times, covered by Triassic deposits and has now been uncovered (exhumed) by more recent erosion.

There is a good view from this point. The adjacent headlands are also made of Carboniferous Limestone - Nell's Point (Barry Island's other headland) to the east (left) and Cold Knap Point to the west (right). In the Bristol Channel can be seen the islands of Flat Holm (11 km away) and Steep Holm (12 km away) which also consist of Carboniferous Limestone. On a clear day the view across the Bristol Channel extends from the headlands at Weston-super-Mare in the east (made of Carboniferous Limestone) to Dunkery Beacon, the highest point of Exmoor, in the west (made of Devonian rocks).

Walk north along the cliff-top path on the east side of the headland for 300 m.

Stop 4 This locality provides another opportunity to examine the unconformity between Triassic and Carboniferous rocks, with its shore platforms and cliffs. Fossils in the Carboniferous Limestone include solitary and colonial corals, brachiopods and crinoids.

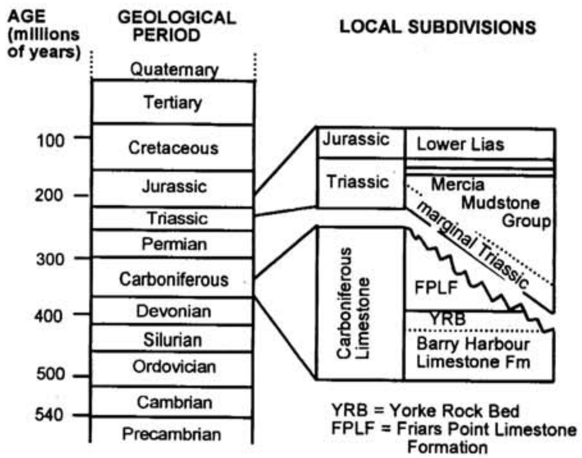
Walk north at beach level past a ruined paddling pool to the north-west corner of Whitmore Bay, adjacent to the steps.

Stop 5 These rocks are fine-grained, red and green **mudstones** of the Mercia Mudstone Group. They include small lumps known as 'potato stones'. These are nodules which grew within the lake-bed sediment and originally were made of **gypsum** (hydrous calcium sulphate). Most of the gypsum has been replaced by calcite. Similar sulphate nodules form today at shallow depths in shoreline sediments around tropical coasts such as the Persian Gulf, where they are known as **sabkhas**. They show that the late Triassic climate in Barry was hot and arid, and suggest that the lake level varied on short time scales as well as the longer-term changes implied by the stepped shore terraces.

During Triassic times the British Isles lay between 15° and 20° north of the equator and had a hot, dry, desert climate. The changing latitude and climate from Carboniferous to Triassic to modern times has been brought about by **plate tectonics**. The Earth's crust is broken into several slabs, or plates, which move slowly. Over hundreds of millions of years this causes **continental drift**.

Return to the car park past the entrance to Friars Point House.

Nell's Point (the eastern headland of Barry Island) and Jackson's Bay are accessible at most states of the tide. Their geology is similar to Friars Point. Similar unconformities are exposed further east at Sully Island and The Bendricks, where the Triassic deposits include dinosaur footprints and alluvial plain sediments. A reconstruction of these environments can be seen in the permanent exhibition ***'The Evolution of Wales'*** at the National Museum of Wales in Cardiff.



Produced by the Geologists' Association South Wales Group.
If you want to know more about rocks, fossils and the geology of South Wales contact the **Geologists' Association South Wales Group** (Cymdeithas y Daearegwyr - Grŵp De Cymru) at The National Museum of Wales, Cathays Park, Cardiff.

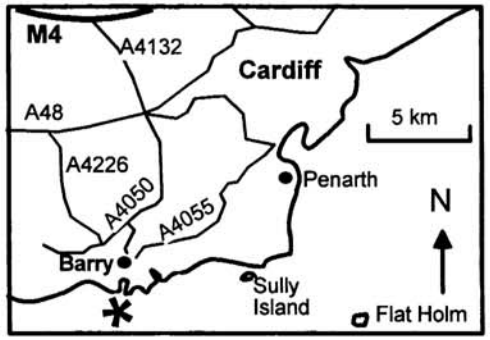
Alun J Thomas, Barry, April 1998.

Geological Walks in Wales Series Editors: Geraint Owen, Stephen Howe, Tom Sharpe.

Geological Walks in Wales 12

Barry Island Friars Point

This short walk around Friars Point, the western headland of Barry Island, examines the fossiliferous Carboniferous Limestone and its relationship to overlying Triassic rocks. The round trip is about 2 km and should take no more than half a day. The walk lies within the *Barry Marine Conservation Area* and the area forms part of the *Little Island and Nell's Point* Site of Special Scientific Interest.

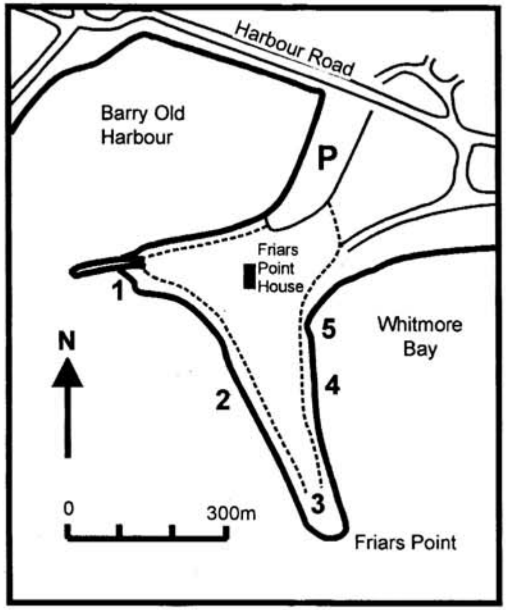


LOCATION Barry Island is south of Barry, about 10 km south-west of Cardiff. Access to the car park at grid reference ST 1100 6650 is by a left turn off Harbour Road, shortly after crossing to Barry Island.

Maps Ordnance Survey 1:50,000 Landranger Sheet 171 (Cardiff and Newport) and 1:25,000 Pathfinder Sheet ST06/16 (Barry); British Geological Survey 1:50,000 sheet 263 (Cardiff).

The route is accessible at all states of the tide. Beware large waves on an incoming tide and soft mud in the Old Harbour. The rock surfaces can be slippery when wet. Follow the Geological Fieldwork Code.

The Geologists' Association South Wales Group acknowledge the assistance of The Curry Fund of The Geologists' Association in the production of this leaflet.



From the southern end of the car park walk west to the Yorke Rock Breakwater.

Stop 1 The rocks of Barry Island are **sedimentary rocks**, which formed as layers or **beds** of sediment on the Earth's surface or beneath the sea. As more sediments accumulated, older layers were buried and became cemented into solid rock. Erosion has since removed the overlying rocks.

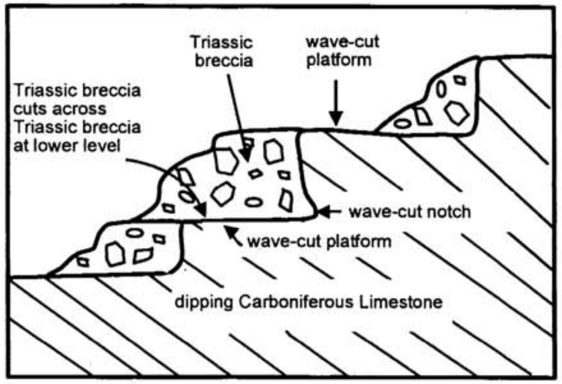
Look across the Old Harbour. A sharp boundary separates rocks on the south (left) in which the beds are tilted (**dip**) at about 30° towards the sea, from rocks on the north (right) which are flat-lying. The rocks on the left formed as sea-floor sediments during the **Carboniferous Period** of geological time, some 350 million years ago, and belong to the **Carboniferous Limestone**. The rocks on the right formed during the early **Jurassic Period** about 200 million years ago, and belong to the **Lower Lias**. The Lower Lias usually overlies the Carboniferous Limestone. The boundary between the rocks here is a **fault**, known as the **Cold Knap Fault**. The rocks on the north side have moved downwards (been **downthrown**) by about 50 metres relative to those on the south. The movement may have taken place during the **Tertiary Period**, some 15 million years ago.

If the tide permits, descend to beach level. A prominent dark grey bed of rock, 3 to 5 m thick, dips seawards at 60°. This is the **Yorke Rock Bed**, which marks the top of the **Barry Harbour Limestone Formation** of the Carboniferous Limestone. It contains fossils, including many disc-shaped fragments. These are parts of **crinoids**, or **sea-lilies**, animals related to starfish that live fixed to the sea bed by a stem made of disc-shaped segments (**ossicles**). The crinoid stems here are up to 20 cm long. The fossil material is normally **calcite** (calcium carbonate) but has here been replaced by much harder **silica**, so the fossils stand out from the surrounding rock. The Yorke Rock Bed also contains dark **nodules** of silica (**chert**) that grew in the sediment by chemical processes after it was buried, and **lamination** (**cross-bedding**) which was formed by currents on the sea bed washing the sediment about.

Continue south-east (either at beach level or on the cliff-top footpath) for 300 m to near a ruined blockhouse from World War 2.

Stop 2 The route has passed beds of limestone tilted south at about 60°. These belong to the **Friars Point Limestone Formation** of the Carboniferous Limestone. They contain fossils, including some horizons rich in **corals**.

The beds of limestone are cut across by up to 5 gently sloping terraces at different levels. Some are overlain by **breccia** - a rock made of large, angular blocks of limestone. The breccias contrast markedly with the normal, bedded limestone. Their fragments must have been broken from the limestone and deposited on the terraces without much transport or rounding. They have since been cemented together.

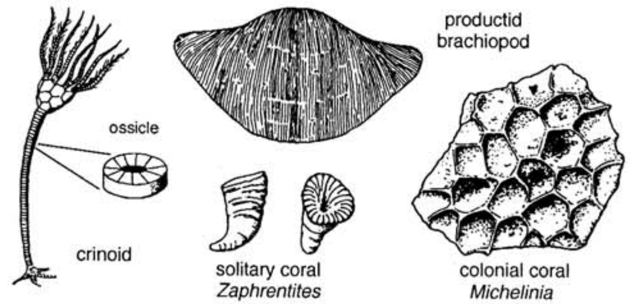


The terraces are **wave-cut platforms** that were formed during the **Triassic Period**, about 220 million years ago. At that time the Bristol Channel area was a large lake. Wave action at the lake shoreline eroded the platforms, each of which is backed by the remains of a near-vertical cliff of limestone. At the foot of some cliffs is a recess representing a **wave-cut notch**. Such features form today where wave energy is concentrated near the base of a cliff, and result in the undercutting and collapse of the cliff. The breccias represent **scree** which accumulated as rubble at the foot of the cliffs following collapse. The different levels of the terraces indicate changing water levels in the lake. Some cut across Triassic breccias as well as beds of Carboniferous Limestone, showing that the lake level was rising as time went on. The breccias are known as marginal deposits, which developed only locally near shorelines. Similar deposits elsewhere around the Bristol Channel are known as 'Dolomitic Conglomerate'. Away from the shorelines different deposits accumulated: these will be seen at Stop 5.

The boundary between dipping limestone beds and flat-lying Triassic rocks represents a long period of time (over 100 million years) for which no rocks are preserved here. Any rocks that formed during this time were removed by erosion before the Triassic rocks were deposited. Such a time-gap in the rock record is called an **unconformity**.

Walk south along the cliff top towards the headland. A small fault disturbs the sequence. Stop at the highest point (15 m above sea-level).

Stop 3 The headland comprises limestones of the Friars Point Limestone Formation dipping south at 30°. This formation is almost 400 m thick and contains fossiliferous beds with crinoids, corals and **brachiopods**, fossils whose living relatives flourish in warm, clear, shallow seas. In early Carboniferous times the British Isles lay just south of the equator, with an environment and climate not unlike the Bahamas today. There are also rare **trilobites**, an extinct group of marine arthropods that resemble woodlice.



On top of the headland are small outcrops of red, fine-grained rocks belonging to the **Mercia Mudstone Group** of the upper Triassic (formerly known as the 'Keuper Marl'). These accumulated in the Triassic lake but further from the shoreline than the breccias at Stop 2, at a time when the lake had over-topped Friars Point. The surface of Friars Point was eroded flat during Triassic