

## Geology in St Paul's Churchyard and Paternoster Square

*Ruth Siddall*

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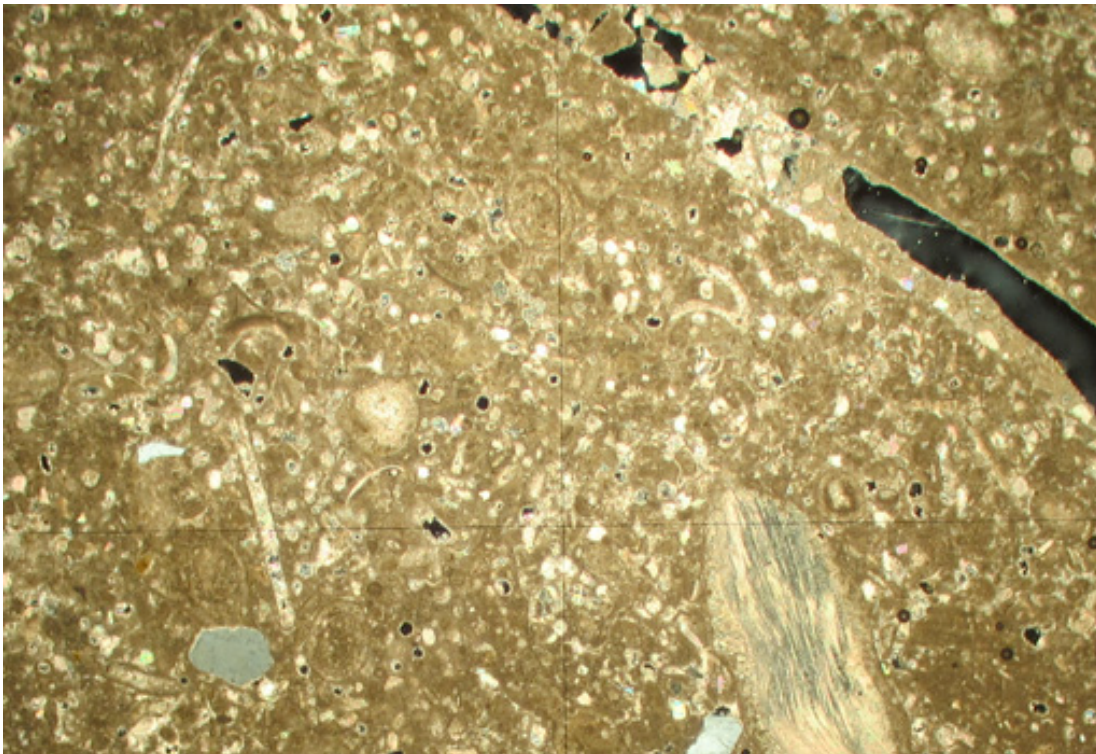
*Looking From Newgate Street across Paternoster Square to the Temple Bar and St Paul's Cathedral.*

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This walk starts at St Paul's Underground station, and takes in a circuit around the Cathedral via Paternoster Square and St Paul's Churchyard and back to the tube station via the west end of Cheapside. This area has seen a large amount of redevelopment since Eric Robinson wrote his guides to street geology in this part of the city of London (Robinson, 1984 & 1997; Robinson & Bishop, 1980), including the relocation of two of the City's monuments into the vicinity. Culturally and archaeologically this is one of the oldest, continuously occupied parts of the City of London, particularly as a religious centre. It was part of the Roman city of Londinium, with the Lud Gate in place in the earliest 3<sup>rd</sup> Century AD. This Roman gate house survived until 1760 when it was demolished. The first St Paul's Cathedral was constructed in 604 AD by the Bishop of London, Mellitus. This was replaced (with probable intervening buildings) in 1087 with a new Romanesque cathedral built by Bishop Maurice. In the 13<sup>th</sup> Century a crypt (still in tact under the current cathedral) and a choir were added, and a cloister and chapter house were added in the 14<sup>th</sup> Century. In the mid 17<sup>th</sup> Century, the architect Inigo Jones was surveyor of the fabric and added classical details to the Cathedral. He was succeeded by Sir Christopher Wren who proposed major refurbishments due to have taken place in 1666. Notoriously, the old cathedral was destroyed in that year by the Great Fire of London and Wren found he had more scope than he had wished for and subsequently submitted his designs for the current building. The plans received a Royal warrant in 1675 and building work commenced. The Cathedral was completed in 1710. The street plan we see today, with the exception of Paternoster Square was already established, and significant redevelopment of the surrounding area took place in the 19<sup>th</sup> Century. The areas directly north and southeast of the Cathedral was destroyed by bombing in World War II and these were developed in the 1960s and 70s with the creation of Paternoster Square and the construction of new office buildings. This part of London had been the centre of the book trade from the

14<sup>th</sup> Century, and millions of books were destroyed during the blitz, effectively putting an end to over half a century of book production. The 1960s and 70s buildings, described by Robinson (1984, 1997), were largely demolished in the late 1990s and the area was redesigned and rebuilt, along with neighbouring Cheapside. Redevelopment still continues at the time of writing around St Paul's underground station and we await to see what will emerge when the scaffolding and plastic sheeting is removed from what was an unattractive and poorly built polygonal tower.

The geology of the building stones used is unusual for the city in that it is dominated by British stones, and predominantly varieties of Portland Stone. Portland Stone comes from the Isle of Portland, near Weymouth in Dorset. It is of Upper Jurassic age and is the iconic building stone of post-Great Fire (1666) London. However use of the stone was pioneered by the architect Inigo Jones and he used it in London in the Banqueting House, Whitehall, completed in 1622. In fact there is so much building in Portland Stone that it is difficult to believe that the quarries of the Isle of Portland alone could have produced so much material, however it does and the quarries are still in production and the quarry firms have estimated that there is enough stone left for 500 years of use. When freshly quarried Portland Stone is pale cream-coloured, weathering white with time. The history of quarrying on the Isle of Portland has been described by Stanier (2000).



*A thin section of Portland Roach x50 magnification, viewed under crossed-polarised light. The rock is composed of detrital oolites, shell debris and a few detrital quartz grains. An oyster shell fragment is present at bottom right, composed of finely laminated calcite. The dark band across the top right corner is a cavity left by a leached out, aragonitic shell.*

The Portland Freestone Formation was deposited during the Tithonian stage of the Upper Jurassic, known locally as the Portlandian (Wimbledon & Cope, 1978; Cope 2012). The stratigraphy on the Isle of Portland is described by Cope (2012), West (2012), Townson (1975) and Howe (1910). The stratigraphically lowest unit of the Portland Freestone Formation is known as the Basebed or 'Best Bed'. It is slightly soft and porous and actually not the best building stone of the formation. This is overlain by a thin shelly, chert-rich layer, 'The Curf' which is not exploited for building. Above the Curf is the Whitbed. This is actually the best bed for building and it is from this layer that much of the classic Portland Stone is derived. This is a thickly-bedded, pale grey, oolitic limestone with sparse shell fossils. The Whitbed passes upwards into a very distinctive facies of Portland Stone called the Roach. This is full of fossil-shaped holes. The holes are in fact casts and molds of once aragonitic shells. The most common, well-preserved fossils in the Portland Stone are oysters which secrete calcite shells and therefore are still with us.



The whole sequence is an oolitic limestone, composed of round carbonate sand grains known as ooliths (also called ooids). The ooliths, spherical particles of calcite, are about 0.5-1 mm diameter and are just visible to the naked eye on close inspection of the stone, especially in older, more weathered surfaces. In the quarries, the rock is dissected by widely spaced joints allowing blocks up to 3 m square to be extracted, making it excellent for ashlar masonry. The properties as a freestone with a uniform fine-grained texture allow Basebed and Whitbed to be intricately carved, as can be seen on St Paul's and on the St Lawrence Fountain (below). The Portland Stone and its use has been recently described by Hackman (2014).

*This walk begins at St Paul's Tube Station.*

### St Paul's Tube Station



*St Paul's Station Kiosk, with left, close up of 'Tatra B' gneiss.*

The kiosk forming the entrance to St Paul's Tube Station is faced along its lower portions with a very attractive and unusual stone. Composed of black and white crystals of amphibole and plagioclase, it is a medium to coarse grained metadiorite with a well developed foliation. Eric Robinson was able to identify this stone on the St Paul's Station Kiosk with help from a collector of building stones, Alan Nicholson (Robinson, 1984). This has not been corroborated from other sources and I would be very grateful if any readers could shed further light on this stone. Nevertheless, metadiorites are reported from the Tatra Mountains of Slovakia (Burda & Klötzli, 2011). These are fragments of pre-Variscan basement situated in the Central western Carpathians, these rocks were metamorphosed at amphibolite facies at c. 540 Ma.

### Paternoster Square

Paternoster Square is accessed from several pedestrian passages, designed to allow views of the dome of St Paul's. On leaving St Paul's underground station, turn left (towards the Cathedral) and take the passage with the sushi shop Itsu on the corner. Itsu is faced with Portland Stone Whitbed, but the foundations are of a white granite. It is necessary to kneel down to properly examine this stone. It is medium grained and composed of white feldspar and quartz, the latter slightly translucent. However the mica is distinctive being pink in colour as opposed to the more usual silver or brown. Pink micas are rich in lithium and this may be the species lepidolite. The origin of this granite is unknown, but it may be derived from Portugal, Germany or even China.

Further along red brickwork takes over from stone; the upper stories of Paternoster House, on your left are brick and these can be observed at pavement level before you enter the square. The bricks used in this building, designed by architects Siddell Gibson were hand made by Ibstock Brick in their works at Swanage, Dorset. They are thinner than 'normal' bricks and are intended to echo Roman-period brickwork. Roman bricks were typically around 1 to 2 inches thick and separated by a corresponding thickness of mortar, these examples are separated by standard 1 cm thick mortar bonds. Note how the bricks are laid 'smiley side up'; the creases in them for a downward facing curve, known as a 'smile'. These creases are indicative of bricks handmade in a mould.

The passage leads into Paternoster Square, an open space surrounded by colonnaded buildings. Right in front of you there is a sculpture 'Sheep and Shepherd', cast in 1975 by sculptor Elizabeth Frink (1930-1993). This stood in the old Paternoster Square and was reinstated here in 2003. Cast from bronze, it stands on a plinth of Portland Stone.



*Paternoster Square and Paternoster House.*

The square is paved in a geometric design with a monumental column standing off-centre. The column, standing 23.3 m tall, has a water-feature at its base and is surmounted by a Corinthian Capital supporting a 3 m high, gold-plated urn with a flame sprouting from it. The column was designed by architects Whitfield Partners and is built from blacks of Portland stone by the stonemasons' Cathedral Works Association (Chichester). It was inspired by Inigo Jones's columns used on the West Front of Old St Paul's. The Corinthian capital weighs 10 tonnes alone. The granite used is Cornish, from the De Lank Quarries on Bodmin Moor, the only granite quarry in south west England still producing dimension stone. The column very much sets the pattern for building stones used in the Square, where Portland Stone is used as the main cladding material with foundations of Cornish Granite, with features in red brick, as we have seen above. Whitfield Partners were responsible for the overall design of the Square which belongs to the Mitsubishi Estate.

The paving features a radiating geometric design worked in grey granite (probably De Lank) and a yellow-buff sandstone. Close examination of this stone shows that it is medium to coarse grained and cross-bedded. It is a silica-cemented arkosic sandstone from the Pennines, the Rough Rock from the Rossendale Formation of the Millstone Grit Group. This is a fluvial sandstone of Upper Carboniferous age, quarried by Johnson Wellfield on Crosland Hill, near Huddersfield and is marketed under the name of Crosland Hill Hard York Stone.

On the north side of Paternoster Square, number 10 is the New London Stock Exchange by Eric Parry Architects. It is clad in Albion Stone's Grove Whitbed, as is Warwick Court (1, Paternoster Square) on the west side, by architects McCormac Jamieson & Pritchard. Grove Whitbed is a particularly shelly variety of the Whitbed, packed with grey oyster shells and cavities of other, leached out, fossils. Looking up above the entrance of number 10 Paternoster Square, is an analemma, a noon-mark sundial by the Lida Cardozo Kindersley Workshop and the sundial maker Frank King. The shadow indicates the day of the year in the midday sun.

Turning right towards Newgate Street, the last building in the left, Christchurch Court is clad with a fine-medium grained, brown to pinkish-coloured sandstone. This shows cross-bedding and liesegang banding

iron staining. This is Peak Moor Stone, also known as Stanton Stone after its quarry location on Stanton Moor, near Matlock in Derbyshire. Geologically it belongs to the fluvial Marsden Formation of the Upper Carboniferous Millstone Grit Group. The foundations of Christchurch House are clad with a foliated, dark grey-green charnockitic granite. Charnockites are Precambrian granitoids of poorly understood origin, however they are now generally believed to be metamorphic. Charnockites are coarse grained rocks containing quartz, orthoclase feldspar, often the bluish microcline, and a mafic phase, typically orthopyroxene. The origin of this stone is unknown. Greenish charnockites are worked in South Africa, but this stone could have been derived from many other locations, including Brazil, Canada and India. This stone is named after Job Charnock, founder of Calcutta. The stone was first observed on Job's mausoleum by geologist Thomas Henry Holland, Director of the Geological Survey of India in 1900 who coined the name before he found the provenance of the stone.

*Turn around and cross Paternoster Square to the Temple Bar.*

### Temple Bar

In the SW corner of Paternoster Square, one enters St Paul's Churchyard through the re-erected Temple Bar. The Temple Bar was one of the historic gateways into the City of London, standing where the Strand meets Fleet Street. A gate had stood in this place from the 13<sup>th</sup> Century, but the Temple Bar we know today was probably designed by Sir Christopher Wren and built c. 1660. In the 1878 it was removed so that Fleet Street could be widened, but it was dismantled piece by piece, and the blocks numbered, so that it could be re-erected. It was subsequently purchased by socialite, racehorse owner, banjo player, collector of antiquities and former barmaid, Valerie, Lady Meux. Married to brewery owner Henry Meux, Valerie had Temple Bar erected as the gate to her country house, Theobalds Park. However in 1976, a trust was established to campaign and fund raise for the return of Temple Bar to the city and this goal was finally achieved with the installation of the Bar in Paternoster Square in 2004. The bar was originally built from Portland Stone and quarrymen Albion Stone supplied Basebed and Whitbed for replacement stone. Close inspection shows the Bar to be coated in limewash, so that the colour contrast between the old and new Portland Stone is reduced.

*Pass through the Bar and turn left towards the North Portico of St Paul's Cathedral and ascend the steps up onto the porch.*



*The Temple Bar*



The North Portico is paved with black limestone and white marble, both of unknown origin. These two stones are hard to provenance with many areas producing such stones. Black limestones are primarily quarried from the Lower Carboniferous strata of Belgium and Ireland. However, we have some documentary evidence from Cathedral Surveyor, F. C. Penrose who wrote in 1876 *“The pavement within the porticos both N. and S. are being replaced with new marble. The black being brought from the Pol Ash [sic] quarries in the Isle of Man from whence the Cathedral was originally supplied . . .”*. Directly under the doorway a slab of particularly dense and shiny black limestone occurs, which does in fact resemble the ‘Pol Ash’, or more correctly, Poolvaish Stone from the Isle of Man. This is a shaley black carbonate mudstone, which has in parts undergone contact metamorphism due to the presence of a dyke and so become harder and more resilient. Much myth surrounds the use of Poolvaish Stone at St Paul’s, and it is oft misquoted as being used for the front steps. For a full discussion on this subject, the interested reader is referred to Wilson (1982). Incidentally, the South Portico, which is inaccessible to the general public, is paved with red Rosso Antico marble from the Mani Peninsula in southernmost mainland Greece (Warren, 2012) and, once again reputedly Poolvaish Limestone.



In front of the Portico is a low, circular memorial, dedicated to the 30,000 Londoners killed during the blitz of the Second World War. Designed by Richard Kindersley it was erected in 1999. It is again of a black limestone, but close inspection shows it to be packed with tiny (5 mm diameter) grey fossils. These are the ‘ossicles’ of crinoids, a marine organism commonly known as the sea lily. The artist’s website describes the stone as a ‘three tonne block of Irish Limestone’. This clue tells us that this stone is almost certainly Carlow Blue, a Lower Carboniferous, crinoidal limestone from Kilkenny.

Just before leaving the churchyard gate, note that the borders of the churchyard are paved with flint cobbles. These are of uniform size and are unsplit, with their surface colour ranging from grey to pale brown. The cobbles would have been weathered out of the Chalk and accumulated on the beaches of either the Norfolk or Southern English coasts.

*Turn back towards Juxon House, with its curved colonnade forming the northern boundary of St Paul’s precinct.*

### Juxon House

Juxon House, by architects Sidell Gibson Partnership, has a crescent-shaped façade forming the northern side of the St Paul’s Churchyard. The doorway is sited in a recess which is the full height of the building, with the doorway itself flanked by two Corinthian columns, no doubt inspired by the architecture of the Cathedral opposite. Juxon House is clad in Portland Stone Whitbed with details around the windows in yellowish-buff Bath Stone. The stone is actually attached to pre-cast concrete panels which were then fitted as single elements to the façade of the building. Bath Stone comes from the Chalfield Oolite which contains both the Bath Stone and the Combe Down Stone freestones. Bath Stone comes from the Bath Oolite Member, a fine- to coarse-grained, cross-bedded, oolitic limestone, with colour ranging through cream to grey and yellow. Bath Stone is a relatively pure oolite with minor shell debris. It has been quarried since Roman times, and throughout the Medieval Period to the present day (Stanier, 2000). Look up from here to the dome of St Paul’s and you will see that the same two stones are used in the niches and colonnades around the rotunda. Cornish De Lank Granite is used in the foundations of the colonnaded front. Columns support sculptured faces by artist Emily Young in Portland Stone; the tops of the columns are also De Lank Granite.

## St Paul's Cathedral

The building stones of the exterior of St Paul's Cathedral have been described in detail by Robinson (1984 & 1997), Robinson & Bishop (1980) and Wilson (1982), and I will not go into too much detail here. In summary, the Cathedral exterior is built of Portland Stone, both Whitbed and Basebed. The intricate carvings of saints, cherubs and garlands show off the fine qualities of the Portland oolites as a freestone. The steps have paving of grey-green and red Öland Limestone from Sweden. These limestones are Ordovician in age and contain large fossil orthocones. The Precinct is surrounded by bollards of Dark Shap Granite with its prominent phenocrysts from Shap Fell in Cumbria. Numerous stones are used in the paving of the precinct, including marble, sandstones and granites. The statue of Queen Anne, a reproduction of the original, is in Carrara Marble.

*Cross over St Paul's Churchyard, to a terrace of what were once Edwardian textile warehouses and are now cafés with offices above. The lower storeys are clad with a range of igneous rocks.*

## 1-3, St Paul's Churchyard

At the time of writing, 1-3, St Paul's Churchyard has just emerged from scaffolding. It is built in freshly cleaned Portland Stone with foundations of a fine to medium grained granite. This is of unknown origin and maybe a new addition to this building. In their walk around St Paul's, Robinson & Bishop (1980) described Bessbrook Granite here, but that is a much darker grey and coarser grained rock. This granite is grey and flecked with black biotite and pale brownish feldspars, giving an oatmeal-like texture. The recessed entrance porch to the offices is also worth a look, being faced and paved with Jura Limestone, containing fossils of belemnites, ammonites and sponges. These stones come from the Jurassic Treuchtlingen Formation of Bavaria, Germany.

## 4, St Paul's Churchyard

Strada Restaurant, next door at 4, St Paul's Churchyard has a rather robust frontage carved in varieties of larvikite from Norway. These rocks were intruded around 300 million years ago in the Oslo Graben of southern Norway. Several varieties are extracted from the Larvik Plutonic Complex including the two varieties used here; grey 'Marina Pearl' and dark bronzy green 'Emerald Pearl'. Larvikite is of an unusual mineralogy. To the observer of building stones, this is distinctive for its 'schillerescent' feldspars, oligoclase antiperthites. Other minerals present are a variety of biotite called lepidomelane and the pyroxene titanite. This stone became very popular as an exported stone in the late 19<sup>th</sup> Century. It is pretty much unique, globally and is now Norway's National Stone.

## Condor House

The last parade of shops is Condor House, currently housing Yo Sushi, Café Rouge and Pizza Express and other coffee shops (above). The façade is lifted by a row of rectangular, engaged columns. These are in pink Peterhead Granite with pedestals of grey Cairngall Granite. Both stones are obtained from the region around Peterhead in north Aberdeenshire. Two granites are found in this region. The older Forest of Deer Pluton (475 Ma) produces the Cairngall Granite. The disused Cairngall Quarry is near the village of Flushing and is now used as a rifle range. Howe (1910) described this stone as having '*... a very beautiful cool grey colour, with small, irregular-shaped white feldspars [sic] sprinkled in the grey ground ...*'. The Forest of Deer Pluton lies to the northwest of the better known pink Peterhead Granite, and is cross-cut by it. The Peterhead Granite is 406 Ma and is extracted from coastal quarries around Stirlinghill. A distinctive texture of the Peterhead Granite are diffuse, grey xenoliths, often a few centimetres in diameter. These are xenoliths of the older Cairngall intrusion. Taking a short detour down the lane between Strada and Yo Sushi (Dean's Court), the Yo Sushi façade has been continued in similar coloured stones. Cairngall and Peterhead quarries have closed and the red granite has been replaced by Balmoral granite, from Vehmaa in SW

Finland, a 1.5 Ga Svecofennian rapakivi granite. The grey granite is Blaubrun, from Flivik in Sweden, somewhat older at 1.8 Ga, part of the Transcandinavian Igneous Belt.



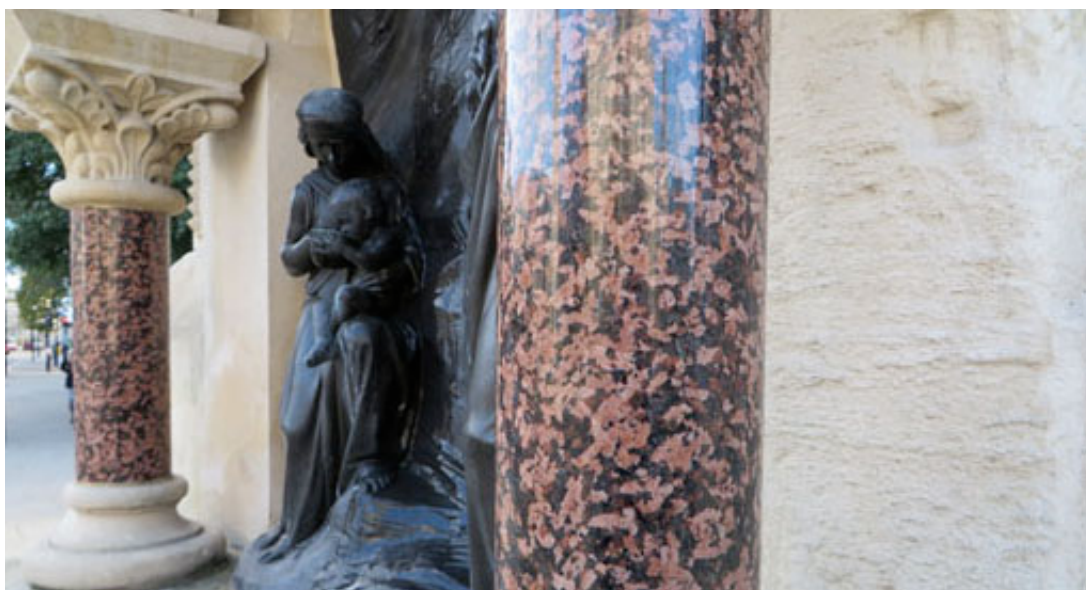
*Condor House, St Paul's Churchyard*

*Continue along on this side of the road, past the Tourist Information Centre to a Victorian gothic fountain.*

#### **St Lawrence & Mary Magdalen Fountain**

This Victorian Gothic drinking fountain, now restored to full working order, once stood in front of the church of St Lawrence Jewry in Guildhall Yard. It was dismantled in the 1970s and the blocks were put into storage following the establishment of plans to remodel the Guildhall Yard to create a large, public space.

As with Temple Bar, all the blocks were numbered, allowing the fountain to be re-erected and subsequently installed here, in Carter Lane Gardens, in 2010. Nevertheless, its disappearance during the last 40 years resulted in this fountain being somewhat ignored by both Pevsner or Robinson's guides both to this area and that of the Guildhall. The installation and restoration of the fountain was carried out by architects Freeland Rees Roberts. The fountain was designed by Joseph Durham and originally built in 1866. In the restoration, a new plinth and steps have been added as well as new carved masonry to replace damaged stones.



*Granite Pilasters and bronze relief on the St Lawrence Fountain.*



The main body of the fountain is carved from Portland freestone, but small granite pilasters support the canopy. They are made of a striking and unusual granite with particularly dark, smoky quartz, set with pale and darker, salmon pink feldspars, the larger of which show well-developed Carlsbad twins. The origin of this granite is unknown. It is very similar to that from Rorandle (Rowrandle) in Aberdeenshire, however it may equally be derived from Scandinavia. The water basins are supported by half-drums of pink Peterhead Granite from the coast north of Aberdeen.

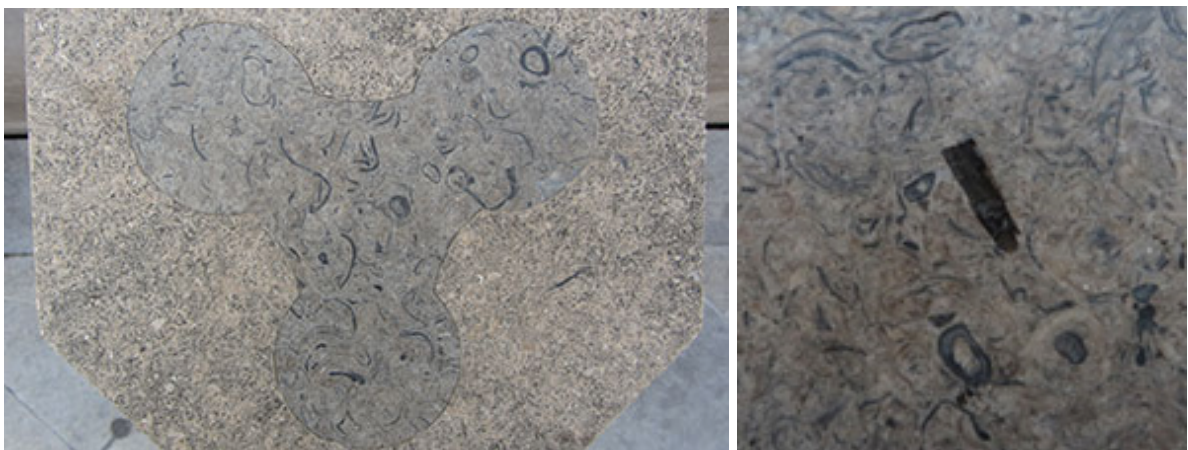
This is one of the few working drinking fountains, providing free, freshwater to Londoners. A second (modern) drinking fountain is located in the South Churchyard Gardens.

*Cross back over the road to the South Churchyard, directly under the walls of the South Porch of the Cathedral.*

### South Churchyard

The South Churchyard has recently been landscaped and enclosed in an innovative manner. Designed by Martin Stancliffe of architects Purcell Miller Triton, it displays a footprint of part of the architecture of Old St Paul's Chapter House and Cloister and a decorative plan by artist Richard Kindersley of the old Cathedral superimposed on that of the modern church. The construction won a Stone Award in 2008. Archaeological excavations around St Paul's have shown that Purbeck Marble was used in the interior fittings of the old cathedral and this inspired the architects to use varieties of Purbeck Stone (though not the marble) in the hard landscaping of the yard and this was supplied by family-owned quarries working the Purbeck Limestone in Dorset, namely H. F. Bonfield & Son and W. J. Hayson & Son.

The varieties of Purbeck Stone are extracted from the Early Cretaceous Purbeck Group which occurs in outcrop and subcrop on the Isle of Purbeck in Dorset (see Cope, 2012). They are a series of thin beds of limestones, mudstones and calcareous clays laid down in a shallow freshwater to brackish and marine environments, with evidence of a climate changing from semi-arid to humid upwards. Fossils of mammal and reptile bones, insects and plants have been found in the Purbeck beds, but most of the beds are dominated by a fauna of freshwater mussels. The Purbeck Group is known to quarrymen as the Upper and Lower Building Stones, separated by the non-commercial Cinder Bed. These units correspond with the sequences known to geologists as the lower part of the Durlston Formation and the Lulworth Formations respectively (Westhead & Mather, 1996).



*Purbeck Stone in St Paul's South Churchyard. Left; Purbeck Thornback with insets of Grub. Right; Purbeck Grub with a bone fragment (now phosphate) ~ 10 mm long.*

Various beds are worked, many only a few tens of centimetres thick and not all beds are found in all quarries. Four varieties of Purbeck Limestone are used in the South Churchyard; Grub, Feather, Whetson and Thornback. The various limestone beds were known as 'veins' by the local quarrymen (Stanier, 2000); the Grub comes from the Freestone Vein in the Stair Hole Member of the Durlston Formation. It is a

freshwater limestone containing numerous, greyish, *Unio* species mussel shell fragments. The colour varies from bluish, grey to buff. Feather is a blue grey-coloured freshwater limestone from the Luworth Formation, crammed with mussel shell fragments. Whetson is a buff-coloured freshwater limestone, also from the Stair Hole Member of the Durlston Formation. Finally another Stair Hole Formation lithology, Thornback is a beige-coloured, freshwater limestone crowded with *Praeexogyra* species oyster fossils.

The famous Purbeck Marbles, quarried since Roman times and used in the Old Cathedral (and most other cathedrals in the British Isles) are extracted from the Peveril Point Member at the top of the Durlston Formation. The main paving in the South Churchyard is Purbeck Feather. The decorative stone-work evoking the old cloister is constructed with walls of Purbeck Whetson, with the tops of the walls capped in Purbeck Thornback with inlays of Purbeck Grub. The plan of the old and new cathedrals lies towards the west end of the churchyard. The foundations of the pre-Great Fire St Paul's is picked out in dark grey Welsh Slate, probably from the Ordovician slate belt of North Wales which is worked around Blaenau Ffestiniog. The footprint of new St Paul's and the frame with the inscription are in grey-blue Purbeck Feather. The buff limestone is Purbeck Whetson. These polished and honed examples are an excellent place to observe the variation in the less well-known Purbeck Limestones.

*Walk east through to the South Churchyard Gardens, looking out for the Robert Hooke Biodiversity Bell on your left, by the entrance to the gardens.*

### The Robert Hooke Biodiversity Bell

In the South Churchyard Gardens, is a monument which could be easily ignored by the casual street geologist. This is the Robert Hooke Biodiversity Bell by sculptor Marcus Vergette. This is a maquette for a bigger bell which has yet to be made, but both this and the big bell were commissioned by the Mass Extinction Monitoring Observatory (MEMO). The Biodiversity Bell is mounted upside down, like a funnel. It is cast from bronze in a stone mould which was made from Portland Limestone Roach. The Roach is distinctive in that it has cavities where aragonite shell has leached out leaving casts and moulds mainly of the spiral gastropod the Portland Screw (*Aptyxiella portlandia*) and trigonia species bivalves (*Laevitrigonia gibbosa* and *Myophorella incurva*), known to the quarrymen as "osses 'eads" (horses' heads). These shells have thick, ornamented shells with well defined ribs and nubs. During casting, the bronze flowed into the cavities of the roach and has produced negative casts of the cavities, which consequently stick out from the surface of the bell; a rare opportunity to see the internal cast of the shells and their three dimensional shape. The Bell sits on a plinth of Roach, which enable the casting stone to be examined. Lots of Portland Screws are visible which are typical of the roach and are uncommon in the other Portland Stone facies.



*The Robert Hooke Biodiversty Bell*

Continue walking through Festival Gardens and turn left when you reach New Change. On your left-hand side is St Augustine's Steeple and the 1960s building on the site of the old St Paul's School is St Paul's Choir School. This building is clad in Grove Whitbed with panels of Portland Roach, as described by Robinson (1984 & 1997) and Robinson & Bishop (1980). Continue up New Change, and cross-over at the junction with Cheapside.

### Stone Bench

A functional work of art is situated at the west end of Cheapside, opposite the Kiosk to St Pauls' tube station where this walk started. Looking rather like the discarded vertebrae of a dinosaur, it is a curved row of blocks of very fossiliferous Portland Stone Whitbed of diminishing size. A sculpture which functions as a bench, this was the prize winning design by architecture students Craig Mitchell and Chris Dove, and it was erected in 2012.

The blocks for the bench was carved by masons at St Paul's Cathedral works department from Grove Whitbed, supplied by Portland quarrymen, Albion Stone. Grove Whitbed is packed with fossils, which here include well preserved *Liostrrea* species oysters and trigonia species bivalves. Also present are chunks of the red algae *Solenopora portlandica* are also present, which look somewhat like cauliflower florets. These fragments are debris derived from patch reefs which were dominated by these organisms (Fürsich et al., 1994), indicating a much higher energy, erosional environment than the standard lagoonal facies of the Portland Freestone Member.



Purbeck Stone Bench, Cheapside

This is the final locality visited on this walk. Cross back over New Change to St Paul's Tube Station.

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**Useful web links:**

- About Paternoster: <http://www.paternostersquare.info/about-paternoster.aspx>
- Albion Stone: <http://www.albionstone.com>
- Harris Digital Productions: St Lawrence Jewry Fountain <http://www.stlawrencefountain.co.uk/>
- Harris Digital Productions: Temple Bar <http://www.thetemplebar.info/history.html>
- Heldal, T., Kjølle, I., Meyer, G. & Dahlgren, S., National Treasure: Larvikite. <http://www.geoportalen.no/nasjonalbergart/artikler/nationaltreasure/>
- Lady Meux: [http://en.wikipedia.org/wiki/Valerie,\\_Lady\\_Meux/](http://en.wikipedia.org/wiki/Valerie,_Lady_Meux/)
- MEMO project: <http://www.memoproject.org>
- St Lawrence Jewry Fountain: <http://www.frrarchitects.co.uk/news-story/st-lawrence-jewry-fountain-reinstated-after-40-years-2/>
- Ibstock Red Bricks: <http://www.ibstock.com/pdfs/portfolio7/Reds.pdf>
- People of London Memorial: <http://www.kindersleystudio.co.uk/people-of-london-st-pauls-cathedral/>
- Peak Moor Stone: <http://www.blockstone.co.uk>

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*The plan of old and new St Paul's in the South Churchyard*

## Author's Note

Please note that this guide has been recently revised to reduce the text giving detailed description of the geology of the Portland Limestone Formation. This has now been revised and will be used in a guide dedicated to Portland Stone which will be available in May 2015.

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