Hope's Nose and Thatcher Rock

D.H. Keen

Highlights

The Torbay raised beach deposits are among the most fossiliferous of their kind on the south coast. Together with shelly raised beach sediments at Portland Bill, they provide a cornerstone for Pleistocene palaeoenvironmental and stratigraphic studies in the South-West.

Introduction

The raised marine deposits in Torbay have received considerable attention since their earliest description by Austen (1835). Much work was done on the sequences and their faunas in the nineteenth (De la Beche, 1839; Ussher, 1878; Hunt, 1888; Prestwich, 1892) and early twentieth centuries (Hunt, 1903, 1913a, 1913b; Ussher, 1904; Jukes-Brown, 1911; Shannon, 1927, 1928; Lloyd, 1933; Green, 1943). In recent times, Orme (1960b) provided new material, while reviews by Zeuner (1959), Macfadyen (1970) and Mottershead (1977b) drew substantially on earlier data, especially those of Hunt and Lloyd. Amino-acid ratios derived from shells in the beaches were presented by Davies (1983) and Bowen *et al.* (1985): a recent detailed study by Mottershead *et al.* (1987) uses these and other palaeoenvironmental data to establish a geochronological framework for the sequence.

Description

The raised beach deposits in Torbay occur on both of the two limestone promontories which enclose the bay. In the south, around Shoalstone Point [SX 939 568], 1.3 m of beach sediment is overlain by *c.* 2 m of head. The exposures here extend nearly 300 m from Shoalstone, east towards Berry Head. On the north side of the bay, Pleistocene sediments are best seen at Hope's Nose [SX 949 637] where the total thickness of marine and terrestrial deposits is around 9.5 m. Offshore, the islet of Thatcher Rock shows a thin development of both head and raised beach sediments. The maximum thickness of Pleistocene deposits here is *c.* 5 m. All of the major beach exposures are fossiliferous, principally with gastropods of rocky shorelines, but also with bivalves from a range of habitats, and a restricted microfauna. Early work on the molluscan fauna (Hunt, 1888, 1903; Lloyd, 1933) suggested that the beach was deposited by a sea colder than the present. Modern work (Mottershead *et al.,* 1987) regards both the molluscan fauna and the microfauna as indicating water temperatures no colder than in the Channel today.

The GCR site known as Hope's Nose and Thatcher Rock includes three main elements: (a) Shoalstone; (b) Hope's Nose; and (c) Thatcher Rock which are described below.

(a) Shoalstone

The deposits at Shoalstone consist of gravel and cobble beach deposits overlain by head. Mottershead *et al.* (1987) describe the following sequence at [SX 939 568] (maximum bed thicknesses in parentheses):

6. Sandy loam with pebbles (0.7 m)

5. Head of angular cobbles of limestone in a loamy matrix and with apparent downslope bedding (2.0 m)

4. Coarse sand with shell debris (0.3 m)

3. Cobble beach of limestone, flint and slate without sand and with little shell (0.6 m)

2. Beach gravel with abundant shells, principally of oysters, but also *Cerastoderma edule* (Linné) and gastropods (0.2 m)

1. Angular cobbles and boulders in a sandy matrix (0.2 m)

The beach deposits rest on a wave-smoothed platform of Devonian limestone and are intermittently cemented with calcium carbonate. The shells are often fractured.

(b) Hope's Nose

The best section occurs at the eastern extremity of the exposure, at [SX 949 637], and is shown in (Figure 6.2). The sequence, simplified from Mottershead *et al.* (1987), is as follows:

4. Head of coarse limestone debris in a loamy matrix (4.0 m)

3. Dune-bedded sand with occasional cobbles of limestone. The boundary of the sand and head is gradational (1.5 m)

2. Coarse sand with intermittent boulders towards the top and interbedded with silt layers lower down. Shelly throughout, but with bedding planes crowded with oysters in the lower levels of the deposit (2.85 m)

1. Boulder bed resting on Devonian limestone and interdigitated with 1.0 m of angular head close to the fossil cliff (0.3 m)

The whole sequence of deposits rests against a fossil cliff and on a platform cut into Devonian limestone. The marine units (bed 2) in general fine-upwards and are well cemented by calcium carbonate. Shells are mainly fragmented, but whole shells occasionally occur. Especially abundant are valves of *Ostrea edulis* (Linné) although other bivalves and gastropods are also present. Overlying the beach deposits is a dune-bedded sand (bed 3) which contains a sparse fauna of land gastropods — *Pupilla muscorum* (Linné) — and derived marine shell debris together with foraminifera (Mottershead *et al.,* 1987). The beach deposit (bed 2) and blown sand (bed 3) are weathered and stained with iron oxide. The overlying head (bed 4), which forms the uppermost unit of the succession, contains much dune sand in its basal metre. Higher up, it is composed of angular limestone fragments, up to 0.5 m long, in a silt and sand matrix.

(c) Thatcher Rock

The Pleistocene deposits on Thatcher Rock occupy two small and unconnected areas on the islet. In the north [SX 944 629], patches of marine and terrestrial sediment total up to 1.8 m in thickness. In the south-east [SX 944 628], two smaller outcrops exhibit up to 5.2 m of head and beach sediment. The following sections were described by Mottershead *et al.* (1987):

North Beach

3. Head with angular blocks of limestone in a red silty sand matrix (0.4 m)

2. Sand, reddened at the top and cemented, with locally abundant shells (1.2 m)

1. Pebbles and cobbles of flint, limestone, and igneous rock. Cemented in places and penetrated by weathering (0.2 m)

East Beach

2. Head deposit of angular, crudely bedded limestone blocks in a sandy matrix (5.0 m)

1. Beach deposit of well-rounded pebbles with shells in a clay/silt matrix (0.2 m)

Both beach deposits rest on a platform and against a cliff cut in Devonian limestone. The elevation of the beach fragments, between 7.8 and 10.3 m OD, has allowed considerable recent erosion of the beach and head deposits by waves: only small areas of sediment remain on an increasingly exposed platform. The higher elevation of the Hope's Nose deposit, between 9.1 and 12.1 m OD, has preserved this beach remnant from present-day marine action.

The shell content of the Thatcher Rock raised beach sediments is described by Mottershead *et al.* (1987). The fossil fauna consists of numerous gastropods, mainly *Littorina* spp. and *Patella* sp., but with 20 other species noted, and also 21 species of bivalve, mostly represented by single shells. The fauna is most numerous in the north outcrop and the East Beach has a fauna composed of the most common species found in the North Beach. Accompanying the fossil molluscs in the North Beach were four species of foraminifera, barnacle plates, fish vertebrae, crab and echinoid debris and rolled 'pebbles' of mammal bone.

Interpretation

The local palaeoenvironment of the raised marine deposits around Torbay can be determined from their mollusc and other fossils. Earlier workers recorded shells from all the outcrops described above and these records were consolidated by Lloyd (1933): the general conclusion was that sea temperatures at the time of deposition were lower than those of the modern Channel. In particular, the occurrence of species such as *Trophon truncatus* (Strom), with a mainly Scottish distribution at present, was used to support this interpretation. Mottershead *et al.* (1987) counted over 1000 individual fossil shells from the three major beach localities, and concluded that sea temperatures were no colder then than now. This assessment is most secure for the Thatcher Rock beach deposit, where faunal remains are most extensive. For these raised beach sediments, the fauna is closely comparable to marine faunas of today, and there is no reason to suggest temperatures different from those of the modern seas around Torbay. The evidence from the Hope's Nose and Shoalstone beach deposits is less clear due to a more restricted fauna, but the inference from these localities is also consistent with a climate no cooler than today's.

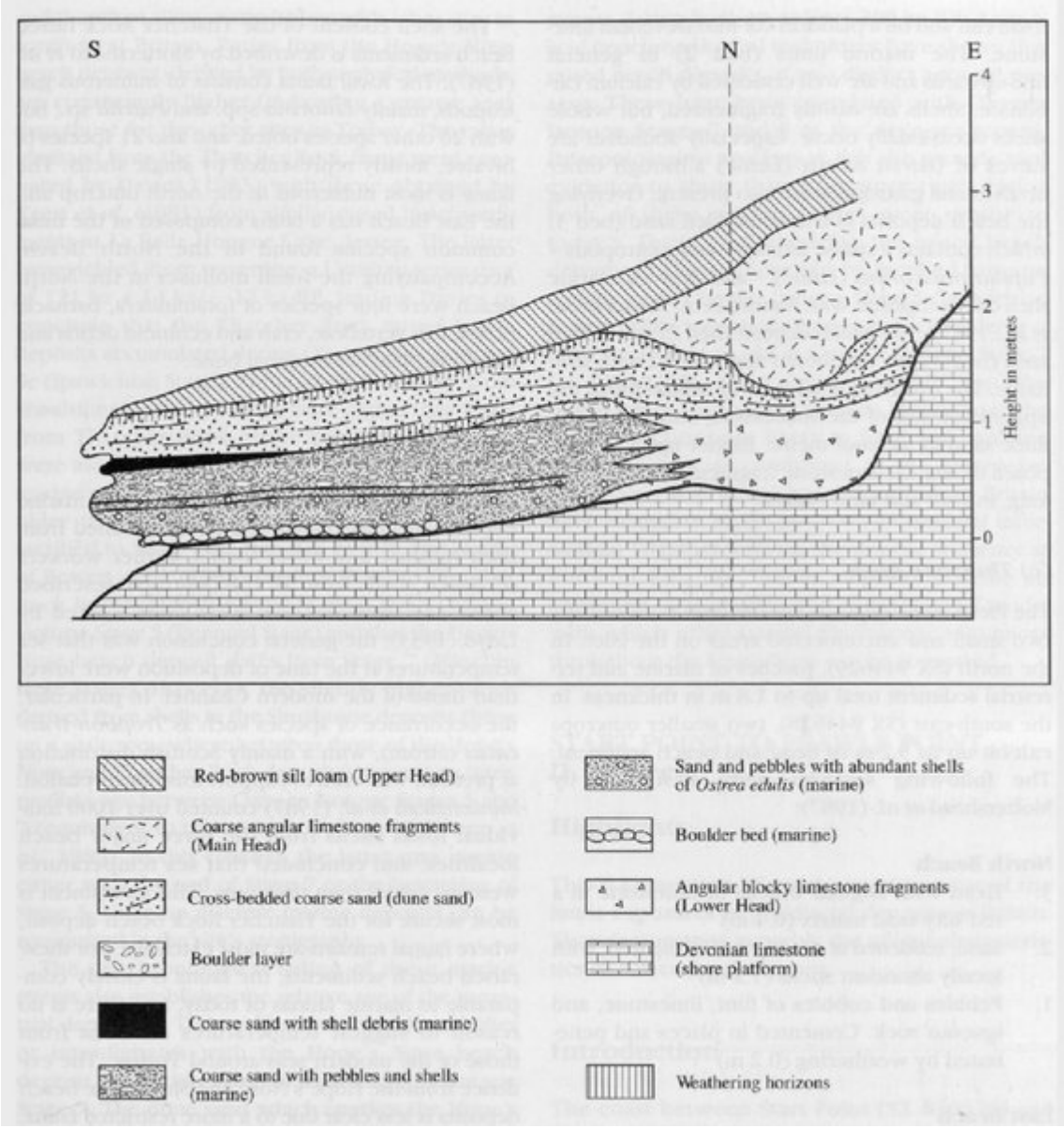
Because the raised beach deposits occur in similar positions and at approximately the same height above sea level, previous authors (see Mottershead, 1977b) have assumed a similar age for them. The application of amino-acid epimerization relative dating techniques (Davies, 1983; Bowen *et al.,* 1985; Mottershead *et al.,* 1987) and further detailed stratigraphic studies, however, have established a more complex chronology. The amino-acid ratios of Davies (1983) and Bowen *et al.* (1985) were obtained by slightly different analytical methods. The data sets, however, are 'internally' consistent and therefore allow comparisons with other sites in south-west Britain. Ratios from the Hope's Nose beach deposits, derived by both analytical methods, are consistently higher (indicating a greater age) than those for the other sites in Torbay. The ratios obtained from the Thatcher Rock fauna were compared by Davies (1983) with those obtained by Keen *et al.* (1981) from similar raised beach sediments at La Belle Hougue Cave, Jersey. The latter have yielded, from travertine, a Uranium-series date of 121 ka + 14 ka/– 12 ka BP, leading Davies to conclude that the Thatcher Rock raised beach deposits accumulated during Oxygen Isotope Stage 5e (Ipswichian Stage). Although the few ratios from Shoalstone noted by Davies were higher than those from Thatcher Rock, these beach deposits also were ascribed to Stage 5. The Hope's Nose raised marine sediments, therefore, were considered to be older than Oxygen Isotope Stage 5 and were ascribed to Stage 7 (*c.* 180–220 ka BP). The results of Bowen *et al.* (1985) confirm that the Thatcher Rock beach deposit probably dates from Oxygen Isotope Stage 5 (Pennard Stage) and that the Hope's Nose beach deposit dates from Stage 7 (Minchin Hole Stage). However, the slightly higher ratios derived from shells in the Shoalstone deposits (lying on a scale somewhere between those of the Hope's Nose and Thatcher Rock deposits) suggest an intermediate age between Oxygen Isotope Stages 5 and 7 (equivalent to the 'unnamed' Stage of Bowen *et al.,* 1985). In this context, the latter may equate either with the end of Stage 7 or the beginning of Stage 5, since no discrete marine deposits can be recognized in the site's stratigraphy.

The geochronological dating of these marine events also establishes the relative age of the terrestrial deposits in Torbay. The head, which underlies or interdigitates with the Hope's Nose beach deposit, must date from at least Oxygen Isotope Stage 7. The dune sand which overlies the Hope's Nose raised beach deposit has yielded amino-acid ratios indicative of a Stage 5 age (Bowen *et al.,* 1985) and its snail fauna, and the weathering it has undergone, also suggest interglacial conditions. The head, which overlies the raised marine and/or dune sediments at all three sites, is therefore likely to have accumulated during the Devensian Stage: greater precision than this is not yet possible.

Conclusion

The Pleistocene deposits exposed in Torbay record an impressive variety of marine and terrestrial events dating back to at least 200 ka BP. Amino-acid geochronological techniques have shown that raised beach deposits of two distinct ages are present. These have been correlated with Oxygen Isotope Stages 7 and 5 of the deep-sea record. Palaeontological analyses at this site provide vital evidence to show that sea temperatures during both of these marine phases were similar to today's. Dune sand overlying the raised beach deposits at Hope's Nose can be ascribed to warm conditions in Oxygen Isotope Stage 5 (Ipswichian Stage), while terrestrial deposits which underlie it must be at least as old as Oxygen Isotope Stage 7 (*c.* 200 ka BP). Head deposits which 'cap' the raised beach and dune deposits throughout the Torbay sections are likely to have accumulated under periglacial conditions in the Devensian Stage. Very few raised beach localities in Britain have yielded so much palaeoenvironmental information. Together with the Pleistocene sequence at Portland Bill, the Torbay deposits provide an important stratigraphic and chronological model with which other coastal Pleistocene sequences throughout the South-West can be compared.

References



(Figure 6.2) The Quaternary sequence at Hope's Nose. (Adapted from Mottershead et al., 1987.)