic-reflection profiles commissioned by West Dorset District Council. These show that the original outer wall of what is now the harbour complex was built on a limestone ledge (the Birchi Tabular Stone Band of Lang, 1914) that provided protection from the prevailing south-westerly winds. On the lee side of this ledge, the soft Shales-with-Beef give rise to a sand-floored channel that gave access to the sheltered area behind the wall at all states of the tide.

Early drawings and accounts show that the Cobb wall was not connected to the shore until the 18th century. A low causeway was built to link it to the land when a new wall was constructed in 1756 (Fowles, 1991). With time, this wall and the causeway were increased in height to produce the present-day wall, the landward end of which was last raised in 1939 to provide year-round protection for an air-sea rescue facility.

These changes to the Cobb wall have interfered with the natural west-to-east longshore drift of beach shingle. This has resulted in a steady accumulation of shingle to the west of the wall and the consequential loss of shingle from the town beach (Figure 3). One of the earliest photographs of Lyme, (c. 1850, published by Fowles, 1990, plate 11) shows a short length of Shales-with-Beef cliff below what is now Lister Gardens. The removal of the protective belt of shingle from the foot of this cliff probably encouraged its collapse in the late 19th century, with the result that landslip movements have continued in that area to the present day.

As the tide receded, the party walked westwards along the intertidal rock platform to the eastern end of Pinhay Bay. The alternating limestones and shales of the Blue Lias Formation are continuously exposed in the cliffs and on the foreshore between Devonshire Head [SY 332 914] and Seven Rock Point [SY 328 909]. The limestone ledges contain what Arkell (1933, p. 121) described as "probably the greatest profusion of large ammonites to be seen anywhere in the British Isles". Many of the limestone beds were worked for cement manufacture up to the time of the First World War. The stone was transported to a cement works [SY 335 916] at Monmouth Beach via a narrow-gauge railway than ran along the intertidal area. Short stretches of this were observed below Devonshire Head.

Acknowledgements

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