The Urban Geology of UCL and the University of London's Bloomsbury Campus

Ruth Siddall & Wendy Kirk

This guide to the building stones of UCL and parts of the University of London Bloomsbury Campus, is formed from much accumulated wisdom and knowledge acquired by Eric Robinson and Wendy Kirk of UCL Earth Sciences. Some of the occurrences of stone on campus has been previously partially published in the form of hand-outs and tutorial guides as well as in Volume 2 of Eric Robinson's Illustrated Geological Walks (Robinson, 1985). A previous version of this guide was produced in 2013 with information collated by the current authors. This second version (2017) substantially revises that document and will continue to be updated as UCL's Masterplan of building works and renovations continues and takes place.

This self-led guide is subdivided into six parts; The Wilkins Building; The UCL South Quad and Malet Place; The UCL Cruciform Building; The Institute of Archaeology and the University of London's Gordon Square Gardens; outlying UCL buildings and finally buildings belonging to the federal University of London. This guide mainly focuses on stone used on the exteriors of buildings, but much of UCL's campus as well has University of London's Senate House is public access. However permission should be sought (at the reception) to enter The Cruciform Building.

Architectural information included here is derived from Cherry & Pevsner (2002) and Harte & North (2004) unless otherwise stated. Harte and North is also recommended reading for those interested in the history of UCL whilst Ashton (2012) provides a history of the development of the Bloomsbury area, including that of the University of London and University College London.

UCL Portico and Main Quadrangle, Autumn 2013

Part 1: UCL Main Quad and the Wilkins Building

UCL Main Quadrangle

The Wilkins Building (1827-9), named after its architect, the Greek Revivalist William Wilkins was the earliest building of the then University of London, which opened in 1828. The Portico with the ten columns in **Portland Stone Whitbed** was the first of its kind to be built in Britain and the columns, with their Corinthian capitals were inspired by the Roman era Temple of Olympian Zeus in Athens. The symmetrical South and North Wings of the Main Quadrangle were built in 1869-76 and 1870-81 by T. Hayter Lewis, following Wilkins's proposals and Corinthian capitals occur again in the central apsidal sections. The observatories were built in 1905. The Quad was not fully enclosed until the Pearson and Chadwick Wings were built. The former by F. M. Simpson in 1914 and the latter, built to house the Bartlett School of Architecture (now located in Wates House) by Professor A. E. Richardson in 1923. These were extended and completed in 1985 by Sir Hugh Casson.

The column drums on the Portico. The Queen, for scale, is probably 5'4" in hat and heels and Provost James Lighthill (left) and Chair of Council, Sir Peter Matthews (right) are about the same height of the column drums.

The foundations of the Wilkins Building are of **Carnsew Granite** from the Carnmenellis Pluton, just west of Falmouth in Cornwall. These are not obvious. Much of the foundation course around the quad is covered in lead flashing, however a few blocks are revealed in the corner where the Portico attaches to the Wilkins Building on the south side of this structure. The lower steps of the Portico are also granite, probably of the same origin, but this is worn and discoloured and its origin cannot be confirmed.

The main building material used in all phases of the quad is Portland Stone Whitbed. Portland Stone is quarried in the Isle of Portland near Weymouth in Dorset. It has probably been used locally since Medieval times but it came into popularity in the 17th Century when it was used by architect Inigo Jones for the construction of the Banqueting House in Whitehall (completed 1622). Following the Great Fire of London in 1666, it became the building stone of choice for Christopher Wren and his followers' reconstruction of the City and has remained popular ever since. It is an Upper Jurassic (Tithonian) oolitic limestone. The building stones come form the Freestone Member of the Portland Limestone Formation. The stratigraphic succession starts with the largely fossil free Basebed, then a layer called the Curf which is not suitable for building. This is overlain by the Whitbed which has variable facies, ranging from sparsely fossiliferous to crowded with the fossil oyster *Liostrea expansa*. It also has cross-bedded facies with detrital shell and algae fragments. As a rule of thumb, 'classic' Whitbed is relatively fossil free in its lower portions, becoming more fossiliferous upwards, though there is also lateral variation in facies. Finally the Whitbed is overlain by the Roach, which is very distinctive due to the cavities formed by fossil shells that have been dissolved away. The Roach is not used as a building stone at UCL. The Portland Limestones were deposited in shallow,

tropical seas and lagoons and the whole sequence varies between only 10-15 m in thickness. Whitbed is predominantly used in the UCL quad buildings and a good place to view it is in the column drums on the Portico. Here drums approximately 1.5 m high show the thickness of the Whitbed, they can be seen becoming fossiliferous towards the tops of each drum (though some drums are upside down and even sideways). Oolites can be seen with the use of a hand lens on most surfaces. Portland Stone suffered in the polluted atmosphere of the 19th and 20th Centuries, causing a blackening which has necessitated cleaning on several occasions. This is cosmetic, the stone's durability is not affected by the grime and it indeed arguably protects it. Some of the stone on the Portico has been damaged by over cleaning over the years resulting in a rather unsightly, flaky crust developing. Steam blasting is the preferred modern method for cleaning Portland Stone.

On the north side of the quad stands the Slade School of Fine Art. Also built of Portland Stone Whitbed the slabs forming the floor of the entrance porch are of particular interest as they have some nice fossils. The steps on the right hand side (approaching the building), have very well preserved fossil bivalve shells, oysters and (half) a well preserved *Camptonectes lamellosus,* a variety of scallop shell. The slabs immediately in front of the door contain sections through a large ammonite of *Titanites* sp. There are two main species found in the Portland Stone, *T. anguiformis* and *T. giganteus*, with the former, described by Wimbledon & Cope (1978) being the most abundant. This example on the steps of the Slade is just a small fragment of a whorl. But we get three views for the price of one, because the opposing slab appears next to it and a third just beyond. This species was true giant of the ammonite world, with shells up to a metre in diameter. (see images at West, 2012) and they are frequently seen as garden ornaments and indeed quarry signs on the Isle of Portland. *T. anguiformis* occurs throughout the Portland Freestone Member but is most commonly encountered in the Roach and the Whitbed, but much more rarely encountered in architecture, partly because good specimens found were often held back by quarrymen as souvenirs. Left is a *Titanites* sp. ammonite on display in UCL's Grant Museum. It is a baby, at approximately 35 cm in diameter.

Above, left, sections through the Slade ammonite, with boot tips for scale and right, half a Camptonectes lamellosus *with a fag-end for scale.*

Inside the Slade School, to the right of the entrance foyer, is the war memorial to members of the school who died in WWI[1]. This is a small wall-mounted plaque with the names inscribed onto a buff limestone and

[1] War Memorial #191631; War Memorials online; http://bit.ly/1xCaCoN

these include the war poet and artist Isaac Rosenberg. The stone has not been securely identified, but it is compact and apparently fossil free. It is possibly, and appropriately, a slab of **lithographic limestone**.

The paving in the Main Quadrangle (the 'Front Quad') as we know it today was probably laid down in the 1950s. The lawns are surrounded by a pavement of sandstone flagstones, which are in turn bordered by red granite sets. The main driveway is covered in an aggregate-rich tarmac and the bollards are a white granite, also probably Carnsew Granite. Although predominantly medium grained, a few megacrysts of orthoclase feldspar can be found. These are more prominent after rain has wetted the surface. These bollards acquired brief fame when one was hit by the Queen's chauffeur during the opening of the extension to the front wings in 1985.

The setts are of **Mountsorrel Granodiorite**. Located near the village of Mountsorrel in Charnwood, Leicestershire, the granodiorite quarry is reputedly the biggest granite quarry in Europe, now worked predominantly for aggregate and roadstone and currently operated by Lafarge Aggregates Ltd. It has been in production from at least Roman times, but industrial-scale quarrying began in the early 1800s (see Horton & Harald, 2012). The Mountsorrel Granodiorite is now accepted to be Ordovician in age (c.400 Ma) in contrast to other igneous rocks in the Charnwood area which are probably Neoproterozoic in age. It contains quartz, orthoclase, plagioclase, biotite and brown hornblende. The red colour is mainly imparted by the presence of iron oxides. The aggregate in the tarmac is also crushed Mountsorrel Granodiorite.

The Main Quad during a fete in 1909. The dark colour of the Portland Stone is obvious and streaks can be seen along the front. Compare with the frontispiece photo, taken in Autumn 2013, following steam cleaning earlier in the year.

The flagstones around the quad are a yellowish-brown, slightly micaceous fine sandstone known as **York Stone**. This stone is from nowhere near York. Many varieties of it are extracted from quarries in the Carboniferous strata of Lancashire and south west Yorkshire. It belongs to the Pennine Lower Coal Measures Group which is a series of sandstones, shales and of course, coals (Lott, 2012). The sands produce the perfect flagstone and are ubiquitous as paving stones in English towns. The sandstones are fine grained, thinly bedded silty-sandstones containing quartz and muscovite. They frequently show bedding laminations, ripples and other sedimentary structures. They also show evidence of hydrothermal, iron-rich waters that once flowed through them, creating orange-brown stains and stripes known as liesegang banding.

The two small lodges at the front entrance should be noted. The one on the south side acts as the main reception for the UCL and the one on the left houses exhibitions organized by the Slade School and UCL's Museums and Collections department. They are roofed with very stained slate. Between the mossy strips obscuring the roofs, the colour of the slate can be discerned to be purple, indicating that it is a **Heather Slate** from quarries working the Lower Cambrian Llanberis Slate Formation of North Wales. Numerous quarries are located along the strike of these beds with important centres of production being at Penrhyn, Llanberis and Nantlle. The floors of these lodges are paved with strips of **Purbeck Marble**, a hard blue-grey limestone from the Isle of Purbeck in Dorset. This stone is packed with the freshwater gastropod, *Viviparus* species. Unfortunately, following the restoration of the lodges and the installation of carpets, these can no longer be seen. However the same stone is used in the foyer of the Chadwick Building, by the entrance to the UCL Student Centre.

The Pearson Building is opposite the Chadwick Building and the interior has recently been modified to accommodate both Geography and Earth Sciences departments. Both the entrance foyers at the front gates and in the NW corner of the Quad are paved with a blue-black flag stone, which occasionally shows fine laminations. These are **Brathay Flags** from Kirkstone's quarries near Skelwith Bridge in Ambleside. These are Wenlock (Silurian) aged flagstones from the Tranearth Group of the English Lake District, representing deepening water conditions following the cessation of the igneous activity of the Borrowdale Volcano.

The ramp and stonework around the entrance to the Pearson Building in the NW corner of the Quad is constructed from a medium grained, micaceous arkose sandstone with minor iron staining. Quartz, feldspar and muscovite are all visible to the naked eye. The origin of this stone is unknown but it is likely to be one of the buff Carboniferous fluvial sandstones of either the Pennines or the Scottish Borders.

The Cloisters

The main stone used for paving on the floor of the cloisters is the non-fossiliferous **Portland Basebed**, but varieties from the overlying **Whitbed** are apparent including cross-bedded oolitic limestones, with broken shells and fragments of the algae *Solenopora*. Other slabs show the marks of bioturbation from burrowing organisms.

The black slabs are of a largely non-fossiliferous, black limestone. The colour is produced by the presence of carbon and pyrite. There are a few fossils (these can be observed on slabs at the north end of the north cloisters) which are white in colour and generally poorly preserved. They appear to be conical gastropods. Black limestones are very difficult to provenance and several varieties are known particularly from the lower Carboniferous strata of Belgium, Ireland and the Isle of Man. Traditionally Eric Robinson has identified these stones on the Cloisters as being Irish **Kilkenny Black**.

We will start our tour of the Cloisters at the north end, and will exit through the garden doors to the Wilkins Terrace.

The Wilkins Terrace

Completed in June 2017, the Wilkins Terrace is accessed from the North Cloisters. It was designed by architects and landscape architects Levitt Bernstein as part of UCLs on-going estates masterplan. The stone has been provided by Albion Stone and in keeping with much of the UCL Buildings, Portland Stone is used. However a wide variety of facies of Whitbed are used which are not seen elsewhere in UCL's older buildings. Albion supplied stone from their Jordans and Grove mines (much of Portland Stone is extracted from underground working these days). The following stones are used: **Grove Whitbed**, **Jordans Whitbed**, **Jordans Fancy Beach Whitbed**, **Jordans Basebed** and **Patch Reef**.

Grove, Jordans and Fancy Beach Whitbed varieties have much higher fossil shell contents than the average Whitbed, such as those seen in UCL's Front Quad. These are predominantly fragments of the oyster

Liostrea expansa. Looking at examples of these, many of the thick-walled, laminate shells show borings by worms (*Glomerula* sp.; Townson 1975).

Jordans Whitbed is used for some of the paving and is slightly browner than the slabs of Grove and Fancy Beach. It shows tidal cross-bedding and along with oyster shell fragments (which are aligned parallel to the cross-bedding) are small, white 'florets' of the algae *Solenopora portlandica*. These facies represent reworked fossil material derived as reef debris.

Top, The Wilkins Terrace, with UCL Vice-Provost Research Professor David Price, pointing out Patch Reef, for scale. Below, fossils in the Portland Stone. Left, oysters shells; Middle, external casts of the turret-shaped gastropod Aptyxiella portlandica*, more commonly known as the 'Portland Screw'; Right, a 'floret' of reef forming algae* Solenopora portlandica *with seasonal growth rings representing lighter Winter layers and darker Summer layers (see Fürsich et al., 1994).*

Patch Reef is used around the rather monumental doorway which will eventually lead to the Bloomsbury Theatre and a new entrance to UCL from Gordon Street. Reefal structures in the Portland Limestone Formation and their biota have been described by Fürsich et al. (1994) and can form structures up to 4 m high and 8 m diameter. When encountered in the upper parts of the Whitbed and Roach, the stones are

extracted, slabbed and stored until there is enough accumulated for a project. The reefs were not formed by corals as we would often expect today; the Portland patch reefs were composed of bivalve shells (*Liostrea* oysters and *Plicatula damoni*. 'kitten paw clams') which cemented themselves together, *Solenopora* algae and bryozoans (*Hyporosopora portlandica*). Any remaining pore space would have been filled with lime mud and oolitic sediment. The reef-forming organisms were also bored by the thin-walled bivalve shells *Lithophaga* sp. and encrusted by worms. The remains of borings made by the bivalve *Lithophaga subcylindrica* form trace fossils in their own right, looking like small skittles, this trace fossil, evidence of grazing bivalves, is called *Gastrochaenolites torpedo* and can be seen inside shell cavities.

Left, close up of Patch Reef, a mass of bryozoa and bivalves bored by thin walled Lithophaga; *field of view 15 cm; Right,* Gastrochaeonolites torpedo *borings and worm casts inside a shell cavity in Portland Patch Reef. Field of view 8 cm.*

Return now southwards through the North Cloisters and into the Octagon Gallery.

The Octagon

Two statues, featuring seated figures are located in the anterooms between the cloisters and the Octagon. On the north side is L'Innocenza Perduta (Lost Innocence), half heartedly trying to cover herself up, whilst being watched by (the remains of) a snake. This is by Italian sculptor Emilio Santarelli (1801-1886), dated 1862 and was bequeathed to UCL by Lady Louisa Goldsmid in the later 19th Century (see Cleere, 1997). Lost Innocence is carved from white **Carrara Marble** and sits on a plinth of the red serpentinite breccia, **Rosso di Levanto**, from Liguria, Italy.

Opposite Lost Innocence in the south anteroom is a portrait sculpture of John Flaxman, himself an important sculptor, by Musgrave Lewthwaite Watson, dated 1843-7 (Banerjee, 2009). Plaster casts of Flaxman's sculptures are displayed in the Flaxman Gallery in UCL's main library, above the Octagon (Look up! You will see Flaxman's St Michael defeating the monster). Flaxman is carved from Carrara Marble and is sitting on a plinth of pale grey, streaky **Carrara Arabescato** marble.

The flooring in the Octagon is predominantly Lower Carboniferous **Hopton Wood Stone** from Wirksworth in Derbyshire. This is a crinoidal limestone of the Bee Low Formation. One needs to get on hands and knees to see the small button or sequin-like crinoid ossicles. The paving also contains more obvious fossils of white, thick-shelled Productid brachiopods, which readily distinguish it from the paler-coloured Portland Stone, which has been used to patch a few damaged slabs. The Hopton Wood Stone was laid after World War II. UCL suffered considerable damage during the war, with the dome and part of the south cloisters destroyed by bombing and fire in September 1940 and again in April 1941 (Harte & North, 2004). Slabs of **Carrara Sicilian** marble surround the Hopton Wood Stone.

Entering the South Cloisters, turn immediately left and look back at the marble intarsia panel behind you.

The South Cloisters: *Marmor Homericum* and the Koptos Lions

Apart from the auto-icon of Jeremy Bentham, the most striking feature of the South Cloisters is the intarsia panel in marble and paint, depicting scenes from the works of Homer, *Marmor Homericum*. The sculptor, Henri Joseph François de Triqueti (1803-1874) was born near Orléans, France. He moved to England in the mid 19th Century and achieved popularity. He was commissioned by Queen Victoria to produce intarsia panels in stone to line the walls of he Albert Memorial Chapel at Windsor Castle in 1864. Triqueti's panel *Marmor Homericum* was presented to UCL by George Grote in 1865 (Banerjee, 2010). The main image depicts Homer reciting the Iliad to a group of people including warriors and temple maidens, whilst the border panels depict scenes from the Odyssey and the Iliad.

The two main stones used here are both from the Hettangian Marbles of the Alpi Apuane in the Carrara region of Italy and are white **Carrara Marble** (sometimes stained orange-brown with ochre) and blue-grey marble with white streaks which was generally known as Dove or **Bleu Turquin**. This was considered a plain and workmanlike marble, recommended for flooring and making electrical switchboards (Renwick, 1909). It was quarried in the Seravezza area of Massa & Carrara Province.

The red straps that divide up the panels are made of an Irish Lower Carboniferous limestone called **Cork Red** or alternatively, Victoria Red. It is a streaky, red, fine-grained limestone with abundant detrital fragments of crinoids. These were once 'sea lilies' animals with stems made up of strings of circular 'ossicles' as seen in the Hopton Wood Stone in the Octagon (above). Other fossil fragments including shells and goniatites are also present. The colour to the original stone is imparted by the presence of the iron oxide hematite. The quarries are between the towns of Cork and Middleton in the far south of Ireland.

Detail of Marmor Homericum: Penelope's suitors are dismayed by the return of Odysseus. Grey Bleu Turquin Marble forms the drapes of the background, whilst the figures and foreground are in white Carrara marble, stained yellow-brown. Fine detail is added in sgraffito infilled with paint.

At the south end of the South Cloisters is the office of UCL's Provost and President, guarded by two Egyptian lions in glass cases. These lions, excavated as fragments by Sir William Flinders Petrie in 1894, are from the Early Dynastic temple at Koptos, an site near the town of Qift, on the east bank of the Nile north of Luxor. They would have been carved between 3100 – 2686 BC. Following excavation, the fragments of the lions found their way into the collection of Sir Henry Wellcome, and the Wellcome Institute returned

them to UCL in 1980. The pieces arrived in tea chests. Barbara Adams, Director of the Petrie Museum, realised that these were the missing lions and collaborated with conservator Richard Jaeschke to restore them. Often identification of stones used in museum objects can only be made from macro observation but the process of conservation allows for samples to be taken and more detailed analyses to be made. Barbara contacted micropalaeontologist Dr Adrian Lloyd in what was then the Department of Geological Sciences (now Earth Sciences) who sampled a few grammes of the limestone. Preservation was poor, but several genera of foraminifera were found, predominantly from the Family *Globigerinacea* which enabled the limestone to be dated to the Lower Eocene (Adams & Jaeschke, 1984). The remaining stone fragments of the lions is composed of a pale grey weathering, chalky limestone from the **Thebes Limestone** Group (Klemm & Klemm, 2008). These were not important building stones in Egypt but were used locally at places such as Koptos. The lions are nevertheless important art historically because the finds from Koptos represent some of the earliest monumental sculpture in Egypt.

The Garden Terrace is located adjacent to the South Cloisters and maybe accessed via the garden doors in the centre of the Cloisters.

Garden Terrace

The Garden Terrace is actually the roof of a single storey building, part of the Bernard Katz Building which houses the Department of Biochemical Engineering. It is accessed from the South Cloisters. Looking over the railings, to the west and north side of the terrace, the sloping roof of **Merrivale Granite** is observed. Best seen when wet, this granite is porphyritic, meaning that it has large crystals set in a finer grained matrix. The larger crystals are known as phenocrysts and are in this example potassic feldspars. There are a few, scattered much larger crystals and these are known as megacrysts. Other minerals are dark, grey brown quartz and black biotite mica. The association of quartz, mica and feldspar define a true granite in the geological sense. Merrivale Granite comes from the Dartmoor Pluton, the most easterly of the SW England Granites which are collectively known as the Cornubian Batholith. They were intruded at the end of a major mountain building episode called the Variscan Orogeny, in the early Permian. The Dartmoor Granite was intruded at 290 Ma. The coping stones around the perimeter wall of the terrace are also Cornubian granite, this time from De Lank Quarries on the Bodmin Moor Pluton. It also contains quartz, mica and feldspar but it is altogether paler in colour than the Merrivale stone. Nevertheless it is about the same age. In addition, honed (unpolished) Merrivale Granite (left, field of view is 8 cm) is also used to pave the porch of the entrance to the Bernard Katz Building and De Lank is used in conjunction for foundations and bollards.

Former UCL Vice Provost and Head of History of Art, Professor John White was responsible for the erection of the memorial to the Japanese students who studied at UCL in 1863-5 on the south side of the Garden Terrace. The memorial was installed in 1993 (*right*). We are indebted to Professor White for informing Eric Robinson[2] that the stones used in the monument are black Zimbabwe 'granite' and a white **Portuguese granite**. Unfortunately more precise provenance is not possible. Like the Cornish Granites, Portuguese granites were predominantly

[2] Robinson, E. ' A New Geological Monument at UCL.'

emplaced during to the Variscan Orogeny and there are an awful lot of them, often with many quarries in each granite. Little more can be said about this granite except that it is a typically Variscan leucogranite (meaning it is pale in colour), containing quartz feldspar and mica and probably around 300-290 million years old. The black Zimbabwe 'granite' is actually a dolerite, with variably medium to coarse grain size. These stones, marketed under the name of **Nero Assoluto Zimbabwe** are amongst that country's major exports. They are derived from a suite of sheet-like intrusions which outcrop as a series of low hills in a large region east and south-east of the capital Harare. Known as the Mashonaland Sill Complex, these intrusions are 1870 million years old (1.87 Ga). Dolerites are composed of the mineral plagioclase plus black pyroxene. The black iron oxide magnetite is also a major contributor to the colour of this particular stone.

A mystery surrounds a reputed use of Northumbrian **Prudham Stone** at UCL. Elsden & Howe (1923), a normally reliable source on building stones, says that Prudham Stone was used at University College London during the building phases of 1882-3. This 'fact' is repeated in an equally respected text by Ashurst & Dimes (1998). However, there were no major building phases at UCL in the early 1880s and architectural sandstone is uncommon on campus.

The quarry at Fourstones, near Hexham in Northumberland produced coal, limestone used for lime burning and also a cream-coloured, fine grained, Carboniferous sandstone known as Prudham Stone. According to Coombs *et al.* (2009), the quarry and colliery were probably in operation from the 1820s, however the date of the start of Prudham Stone extraction is not known. It was certainly occurring on an impressively industrial scale when 100 members of the North of England Institute of Mining and Mechanical Engineers visited the quarry in 1877 to see Hunter's patent stone dressing machine. The visitors witnessed this fancy device in action; '*a stone about five feet nine inches in length and eighteen inches broad was dressed in about four and a half minutes*.' (Anon., NEIMME Papers, 1877).

The 1849 Library Extension. Note the yellowish stones framing the windows in contrast to the white Portland Stone along the roof line.

So where is this stone used at UCL if at all? In the absence of other documentary sources, the most likely candidate is the stone used on the window arches on the Main Library extension to the Wilkins Building, constructed in 1849 (Harte & North, 2004). Unfortunately this stone is not accessible to view at close hand. From the Garden terrace, look up towards the building which connects the Dome to the Bloomsbury Theatre. The highest row of half-moon windows, interspersed with terracotta roundels, are framed in a yellowish stone (compare with the white Portland Stone forming the coping on the top of the building). This is the correct colour for Prudham Stone, and viewing through binoculars suggest that it is a sandstone. Could this be the mystery solved?

Leave the Cloisters via the South Wing staircase and then exit the Wilkins Building into the South Quad.

South Wing Staircase
In the stairwell, **Hopton Wood Stone** is used to frame the lift doors and for the floor of the lift in the South Wing Stairwell. Although cast in terrazzo, the treads of the stairs have also been set with tiny cubes of a dark purple porphyry to aid grip. This is by far the busiest thoroughfare in the College and not really a place to stop and get out a hand lens, especially on weekdays between lectures. Nevertheless, this is most probably Permian **Trentino Porphyry** from northern Italy.

Part 2: Around the South Quad and Malet Place

Huxley Court, 'MRC Circle'
The turning circle between the Huxley Building and the Medical Research Council's (MRC) Laboratory for Molecular Cell Biology is mainly paved in tarmac but the centre of the area is a circle of cube-shaped setts of a blue grey granite. This stones has not been securely identified but it is probably a Portuguese granite from near Braga called **Azul Gondomar**. Although this stone was an important construction material in Portugal and particularly in the town of Braga from at least the 16th Century, the main export used of the stone is as paving setts. It is frequently seen in London and many other European cities. The 310 Ma Braga Pluton is one of the extensive plutons intruded during the closing episodes of the Variscan Orogeny in the Late Carboniferous to early Permian. It is a blue-grey, porphyritic, medium-grained, granite with sparse but large, prismatic, euhedral white feldspar phenocrysts, 3-4 cm long. The groundmass plagioclase, quartz, orthoclase, biotite and muscovite.

Take the passage between the MRC and the backs of the terrace to the rear of the Medawar Building.

Pewterers' Gate, the Medawar Building
The rear of the Medawar Building is a rather gloomy and seldom visited corner of UCL's main Campus, but has a hidden gem. Pewterers' Gate (1668) forms the back door to the Medawar Building and is an unexpected architectural element on this Campus. Predating the building of UCL by some 150 years, this once formed the entrance to the Pewterers' Hall in the City of London. The doorway was brought to UCL by architect and Bartlett professor, Sir Albert Richardson, in 1932 and is reputed to have been designed by Sir Christopher Wren (Harte & North, 2004). It is constructed from **Portland Stone Whitbed**.

Malet Place
A first glance Malet Place does appear to offer much to the urban geologist, being lined with brick or concrete-clad built buildings occasionally dressed with Portland Stone. This is nevertheless a significantly improved piece of UCL's estate having been treated pretty much as a goods entrance until a few years ago. The road has been resurfaced, traffic restricted and new buildings have been designed and built. The entrances to several buildings have been shielded with short stretches of wall built from **De Lank Silver-Grey Granite**. De Lank Quarry, near St Breward in Cornwall is the only active quarry working the Cornish Granites for dimension stone. Situated on the west side of Bodmin Moor, this is a relatively non-porphyritic, weakly foliated grey granite, composed of grey quartz, white feldspar and two micas, black biotite and silvery muscovite (which has given the granite its trade name). De Lank Quarry has been in continuous operation since 1834 and has supplied stone to many prestigious buildings including the Eddystone and Bishop's Rock lighthouses and of course here at UCL.

The entrance to 33-35 Torrington Place is on Malet Street first door on the right as you enter the campus, behind the first wall of De Lank Granite. Of brief geological note is the small patch of paving in front of the door. At first glance this is a black rock of little interest, but close inspection shows that it is a basalt porphyry with 5-8 mm diameter, black, phenocrysts with a distinctive polyhedral shape. These are the minerals clinopyroxene. This basalt comes from spectacular columnar jointed lava flows located in Fujian Province, erupted in the Cretaceous, between 140-130 million years ago. It is marketed as **Black Pearl** and has become a very popular paving stone in recent years.

The war memorial on the right hand side, just before the entrance to Foster Court commemorates the residents of University College Hall who fell in WWI[3]. It is a wall-mounted plaque of **Lake District Green Slate**, deposited during the Ordovician eruption of the Borrowdale volcano, similar to that seen on the Institute of Archaeology. This is a coarser grained version, a lapilli tuff. The grey-green colouration is characteristic of these formations.

De Lank Granite wall on Malet Place.

The entrance to Foster Court is just before the 'Anatomy Arch' (look for the '*Please Hoot … Slo*wly' ghost-sign on the brickwork to the right of the arch). The reveals and soffits of the porch are clad with book-matched slabs of a white marble, cross-cut with grey veins. This is **Carrara Calacatta** marble that has been partially brecciated. Above is a slab of grey Bardiglio Marble, also from the Carrara region. The Carrara Marbles are a texturally very variable sequence of marbles and marble breccias which form the Hettangian Marble Unit of the Alpi Apuane tectonic window. The marbles represent a sequence of Lower Jurassic limestones which were incorporated into the Alpine Tuscan Nappe and subsequently metamorphosed and deformed at greenschist facies during the Oligocene. The steps are made from a medium grained sandstone, figured with iron oxide staining in the form of liesegang bands. This is probably a variety of York Stone from the south Pennines, but equally could be an imitation imported from India.

Part 3: The Cruciform Building

The main entrance to the Cruciform Building is located on Gower Street, opposite the entrance to UCL's front quad. Previously the New Hospital and then University College Hospital, built between 1896 and 1906 by architect Alfred Waterhouse, the building forms an X in plan view, hence its name. The building was closed as a hospital in 1996 and refurbished by HLM Architects in 1997 and is now home to the Wolfson Institute of Biomedical Research as well as teaching labs and lecture theatres. The exterior of the building is clad with architectural terracotta, and recently conserved using specially commissioned pieces from Ibstock Brick Company's Hathern Ware. The entrance porch has steps and columns of a rich, pink-red, streaky granite of medium grain size. The red feldspars and greyish quartz are obvious, but this granite is not rich in

[3] War Memorial #191628; War Memorials online: http://bit.ly/1xzG6Mh

mica. It is **Corennie Granite** from Tillyfourie in Aberdeenshire. This was a popular building stone in the late Victorian era, but not frequently seen in London. Howe (1910) notes that Corrennie Granite was used in the Tay Bridge and in several municipal buildings in Glasgow. It was also used to make 'mill stones and rollers for paper and paint'. Here we see a particularly deep red, streaky variety of this granite. Large volumes of granites tend to be intruded during the closing stages of mountain belts as we have seen with the Variscan granites of Cornwall and Portugal described above. Here in Aberdeenshire we see the same processes connected with an older mountain building event, the Caledonian Orogeny. Corennie granite was intruded at c. 450 Ma. The floor of the porch is paved with a mosaic of stone tesserae. The black and white chequer-board probably uses white **Carrara Marble** and **Belgian Black** limestone. There is a border of bright, grass green, streaky, high quality **Connemara Marble** and then an outer border of a pink-yellow coloured stone. These are varieties of so-called **Numidian Marble** from northern Algeria. The quarries near Sidi Ben Yebka on the Mediterranean coast were worked by the Romans, but rediscovered and reopened in the mid 19th Century and achieved great popularity in late Victorian architecture, and can be seen in buildings contemporary with the Cruciform such as the Hotel Russell in Russell Square and Westminster Cathedral (Rogers, 2008; Siddall 2013).

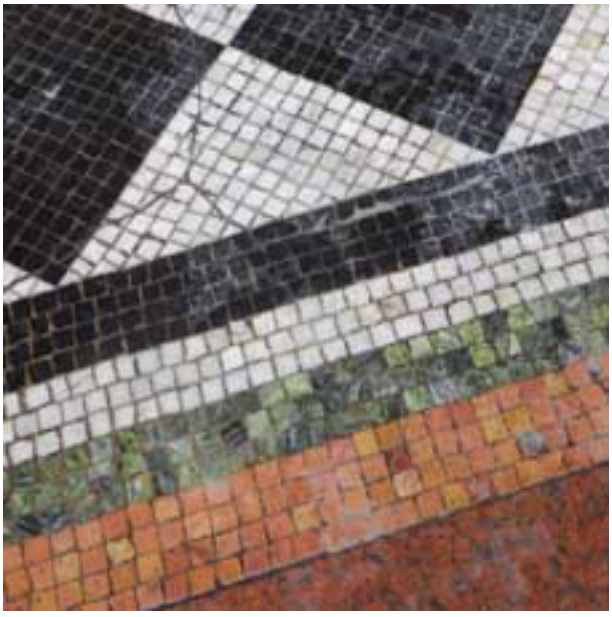
The interior of the Cruciform Building is worth a visit as it has some fine examples of decorative 'marbles' and other stones. If you are not part of an organised walk and are not a member of UCL you may need prior permission to visit the interior of the building.

Foyer

The foyer is paved with mosaic which uses tesserae of a black and white marble (probably **Belgian Black** and **Carrara Sicilian**) and distinctive, green **Connemara Marble** forming diamond shapes around the border. The mosaic is framed by slabs of a black limestone, with white fossils of thick walled shells, probably the large brachiopod *Productus* sp. and cross-cut by a few white calcite veinlets. This is a black Carboniferous limestone, probably sourced from Ireland. Moving up the flight of steps, on the left is a curved stone balustrade set with iron railings. This is Carboniferous **Hopton Wood Stone** from Derbyshire, as seen on the floor of the Octagon in the Wilkins Building. Dark grey shell fragments and the occasional distinctive crinoid ossicle, resembling small buttons, ~ 4 mm diameter, are visible to the naked eye.

Foundation Plaque and Memorial to Lister

A the end of the corridor, a foundation plaque is attached to the building installed in 1898 and dedicated by H.R.H. Albert Edward, Prince of Wales and Sir John Blundell Maple. The lettering is picked out in gold leaf on a slab of **Peterhead Granite** from Stirlinghill, north of Aberdeen. On the other side of the staircase is a memorial to Joseph Lister (1827-1912) in white Carrara Marble



Left: Mosaic floor in the Cruciform Porch. Right: Memorial to Joseph Lister.

First Floor Landing; The Yates Memorial

On the first floor outside the entrance to the Wolfson Institute is a memorial to Edward Yates (d. 1864, aged only 36) a gifted barrister who left an endowment to the UCL medical school (he is not to be confused with archaeologist James Yates who endowed Chairs in Geology and Archaeology; Harte & North, 2004). This panel is also by the French Sculptor, Baron Henri de Triqueti who created the *Marmor Homericum* panel in the Cruciform and the similarity in style is clear. Triqueti's signature and the date of construction, 1870, are to be seen in the bottom right hand corner of the main inscription. Its geology has been described by Eric Robinson in an unpublished hand-out, fittingly entitled 'A Jewel in the Cruciform', and certainly this plaque is much more geologically diverse than *Marmor Homericum*. The plaque depicts an ailing mother and child being given restorative medicine by health personified. They stand around a grey central block carrying the dedication to Yates. This tableau is framed by vines springing from jars. All is executed in coloured stones, some of which have been stained with pigment. The scenes are further embellished using *sgraffito* – scratching lines into the marble subsequently infilled with paint.

Details of stonework on the Yates Memorial

The following stones have been used:

Main panel with figures: White **Carrara Sicilian** marble, with the central inscription in a pale grey, slightly streaky variety of Carrara marble. The origin of the name 'Sicilian' for white marbles from the Carrara region is unknown. Certainly these stones are not from Sicily! However it is possible they may have been shipped via Sicily (or maybe even in a ship called 'Sicily').

Inner frame: This scene is framed within a raised frame of grey **Bardiglio Marble**, also from the Carrara area. A strip of black limestone and then a geometric key design decorate the frame. The key design is made with green, mottled serpentinite and white Carrara Marble. Small roundels of **Connemara Marble** (also used in the vine leaves, see below) are set to contrast with the Carrara, and roundels of yellow Spanish limestone known as **Crema Valencia** marble, with pink veinlets and stylolites, are set into the serpentinite. Another strip of Crema Valencia is set between two stripes of grey marble.

Vine stems: The yellow stem is inlaid with **Siena Marble** from Montarrenti in Tuscany. This is a Jurassic limestone which underwent metamorphism in the Eocene. The green stem is inlaid in serpentinite. Such stones are common throughout the European Alpine belt from the Central Alps to Greece and Turkey. It is most likely that this stone is **Verde Fiorito** from Italy, because Greek and Turkish Quarries were not (re)-opened until later in the century. However such stones are notoriously difficult to identify and so a source cannot be ascertained from observation alone.

Vine leaves: **Connemara Marble** from Galway, western Ireland. This is a Late Proterozoic Dalradian limestone, metamorphosed at c. 480 Ma during the Caledonian Orogeny. It is extracted from various quarries around the town of Clifden. This is a slightly different variety than the bright grass-green marble seen in the mosaics in the porch and the foyer, with paler green and pinkish streaks.

Grapes: the purple grapes are constructed in relief are made from polished cabochons of **amethyst** and **fluorite**. The orange grapes are polished **alabaster**.

Vases: According to Eric Robinson, the vases are inlaid with a red artificial stone. However the one on the left hand side appears to have a trace fossil, a burrow cutting through it, which suggests that this is in fact a natural stone. However no further identifications have been made.

The lower part of the panel behind 'The Yates Memorial' inscription is made from **Breccia Violetta** (also called Breccia di Seravezza) from the Seravezza region of Tuscany, a few miles south of Carrara, The Seravezza Breccia immediately underlies the Hettangian Marble which is the main marble unit quarried in the Alpi Apuane in the Massa and Carrara Province.

Cruciform 'VIP' Staircase

The so-called VIP staircase is located in the NE wing of the Cruciform Building. It is accessed by following signs for the Cruciform Lecture Theatre 1 and 2 in the basement of the building. Follow the main staircase down to the bottom. Once in the basement, walk past the Theatres to the end of the corridor and turn right through double doors into an impressive, 'marble'-lined stairwell.

Cruciform Building, NE Staircase

Few have cause to visit this north-eastern arm of the cruciform, which is a shame. The walls are clad in three varieties of decorative stones, not true marbles in the geological sense, but fitting the trade description for any decorative stone that is able to take a good polish (and is not a 'granite'). Here we have

large slabs of 'book-matched' **English Alabaster** with a cream and red streaky texture, green and white **Campan Vert** from the French Pyrenées and red **Rosso Verona** from Italy.

English Alabaster was a very popular stone for decorative carving since the Medieval period. It is seen in effigies and other aspects of ecclesiastical architecture in British and European churches. It has also been widely used in interior decoration in stately homes and civic buildings. The stone is mined from the Triassic Tutbury Gypsum Beds primarily around Chellaston in Derbyshire and Fauld in Staffordshire (Ashurst & Dimes, 1998; Cooper & Saunders, 2002).

Campan Vert was extracted from Espiadet Quarry, south of Campan in the French Pyrenées. It is a weakly metamorphosed nodular limestone of Late Devonian age, subsequently caught up in Pyrenean deformation and contorted into a series of tight folds (Mirouse, 2008) The green colouration is mainly due to the presence of chlorite. Campan Vert has been a prized decorative 'marble' since the Roman period, but was very popular for interior decoration during the 18th and 19th Centuries (Price, 2007). It is also known as Cipollino Mandolato – 'cipollino' was a famous green banded true marble from Greece and mandolato means almond, because the flattened limestone nodules in this stone are the size and shape of almonds.

Rosso Verona is another nodular limestone, this time stained red with the iron oxide hematite. It belongs to the Ammonitico Rosso formation of the Alps and represents a Late Bajocian-Tithonian (Jurassic) carbonate platform. There are many quarries for this and associated stones on the Trento Plateau to the north of Verona, and similar facies are also quarried from near Epidaurus in Greece. However, this is almost certainly Italian Ammonitico Rosso which, like Campan Vert, has been a popular decorative stone since the Roman period.

Part 4: The Institute of Archaeology and Gordon Square

Institute of Archaeology

Institute of Archaeology. Riven Lake District Green Slate.

Designed by Booth, Ledeboer & Pinckheard and completed in 1958, The building housing the Institute of Archaeology facing Gordon Square and onto Taviton Street (Department of Anthropology) is of principal geological note because of it's facing at pavement level with riven (i.e. rough split, unpolished) slabs of **Lake District Green Slate**.

The green 'ornamental' slates of the English Lake District are quarried from two geological formations; the Seathwaite Fell Sandstone Formation is worked at Kirkstone, Seathwaite, Elterwater, Broughton and many more localities. The Eagle Crag Sandstone Member of the Birker Fell Formation is quarried at Honister. All varieties have been metamorphosed at greenschist facies which transformed them from sandstones into slates and also imparted the greenish colour as a result if the growth of minerals including epidote and chlorite. However the metamorphism did not erase the often delicate banding that gave the 'ornamental' slates their name. They are ultimately part of the Borrowdale Volcanic Group and these rocks formed as volcanic ash and other pyroclastic material which was deposited in a crater lake environment during the Ordovician. At that time, the Lake District was part of a continental margin, similar to the Cascades Range of the West Coast of the USA. The porch of the IoA is paved with black Carboniferous limestone, probably from Belgium or Ireland, and white and grey Calacatta marble from Carrara.

Cross the road and enter Gordon Square Gardens.

Gordon Square Gardens

Gordon Square was laid out between 1820-1850 and now belongs to the University of London. Two monuments are worth looking at here. The first in the NE corner is a memorial to Noor Inayat Khan (1914-1944), who lived nearby as a child. During the WWII, she became a Special Operations Executive Agent and was the first female radio operator to go to France to help the Resistance, but she was betrayed and captured by the Germans and subsequently executed in September 1944. She was posthumously awarded the Croix de Guerre and the George Cross (London Gazette, 1949). The memorial has a bronze portrait bust by Karen Newman (2012) which stands on a plinth of polished and inscribed **Lake District Green Slate**. The polished surface provides better analysis of the textures of this stone than the riven examples on the Institute of Archaeology above.

From this memorial turn to the NW corner of the square, easy to miss at first, at the edge of the trees is a boulder, about a metre high. This is a **Sarsen**, placed in the Gardens in June 2013 to commemorate the 75th Anniversary of the UCL Institute of Archaeology (right). The Sarsen was donated by a farmer who owns land near Avebury in Wiltshire. Sarsens were used in the stone circle at Avebury, and of course for the monolithic trilithons at Stonehenge. So a modern standing stone is a fitting memorial and provides further geological interest to Gordon Square Gardens. Geologically, Sarsens are isolated blocks of silica-cemented quartz sandstones which are found scattered across Chalk downland. They are Palaeocene in age and belong to the Woolwich and Reading Formations, remnants of what was once a more extensive and coherent layer. The origin of the word 'sarsen' is probably a corruption of the 'sarstan' meaning a stone troublesome to ploughing, but may equally be derived from Saracen, implying that they appeared 'foreign' on

the Chalk downland. The sarsens were also locally known as 'wethers' as they lay on the surface and looked like a flock of sheep from a distance.

Walking towards the south west side of Gordon Square we encounter another bronze portrait. This is a memorial to the poet and former UCL student and Nobel Prize winner, Rabindranath Tagore (1861-1941) by Shenda Amery (2011). The portrait sits on a plinth of grey granite of unknown origin. It is composed of white feldspar, grey-brown quartz an black biotite. It contains small xenoliths of black, biotite-rich schist.

Part 5: Outlying UCL Buildings

Bentham House, 4-8 Endsleigh Street WC1H 0EG

NB: At the time of writing, Bentham House is currently under restoration and renovation and cannot be visited. However hopefully the fossiliferous interior will reappear once works are completed …

Bentham House, housing the UCL Law Department, is on the corner of Endsleigh Gardens and Endsleigh Street. At first glance, it looks like a 1930s building, however, it was built in a rather retro style (an 'eccentric mixture' according to Pevsner) in 1954-8 by H. and H. Martin Lidbetter, Once more mainly constructed of Portland Stone, the foundations are of a Lake District Green Slate. Inside the foyer, and certainly worth a quick look, the walls are clad with a yellowish, polished limestone, absolutely packed with fossil shell fragments, corals and oncoids (balls of algae). The origin of this stone is unknown, but it maybe Forest Marble.

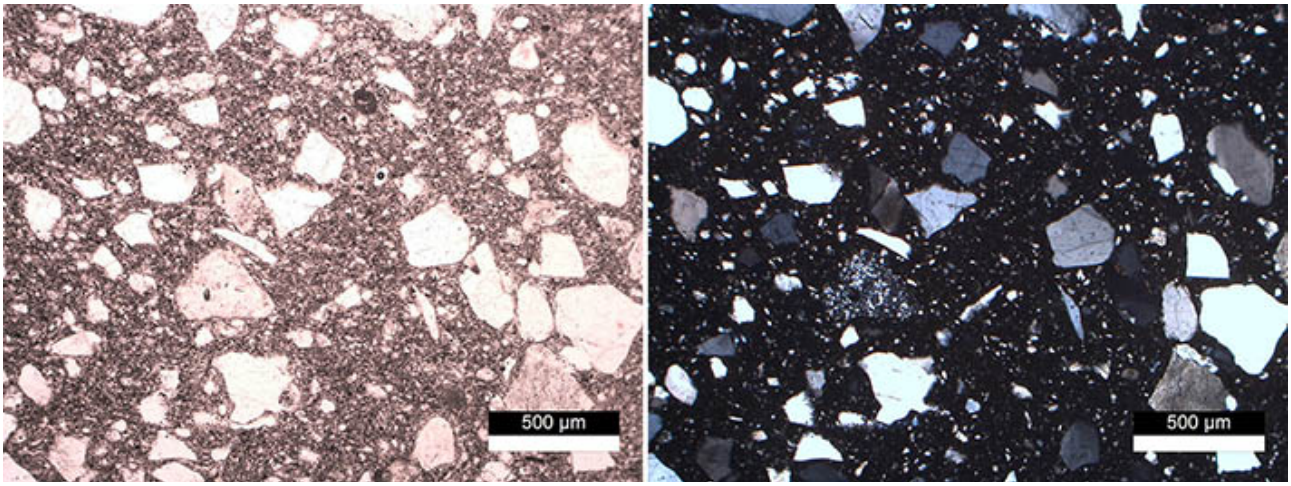
The Bartlett School of Architecture, 22 Gordon Street WC1H 0QB

Above: The Gordon Street Klinker bricks used at The Bartlett School of Architecture. Note the fingerprints and the grey colour denoting a low iron content. Each brick is 290 x 52 x 70 mm.

22 Gordon Street houses The Bartlett School of Architecture. The building was completed in 2017 and designed by Hawkins\Brown Architects. The structure is a retrofit of the former Wates House, the ghost of which still exists in the core of the building. What replaces it is a spacious, fit-for-purpose building for the UCL School of Architecture. The main interior building material is concrete, but the exterior is clad with hand-made bricks, specifically produced for this project by German brickmakers Janinhoff, and with there own special name, 'The Gordon Street Klinker'.

These are water-struck bricks, with high firing temperatures (1200°C) and 140,000 were used in the project. Geologically the clay is derived from the 10-20 ka glaciogenic deposits of northern Germany and Denmark, where iron-poor clays are in abundance. The absence of iron is responsible for the subtle shades of grey

colouring these bricks. A left-over brick was used to make a thin section and this has revealed it to have a sandy temper (or perhaps natural inclusions in the clay) derived from a granitic source (see Siddall, 2017).



Above: A photomicrograph of a thin section of a Gordon Street Klinker; left is in plane polarised light and the right hand image is taken under cross-polarised light (XPL). These two light sources enable geologists to identify minerals via the optical properties. The black matrix of the brick in XPL indicates that the brick is fired > 1000°C and the clay matrix has vitrified. Grey particles are grains of quartz, feldspar and chert.

1-19 Torrington Place WC1E 7HB

1-19 Torrington Place houses central administration as well as a number of teaching spaces and academic departments. This was formerly Mullard House, home of the head office of the Mullard Radio Valve Company Ltd. **Serpentinite** slabs are used to clad the lower wall below the vitrines at 1-19 Torrington Place and also makes up an attractive decorative panel between the main entrance and the entrance to the car park. Here the stone slabs have been separated like opening a book, creating a Rorschach pattern in the rock. Close inspection shows the silvery-green 'bastite' porphyroblasts set in a fine grained black matrix. The rock is chaotically veined with white calcite or dolomite. The origin of this beautiful serpentinite is unknown. It is probably from Italy, Greece or Turkey, but it is equally possibly from Vermont in the USA. An unidentified, but rather beautiful, polished, fossiliferous limestone lines the recessed porch to the building. This is a calcarenite containing various shell fragments, with good evidence of cross-bedding. The slabs are laid with the bedding orientated vertically.

The Grant Museum and the Rockefeller Building, 21 University Street WC1E 6DE

The exterior of the UCL Grant Museum of Zoology is built of **Portland Stone Whitbed**, which grades up into red brick with Portland Stone dressings on the upper stories. The weathered Portland stone on the exterior allows the hard oyster fossils to weather out slightly. These can be easily seen on the University Street façade. The museum itself, of course, has much of palaeontological interest including a specimen of the *Titanites* species ammonite (see p. 3 above).

Leaving the Museum, one can either walk along the internal corridor or along the street to the main entrance of the Rockefeller Building.

The lobby of the Rockefeller Building is clad in slabs of streaky, yellow-white and red **English Alabaster**, from Staffordshire. This is the same stone as used in the Cruciform Building NE Staircase. The floor is paved with black and white tiles of a white marble with grey streaks, probably **Carrara Sicilian**, paired with a black, fine grained limestone with a low fossil content. The origin of this limestone cannot be confirmed but it is either **Belgian Black** or one of the black limestones from Southern Ireland, such as Kilkenny Black. Both varieties are Carboniferous in age. The memorial to the members of the UCL Medical School lost in the First World War[4] is mounted on the wall to one's right as one enters the lobby from the street. It is framed in **Verde Antico**, a serpentinite and marble breccia from Thessaly in central Greece. The panel with the names

[4] War Memorial # 191294; War Memorials Trust: https://www.warmemorialsonline.org.uk/node/191294

is probably a white Carrara marble. The overall yellow-ish colour of the marble along with the yellowed colour of the alabaster suggests that these stones are in need of a good (but very careful) clean.

The Kathleen Lonsdale Building, Gower Place WC1E 6BT
The Kathleen Lonsdale Building, fronting onto Gower Place, is also built of **Portland Stone Whitbed**. The steps up to the main entrance are rich in trace fossils; relics of the burrows of marine organisms in the late Jurassic Portland seas. Y-shaped, branching burrows are typical and observed here.

The building is entered from The Wilkins Building, from a corridor adjacent to the Housman Room.

There are four commemorative plaques in the foyer of the Kathleen Lonsdale Building. Two have similar style and were seemingly installed in 1911, to mark the opening of the Ralph Foster and William Ramsay Laboratories. These have frames of **Verde Antico**, a serpentinite breccia quarried in Thessaly, Central Greece. This stone has been worked since at least the Roman period. The quarries were rediscovered in the 1880s and the stone became very fashionable and was quarried and exported in in great quantities. The inscriptions are on white **Carrara Marble**. Another memorial to Ramsay has a bronze relief on a mount of rather stained, Carrara Marble. A more recent plaque marks the opening of the Haskell High Pressure Laboratory (1989) and has a frame of grey **Bardiglio Marble** and the inscription is on white and grey **Carrara Sicilian Marble**.

UCL Earth Sciences Department Rock Room is accessed (with permission from the Departmental Office opposite) by turning left in the foyer and then it is the first room on the right. This room displays some of the treasures of UCL's geology collections including some building stone specimens.

School of Pharmacy, 29-39 Brunswick Square WC1N 1AX
The School of Pharmacy is predominantly built of red brick, but with trimmings and obelisks at the main entrance of **Portland Stone Whitbed**. Walking inside the interior lobby is clad, both floor and walls with Italian **Tivoli Travertine** (which will be described in detail when seen at Senate House, below). However a dark red stone is used as decorative square tiles on the floor; this is the red serpentinite, **Rosso di Levanto**, also of Italian origin.

The Institute of Neurology, Queen Square WC1
The main point of interest is the bust of Lord Wolfson in Queen Square Gardens. This was installed in 2017 and the bronze sculpture is by Nick Roberson. Of geological interest is the plinth in what appears to be dark grey, Welsh slate. The front of the plinth, with the inscription is a cleavage palne in the slate, and the cleavage and bedding can be seen looking at the sides of the plinth.

Memorial to Lord Wolfsson, Queen Square Gardens.

The grey North Welsh slates are quarried the Blaenau Ffestiniog slate belt which is of Lower Ordovician age. Geologically these strata belong to the Nant Ffrancon Group. The variety used here, with the obvious bedding is called Black Vein and it is worked today from Cwt-y-Bugail Quarry in Blaenau.

Other decorative stones around UCL

A few fine 'marble' fire surrounds which still survive in private offices and a full survey would be required to catalogue these. These examples are ***not*** available for public access. However they include a good example of Griotte de Sost, a goniatite-bearing, red nodular limestone from the Devonian of the Pyrenees in 3 Taviton Street and a Bleu Turquin, grey marble from Carrara, Italy fire surround is in 4 Taviton Street. The Slade Professor's office has a fine coral-rich limestone fire surround made of a Belgian Marble called Sainte Anne. Many more examples probably exist in the older rooms of the college and any further information concerning use of stones, decorative or functional, not mentioned here is gratefully received.

Part 6: Byng Place and The University of London

We now turn our attention to the buildings of the University of London's Bloomsbury Campus, which lies adjacent to UCL. This short tour starts in Byng Place.

Christ-The-King Church

Not part of the UCL Campus (for obvious reasons, we are after all the 'Godless Students of Gower Street'), Christ-the-King certainly encroaches onto it and cannot be ignored. The church was built in the Gothic Style by Raphael Brandon in 1853. The golden colour of the stone is instantly recognised as different from the ubiquity of Portland Stone used elsewhere, and it is Bath Stone from Avon. **Bath Stone** is from the Bath Oolite Member, Chalfield Oolite Formation, of the Great Oolite Group of Oxfordian (Upper Jurassic) age. It will come as no surprise then that this is an oolitic limestone, composed of closely packed, tiny spheres of carbonate sand, ooids or ooliths. So named for their resemblance to fish roe (ooid is derived from the Latin for egg), these develop around tiny particles of shell or quartz grains which accumulate calcium carbonate as they roll back and forth in shallow tropical lagoons. The ooids can just be seen with the naked eye and are easily viewed with the aid of a hand lens.

Byng Place

Byng Place, the area of a wide roadway between UCL and Christ-the-King Church and the University of London Union Building has recently been paved in 'granite' setts in an attempt to make it a shared space for pedestrians, cycles and motor traffic. This has worked well for pedestrians but appears to be irksome to cyclists and London Cabbies, who are irritated at slow moving, wheel-less humans. Nevertheless it looks very nice and is an interesting experiment in the use of urban space. The setts are composed of what are almost certainly granite and gneiss of Chinese origin. Chinese granites lack imaginative names and are marketed in the west by numbers, prefixed by G for granite. The pale pink, fine grained granite is probably the variety **G663**, a Mesozoic granite from Luoyan in Fujian Province in SE China. The origin of the **grey gneiss**, with an attractive banded and folded texture is unknown.

Crossing Byng Place to the south, we move into Torrington Square, the first, raised part of which forms the roof to Student Centre (aka ULU)'s swimming pool. Continue south towards the main entrance to Birkbeck College on the right hand (W) side of the square.

Torrington Square

The paving in front of the main entrance to Birkbeck College is of a porphyritic granite. A scattering of large (up to 4 cm) phenocrysts of both pink and white, euhedral feldspars are present, set in a medium grained groundmass of grey quartz, biotite and feldspar. The grey groundmass shows a weak foliation, which is deformed around the phenocrysts and some phenocrysts show marked colour zoning, with white rims and pink cores. This is another Chinese granite from Laizhou in Shandong Province on the east coast of China, named **G341**.

Left: granite and gneiss setts, Byng Place and right: porphyry granite in Torrington Square, field of view 60 cm.

Senate House

The first view of Senate House from the end of Torrington Square is an extension added to the west of the building. This has a foundation course in **De Lank Silver Granite**, as described above at Malet Place. Enter Senate House from the door on your right. Senate House and Library where designed by Charles Holden and built during 1932-37. This is actually a paired-down version of Holden's original plans which included buildings occupying the land now taken by Birkbeck College, ULU and Torrington Square behind these buildings, leading from Byng Place. Nevertheless the completed Senate House is a striking building and has been used as a film set on numerous occasions. The major building material is dressed **Portland Stone Whitbed** which has retained a good white colour. The lower courses are of axe-dressed **Cornish Granite**, probably from Carnsew Quarry in the Carnmenellis Pluton, near Falmouth in Cornwall. This intrusion is part of the extensive Cornubian Batholith which includes all the granites of SW England from the Scilly Isles to Dartmoor. These were emplaced in the final stages of the Variscan mountain building phase in the earliest Permian, at c. 290 Ma. Generally pale in colour, the rock is a coarse grained, slightly porphyritic granite with phenocrysts of white orthoclase feldspar as well as quartz and two micas, black biotite and silvery muscovite.

The publicly accessible, spacious foyer is paved and clad with **Tivoli Travertine** from Rome. By far the youngest building stones we will encounter on this walk, its age is measured in thousands (ka) rather than millions (Ma) of years. Visitors to Tivoli today will be impressed by the waterfalls depositing travertines. Fewer tourist see the vast quarries which now occupy what was once the swampy Lake Tiburtinus ('travertine' is a corruption of Tiburtinus). This body of water accumulated on a fault zone which produced hot springs associated with the Roman Volcanic Field and deposited these layers of limestone (Facenna et al., 2008). These stones are banded or layered with both micrite and sparite calcite. Another common feature are delicate 'arborescent' or 'shrub' features which are micritic aggregates replacing cyanobacteria build-ups (Ángeles García-del-Cura et al., 2012). Pisoliths, plant fossils and other detrital material may also be present. These travertines were deposited between 115-30 ka and have been worked as building stones since Antiquity. There is a sample of Roman Travertine (from Bagnio di Tivoli) in the UCL Building stone collection which is inscribed on the back 'used in the University of London Building, Bloomsbury'. Interestingly a second sample of **Durban Travertine** from South Africa bears the same inscription – the two stones Italian and South African are similar but it may well be that this more exotic travertine was also used in Senate House.

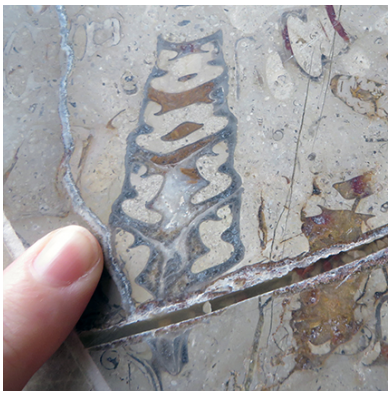
Leave Senate House via the main entrance onto Malet Street, cross over and continue straight ahead along Keppel Street, pausing at the entrance to the London School of Hygiene and Tropical Medicine on the corner of Keppel Street and Gower Street.

London School of Hygiene & Tropical Medicine, Keppel Street WC1E 7HT
Also built of beautifully dressed **Portland Stone Whitbed**, the London School of Hygiene and Tropical Medicine's building is of interest architecturally. Pre-dating Senate House, the building was designed by architects P. Morley Horder and Verner O. Rees and erected between 1926-28. The rather austere architecture is offset by gilded models of flora and fauna associated with tropical disease, and often charming in their character despite their murderous reputations, as well as the names of pioneers in this field. Of geological note are the breccias surrounding the doorways. The door opening on to Malet Street is clad with a serpentinite breccia. As breccias go, this one is quite fine grained with maximum clast size of a few centimetres and with a strong foliation. This is one of the varieties of serpentinite quarried from the ophiolite bodies of the Alpine Piemontese Nappes. They are metamorphosed and tectonised (meaning deformed and broken up) fragments of ancient oceanic crust emplaced and deformed during continental collision. The network of white veins surrounding the dark green clasts are calcite. The clasts themselves are composed predominantly of tremolite and talc. Such stones are therefore often referred to as 'ophicalcites'. This variety is similar to stones used in Westminster Cathedral and described as **Verde Mare** (Rogers, 2008). However the facies of these stones is notoriously variable (see Sandrone et al., 2004) and an identification cannot be made with certainty. The same stone is also used at the main entrance to the School on Keppel Street.

Follow the building around onto Gower Street.

The doorway opening onto Gower Street has reveals and lintel clad in a very different stone, a very weathered, pale grey-brown limestone. This is a compact, low porosity stone with streaky markings. Close inspection show that these have dendritic shapes and this is in fact an algal limestone, called **Boulonnais Marble** and derived from the eponymous region of NW France. Devonian and Carboniferous limestones, representing the southern margin of the London-Brabant Massif, crop out in the Ferques Inlier (Ager & Wallace, 1966). The Visean *Calcaire Carbonifére* has several members which have been exploited for building stone, the Banc Henriette and Banc Caroline of the Haute Banc Formation and the Lunel, Napoléon and Joinville 'Marbles'. The algal marbles with their '*pattes des alouettes*' (lark's feet) markings were much prized; fragments of Productid shells and crinoids may also be present.

One Cartwright Gardens WC1H 9EN
A diversion to Cartwright Gardens is to be recommended for the urban geologist. This University of London intercollegiate student hall of residence has recently undergone renovation and rebuilding by architects Macreanor Lavington and opened in 2016. The entrance portico shows an innovative and decorative use of stone and it is well worth a visit. The stones used here were supplied by contractors Stone & Ceramic Ltd. and four varieties are used in a geometric paving and cladding on the foyer; Gold Travertine, Emperador Light, Cenia Beige and last but not least Nerinea Marble. The yellow stone is **Gold Travertine** comes from Turkey. A more precise provenance is unknown due to very similar stones being quarried at several localities across Anatolia. Main areas of production are at Bitlis, in the east near Lake Van, Denizli in the west and Sivas in north central Turkey (Erdogan, 2011). All are Quaternary travertine deposits associated with active hot springs. The pale grey-brown stone is **Emperador Light** a dolomitic limestone from Bursa in Turkey. The white stone, **Cenia Beige** is one of several varieties of mid Cretaceous (Aptian) limestones quarried around the villages of La Jana and Ulldecona in the province of Tarragona, Spain. It is rich in fossils, but these are hard to discern here as this tone is used with a 'bush-hammered' surface to give it a roughened texture.



Nerinea Marble is the brown and red fossiliferous stone used here and at the time of building One Cartwright Gardens, this stone was relatively new on the market. It is a spectacular stone, rich in well preserved snail shells of *Nerinea* species. Nerineoid gastropods are found in Upper Jurassic and Cretaceous limestones and these stones were quarried from Upper Jurassic strata of Almeria in Spain. These are particularly attractive, turret-shaped shells, which have complex-shaped internal chambers

known as ‘plaits’ (*left*). In section as seen in these slabs, these can be seen as s- or z-shaped internal structures. The rich red and brown shades developed in this rock are a result of the percolation of iron-rich fluids depositing ochres and staining the shells.

Decorative Stonework at One Cartwright Gardens. Yellow stone is Gold Travertine, the pale brown stone is Emperador Light, the white, textured stone is Cenia Beige and the fossiliferous brown stone is Nerinea Marble.

University College Hospital

Though not strictly part of the university campuses, this tour would be incomplete without the inclusion of a stunning piece of urban geology outside University College Hospital (UCH).

John Aiken’s ‘Monolith & Shadow’ outside University College Hospital.

A large pebble, intended as seating, stands outside the main entrance of UCH on Euston Road. This is a sculpture by John Aiken entitled Monolith & Shadow. It was installed here in 2005. On an urban geological tour of the UCL and University of London's Bloomsbury campus, this cannot be ignored, and it is probably the piece of rock in the urban environment that I am most frequently asked about. This is a spectacular conglomerate, containing large, rounded cobbles of quartzite, granitoids, gneiss, basic igneous rocks and ironstones in a green, epidote-and chlorite-rich matrix. This stone was marketed as **Verde Tropicalía** by the stone contractors Granitos Maceiras, who supplied John Aiken with his stone. The conglomerate is quarried around Oliveira de Brejinhos in Bahia State. Geologically, it is derived from the Riacho Fundo Formation (Pajeu Synthem) which is composed of a series of rift-related alluvial fans, part of the Proterozoic Serra do Espinhaço Supergroup of supracrustal rocks. It was deposited at ~ 1.7 Ga and underwent mild thermal metamorphism around 600 Ma (see Siddall, 2016).

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Azul Gondomar – MRC Circle.

Bardiglio Marble – Cruciform Yates Memorial, Plaques in the Kathleen Lonsdale Building Foyer.

Bath Stone – Christ-the-King Church.

Belgian Black – paving in the Cruciform Porch, Foyer and Rockefeller Foyer.

Black Pearl – paving in Malet Place.

Bleu Turquin – Marmor Homericum

Boulonnais Marble – London School of Hygiene.

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Campan Vert – Cruciform 'VIP' Staircase.

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Cenia Beige – One Cartwright Gardens.

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De Lank Silver Grey Granite – street furniture in Malet Place, foundations of Senate House extension.

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G341 Granite – Byng Place paving.

G663 Granite – Byng Place paving.

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Portland Jordan's Whitbed - The Wilkins Terrace.

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Purbeck Marble – paving in the Front Lodge and the Chadwick Building vestibule.

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Verde Mare – London School of Hygiene.

Verde Tropicalía – Monolith & Shadow at UCH.

York Stone – paving in the Front Quad.

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