

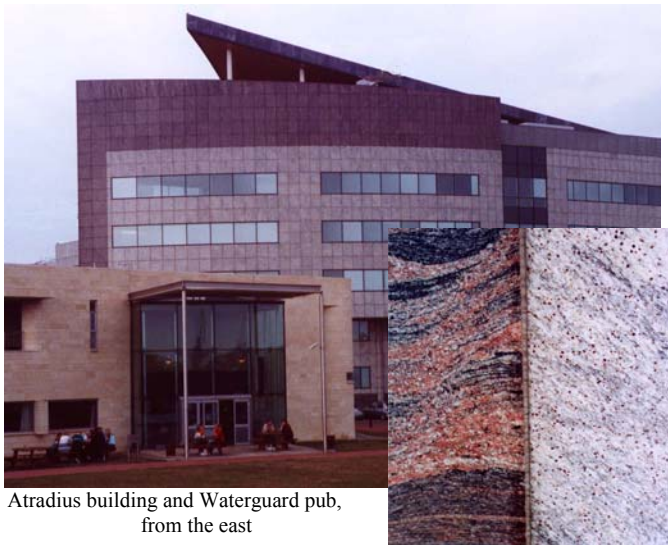
Walk past the front of the Pierhead Building, built of glazed terracotta brick in 1897. Continue east along the front for about 200 metres to the Atradius building.

5: Atradius building

The Atradius Building is another of the new prestigious buildings in the Bay. Opened in 1995, it resembles the prow and sails of a ship. This building is described as having a decorative stone cladding of 'Brazilian granite'. In fact there are two different stones, a light one and a dark one (with the trade names Samba White and Kinawa respectively).

Look at the stones. Don't they give the impression that the rock has melted and flowed? Note the small red crystals in the lighter stone; these are garnets (but of no commercial value!).

The relatively large crystals in both these stones, the banding, and the nature of the minerals, all indicate that they are metamorphic rocks that formed at very great depths in the Earth's crust. Such rocks are called **gneiss**. Further evidence of the high temperatures and pressures that these rocks have been subjected to is shown by the plastic flow textures, and the irregular reddish bands in the dark stone which indicate that some of the rock has melted, possibly more than once. Hence, neither stone is granite!



Atradius building and Waterguard pub, from the east

Technically, geologists would describe the dark stone as a **migmatitic biotitic granodioritic gneiss**, and the light stone as a **garnetiferous gneiss**! Both are probably over 1500 million years old (Proterozoic). Both come from Bahia in north east Brazil.

Continue past the building and cross the road.

6: Waterguard Pub

This was built in 1870 as the HM Customs and Excise House, since moved 50 metres to this location. The old part is constructed of grey **Pennant Sandstone** and yellow buff **Bath Stone**. The new part, added in 2002, is built of fine grained cream **Magnesian Limestone**, supplied by High Moor Quarry, Tadcaster, Yorkshire.

Magnesian Limestone contains a large proportion of magnesium carbonate. It formed in a shallow tropical sea around 260 to 250 million years ago (Permian). Note the black **dendritic** patterns of manganese oxide.

Walk 200 metres northeast beside the Roath Basin, to the entrance to Scott Harbour. Walk along the side of the dock towards the far end.

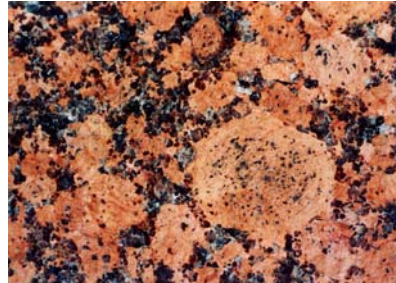
7: Scott Harbour

This is named after Captain Scott, who was particularly well supported by the people of South Wales. His ship the *Terra Nova* sailed from near here for the South Pole in 1910. A commemorative plaque can be seen at the entrance. The buildings, completed in 1997, are clad in a distinctive red stone called **Rapakivi Granite**.

This type of granite is noted for its large rounded feldspar crystals containing rings of dark minerals.

There are several ideas for its formation.

One involves the effect of convection currents on the growth of the minerals in a slowly cooling magma deep inside the Earth. The rock is around 1500 million years old (Proterozoic).



(field of view 18cm)

The rock was quarried in southernmost Finland, sent to Italy for cutting and polishing, and then on to Wales. Its trade name is most probably Baltic Red 'Marble'. A duller brown variety can be seen in some shop fronts around Cardiff.

Walk to the far end, up the steps, to the compass rose. As you walk towards it, note the (unpolished) paving slabs of the stones seen in the Atradius building. Can you also spot the artificial stones in this area?

Compass rose

At the far end of Scott Harbour, there is a beautiful compass rose constructed of many ornate decorative stones. Quite a few are granite. How many different stones can you spot?

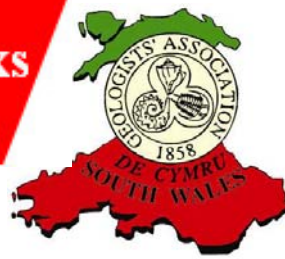


From here it is a short walk back to the start.

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 Daeargwyr Grwp De Cymru** at the National Museum of Wales, Cardiff CF10 3NP. You can also find us at www.swga.org.uk

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Geological Walks in Wales 13



Building Stones of Cardiff 1. Cardiff Bay

A wide range of interesting and attractive stones can be found in the buildings of Cardiff Bay. The older buildings and docks are constructed of stone quarried from Wales and southern England. The newer buildings are concrete-steel structures clad with decorative stone, some of which comes from Wales, some from around the world.

This walk looks at both the old and the new, at how the different stones formed, and at the development of the Bay. The walk should take 1½ to 2 hours.



This area forms part of the estuary of the Rivers Taff and Ely. Over the last 200 years, it has changed beyond all recognition.

The docks were built between 1830 and 1907, the first (Bute West Dock) opening in 1839. Cardiff soon became an extremely busy international port. Millions of tons of coal, mined from the Valleys of South Wales, were exported through the docks.

The last cargo of coal left Cardiff in 1964. Since then, the area has undergone considerable redevelopment, especially since the 1980s.

How to get there

Cardiff Bay lies 2km south of the centre of Cardiff.

By road, from the M4 junction 33, follow the A4232 signposted Cardiff Bay. Take the Techniquet exit, then follow the road ahead round to the traffic lights at the junction of Bute Street and James Street. Car parking is available in the area. There are frequent train services from Cardiff Queen Street station to Cardiff Bay station, also bus and train services from Cardiff Central station.

Map: OS 1:25,000 Explorer Sheet 151 (Cardiff & Bridgend).

DO TAKE CARE: Some of the walk is along main streets, and main roads have to be crossed. Don't step out backwards into traffic if you look up at a building! If it is raining, it may be slippery.

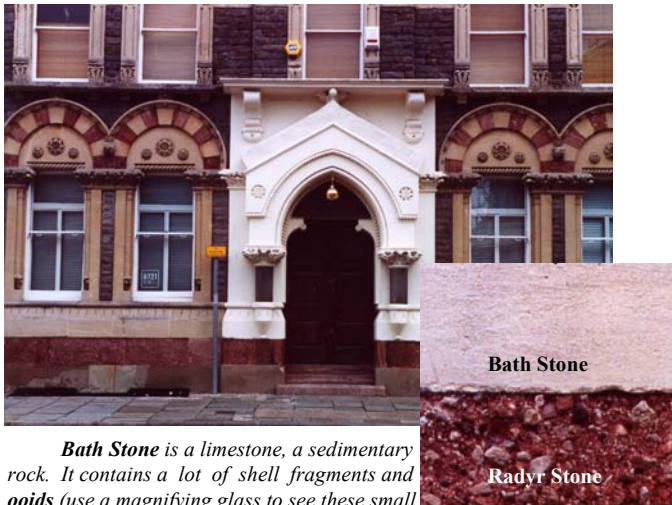
The walk begins at the junction of Bute Street and James Street (ST192746).

From here, walk north along the right hand side of Bute Street for 200 metres. Note the various stones in the buildings you pass, especially the building opposite with the white columns (nos 113-116).

1: Pascoe House, 54 Bute Street

Built in 1875 for the Powell Duffryn Coal Company, Pascoe House is an interesting example of one of the older buildings in Cardiff Bay. There is a better view from the back lane. How many different stones can you see?

The main part is grey sandstone, most probably **Pennant Sandstone**, from the Valleys of South Wales. The yellow buff stone, which has been carved and used to decorate the building, is called **Bath Stone**.



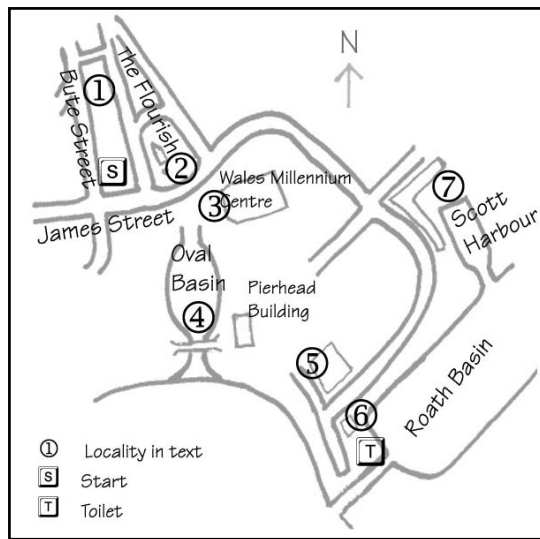
Bath Stone is a limestone, a sedimentary rock. It contains a lot of shell fragments and **ooids** (use a magnifying glass to see these small spherical grains), cemented together with calcium carbonate. It formed in warm shallow seas, as found in the Bahamas today. **Bath Stone** is a shelly detrital (bioclastic) oolitic limestone about 160 million years old (Middle Jurassic). It comes from quarries near Bath.

The red stone, used along the bottom, the entrance steps and in the arches, is local **Radyr Stone**.

Radyr Stone is a breccia (another sedimentary rock). It contains irregular fragments of white, brown and grey rock. It formed in a hot dry climate where occasional torrential rain led to flash floods. These carried rock debris along wadis, which was then dumped as alluvial fans at their mouths. Over time, the fragments were cemented together with sand and calcium carbonate. It is of Triassic age, and is 210 million years old.

Radyr Stone crops out at Radyr, northwest of Cardiff. The quarries, to the west of the railway, were in operation from 1850 until the 1920s. As a local stone it has been much used in the Cardiff area, both for decorative and engineering construction. It is very distinctive.

The polished granite in the columns by the entrance is called '**Bessbrook granite**'. This came from the Mountains of Mourne in Northern Ireland and is about 50 million years old.



The old Provincial Bank building passed on the way (nos 113/116 Bute Street) is built of white **Portland Stone**. This stone was more desirable and prestigious than **Bath Stone**. It comes from quarries in the Isle of Portland in Dorset. Similar in origin to **Bath Stone**, it is a little younger in age.

Several of the older buildings in this part of Cardiff Bay are built of **Bath** or **Portland Stone**, with more exotic stones for decoration.

From Pascoe House turn right at the nearby junction, then right again down Lloyd George Avenue. Before crossing the road to 'Craft in the Bay' note the heather coloured slate on the roof of this building.

2: 'Craft in the Bay', The Flourish

'Craft in the Bay', completed in 2002, is an old dock warehouse that has been moved and enlarged. The bollard in front is **granite** from the south west of England; it comes from the old Bute West Dock which once extended from the Bay along the length of Lloyd George Avenue.

From this point, you can see **slate** on the roof, in the pavement, and in the Wales Millennium Centre nearby (our next stop).

Slate is a metamorphic rock. Metamorphic rocks form when already existing rocks are changed by heat and/or pressure, resulting in recrystallisation, usually with the formation of new minerals.

Sediments, especially mud and silt deposits, can build up to great thicknesses on the sea bed. This can lead, over time, to the formation of shale (a sedimentary rock). Should this shale be buried even deeper, and subjected to increased temperature and pressure, recrystallisation of the constituent minerals can take place, forming the rock we call slate. In slate, the new minerals tend to be very small platy crystals which orientate themselves parallel to each other, at right angles to the direction of greatest pressure. This is why slate can be broken or 'cleaved' into parallel sheets, eg slates for the roof. If Earth processes tilt the sediments before they change into slate, the cleavage planes will be in a different direction to the original bedding.

Can you spot evidence of this in the pavement slates? Can you also spot the yellow **pyrite** crystals (fool's gold)? This indicates that the original sediments were deposited in water containing no dissolved oxygen.

The **slate** on the roof comes from the Penrhyn Quarry at Bethesda, North Wales. The **slate** in the pavement is also from North Wales.

Both slates are about 500 million years old (Cambrian – Ordovician).

Cross the road to the Roald Dahls Plass (Oval Basin) and the Wales Millennium Centre.

3: Wales Millennium Centre

This prestigious international arts centre is clad in Welsh slate, reflecting and inspired by the geological features of the nearby coast. It is due to open in 2004.



There are five different colours and different textures (rough-hewn and cut) in the blocks of cladding, which are all **slate** waste from North and Mid Wales. The green and purple slates come from the Penrhyn Quarry. The dark grey rustic rusty slate comes from the Corris Quarry, north of Machynlleth. The plain dark grey slate comes from Ffestiniog. The colours result from slight differences in the composition of the slates.

Walk south through the Roald Dahls Plass (Oval Basin) to the old sea lock under the foot bridge at the far end.

4: Roald Dahls Plass (formerly the Oval Basin)

Ships passed through the Oval Basin, which joined the Bute West Dock and the Severn Estuary, via two locks. Opened in 1839, some of the original stones must have since been replaced. For example **Radyr Stone**, quarried after 1850, is present in the basin walls. Can you spot it?

Granite is conspicuous all along the top of the basin, where it had to withstand the battering of innumerable ships moored alongside. This is a typical granite from the south west of England, with large white feldspar crystals in a finer mass of feldspar (white), quartz (colourless) and mica (both silvery and dark).

Granite is an igneous rock, formed when molten rock (magma) cools and solidifies. The crystals here are quite large. A long time is needed for them to grow, so this rock must have cooled slowly, which implies a great depth within the Earth's crust. This granite formed 300 to 270 million years ago (Carboniferous-Permian).

Pennant Sandstone, another sedimentary rock, is prominent in the dock walls. When fresh it is grey, but on weathering it has a brownish colour. It has a rough texture, like sandpaper, caused by the quartz present. It is the sandstone which covers much of the Valleys area to the north of Cardiff, forming the prominent steep scarp slopes. Pennant Sandstone is much used as a building stone in South Wales. The original stone for the dock was quarried around Pontypridd.

It was deposited as sand in northward flowing tropical rivers and deltas in the later part of the Carboniferous Period, around 300 million years ago. Note the 'cross' bedding, caused by currents in river channels.