A Geological Walk in the City of London Cemetery

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Introduction

The Cemetery

The City of London cemetery is not only the largest cemetery in London, it is one of the largest municipal cemeteries in Europe. It is attractive, well maintained and has achieved Grade I status in Historic England's 'Register of Parks and Gardens of Special Historic Interest in England'.
The cemetery contains a balance of old and new memorials and buildings. The memorials are made of a range of rock types, and the grounds contain around 3500 trees, together with shrubs and other plants, making it arguably the best in London, including the so-called "magnificent seven" cemeteries.

The cemetery was opened in 1856 after overcrowding in the City graveyards made it no longer a fit place for burials. This was somewhat later than others due to procrastination by the City of London. The buildings, including an Anglican Church, a Chapel for dissenters, the Catacombs and Columbarium, and a little later the Crematorium, were architectural splendours. The grounds were designed to be both a beautiful and tranquil site for burials and a place for quiet enjoyment and recreation. Promotional literature in 1929 described it as a *Cemetery in a Garden.*

The site is notable for the number of memorials marking the reinterment of remains from City of London churches, 38 in all, most of which are no longer in existence.

The City of London Cemetery and Crematorium publishes a Heritage walks brochure, which can be obtained from the gatehouse, as can maps of the cemetery.

See also official website at:-
https://www.cityoflondon.gov.uk/services/births-deaths-and-marriages/cemetery-and-crematorium

The Monuments

The more elaborate of the older memorials tend to be made of either grey or red/pink granite or white marble. Marble is softer and more suited to intricate carving of figures, much of which has been done to such high standards in Italy. Granite is much harder but gives a superb polished surface. Shaping and polishing of this was brought to a high degree of proficiency in Aberdeen during the 19th century.

The older monuments are of traditional materials which are common in many cemeteries and elsewhere. Granites such as that from Peterhead in Scotland and Cornwall, black gabbros from South Africa, slates from Wales and marbles from Italy may be familiar to many. Examination of some of the more recent memorials reveals an intriguing and attractive array of stones from further afield, such as gneisses, migmatites and more exotic granites.

Many different symbols adorn the monuments, which include chests covering vaults. Crosses, figures, angels and columns are a variety of devices which traditionally have some meaning, mainly coming from their popularity in Victorian times. Such meanings include:

hands clasped = close bond or farewell
urn = ancient Greek for mourning, vessel of the soul
anchors = attachment with the sea
broken columns = life interrupted/early death
descending doves = spirit coming down from heaven
dove with olive sprig = hope or promise
Celtic cross = the circle symbolises eternity
torch = life (upright) or death (inverted)
flowers = many things from passion to resurrection to
Obelisk = ancient Egyptian symbol for life and health

For further information see Gravestone symbols

The Geology

Geologists divide rocks into the three broad categories: igneous, metamorphic and sedimentary.

(a) Igneous rocks are formed by cooling and solidification of hot, molten magma; examples found in the cemetery include granites and gabbros. **Granites** and **gabbros** are coarse-grained rocks formed when large bodies of magma do not reach the surface but cool underground very slowly allowing time for large crystals to form. Granites are lighter coloured rocks rich in silica and poor in iron and magnesium, whereas gabbros are darker rocks rich in iron and magnesium and relatively poorer in silica. Granitic magmas cool from about 800-1000^{o}, gabbroic from about 1000-1200^{o} (iron and magnesium rich minerals are the first to solidify and separate from gabbroic magmas). The Earth's mantle, which lies underneath the crust and stretches down to the core, is iron- and magnesium-rich. Generally granites are more 'evolved' with complex histories; this can be seen in the wide variety of granite types. Volcanic rocks are formed where lava has erupted onto the surface and cooled rapidly, producing fine-grained rocks. One example of a common volcanic rock used for monuments is a pyroclastic, **volcanic ash** from Borrowdale in Cumbria, which has been explosively ejected, but then settled in layers under water and slightly altered (metamorphosed).

(b) **Sedimentary rocks** are formed, as the name suggests, from sediments; these are usually either (i) **clastic sediments** - mostly fragments of broken and eroded silicate rocks (such as mud, silt, sand or pebbles which form **mudstones** or **shales, siltstones, sandstones** and **conglomerates** respectively) or (ii) **limestones** - mostly of calcium carbonate formed either as a chemical precipitate, or biological in origin (from the shells of marine animals). Limestones can be almost pure white calcite as in chalk, be rich in magnesium as in **dolomite,** or contain varying amounts of silicate minerals and organic material when it can range from pale brown or grey to dark grey in colour. When these

sediments are buried they are compacted and cemented by percolating fluids to form rocks, a process known as lithification. In the cemetery we will find sandstones and limestones.

(c) **Metamorphic rocks** are formed when a rock of any type is buried and subjected to pressures and temperatures higher than during simple lithification. The minerals start altering to give a quite different rock. A low grade (temperature) metamorphic rock is slate, where some fine-grained, platy minerals give a fabric to the rock which cleaves (splits) in one direction. At intermediate pressures and temperatures the grain size gets larger to form phyllites and then schists; these rocks however are rarely suitable for use as memorial stone. At higher grade, during mountain building episodes, gneiss is formed; this is coarser grained, often with folds evident in the patterns of lighter and darker bands. Yet greater pressures and higher temperatures produce migmatite, a rock with distinct separation into light bands which have undergone partial melting and dark bands of unmelted minerals high in iron and magnesium. A common metamorphic rock found among the monuments is marble. Formed from limestones, the grains of calcite which make up the bulk of limestones have been recrystallised and turned into interlocking crystals, improving the weathering and erosion resistance while maintaining the easily carved nature of calcite rocks (calcite is a softer mineral than silica or feldspar which makes up many other rocks).

For further public engagement activities see
https://www.ucl.ac.uk/earth-sciences/impact/public-engagement

Acknowledgements

We thank the staff of the City of London Cemetery and Crematorium, especially Mr. Gary Burke, for their kind assistance and information.

We would also like to express our appreciation of the beautiful and lasting memorials chosen by relatives and close friends to commemorate their loved ones.

The Geological Walk

The walk starts by entering the front gate and proceeding straight ahead towards the distant Chapel, appropriately along Chapel Avenue.

(A) Haywood Memorial

The first memorial is a large mausoleum on the left holding the cremated remains of its designer William Haywood. He worked on many projects as Surveyor to the Commissioners for the City of London. One such was to report on burial provision within the City of London (1849). As a result of his report on the woeful inadequacy of the existing graveyards and the attendant health risk, he was set the task of finding a suitable location as a final resting place for the deceased of the City of London. His subsequent design for the City of London Cemetery included that for his own mausoleum, which is now a Grade II Listed Building, one of eight within the cemetery. His monument is built mostly of blocks of two different **limestones**, Kentish Rag and Portland Stone. Kentish Rag is an impure, sandy limestone formed under marine conditions relatively close to shore. Close examination reveals a small amount of a dark mineral called glauconite, which is associated with deposition from sea water. Portland Stone is an oolitic limestone (ooliths being rounded grains of calcite) with prominent fossils. The fossils, especially oyster shells, are plainly seen in some areas where they are concentrated. Viewing the groundmass with a hand lens reveals many ooliths forming the matrix in which the fossils are set.

Haywood also worked with Joseph Bazalgette on the Abbey Mills Pumping Station, and with James Bunning on the Holborn Viaduct.

(B) Saunders Memorial

Almost opposite Haywood is a classic style memorial to William Saunders (1825-1901), Medical Officer of Health for the City of London. The main body is of Scottish **red granite**, with **grey granite** pillars at the corners and a base comprising finer-grained grey granite. Note firstly how polishing reveals so much more detail and secondly how the crystals making up the granite interlock in a tight mosaic pattern characteristic of igneous rocks. The greyish glassy mineral in granite is quartz, the white or pink, sometimes rectangular/tabular mineral is feldspar, and there may be platy micas as well. Above is a carved white **marble** figure of Jesus with a cross which is now heavily discoloured, typical of the weathering of marble. The whole monument is on a base of yellowish, laminated sandstone.

Walk up Chapel Avenue, to the junction with Central Avenue. A short way up to the right is a coloured statue of the Hindu deity Shiva in a grey granite stand and canopy (left).

Turn left down Central Avenue to find a magnificent marble memorial to David Vigiland.

(C) Vigiland Memorial

This memorial to the sailor David Vigiland (1926-1946) is based on Ruben's *The Descent from the Cross* (above, left) painted between 1612 and 1614 and now housed in Antwerp. It was carved from a single 25 ton block of white marble in Italy and dedicated in 1955. Although described in the past as a white, Sicilian marble, it has more recently been considered to be the famous Tuscan marble from Carrera. Note the 'sugary' feel to a weathered marble surface; the original polished would have felt smoother. The top image was taken in 2012, the monument having been cleaned in 2010, whilst that below right, taken in 2021, shows subsequent blackening from pollutants.

(D) Central Avenue towards Church

Walk towards the Church. On the right is a dark gabbro headstone in memory of Thomas Watts (d.1971). The stone is composed mostly of a dark, greenish-black mineral rich in iron and magnesium, called augite, together with some light coloured feldspar. Examination of the polished surface may reveal a second dark mineral, possibly magnetite. The appearance of these very dark gabbros can alter if the viewer is some distance or close up and if there is bright sunlight or varying degrees of cloud cover.

Just past Divisional Road is the family vault of David Wilkin, made of limestone with inset marble tablets. The marble has weathered to a varying extent on each side, and the lettering is now quite tricky to read. The base is of sandstone, showing bedding planes parallel to the horizontal.

Close to David Wilkins' vault is a memorial to George Wright Binks, a pioneer in the invention and manufacture of wire rope in the mid nineteenth century. The firm of Binks Brothers was operational in Millwall for just over a century.

At the end of the road, on the corner on the left, is the family vault of Henry and Isabella Mead. It comprises two distinct sandstones, one buff-coloured and the other red, with a white marble tablet. Most sandstones in cemeteries are buff-coloured. A popular sandstone in this area is greensand from the Weald which weathers a little browner at the surface; it was deposited in marine conditions. In contrast, red sandstones may have formed in desert environments, where the air oxidises any iron minerals to a characteristic rusty colour. The bedding showing the original layers of deposition in the red sandstone are clearly visible. The sandstones have started to split along these bedding planes.

Note that some of the monuments around this junction show evidence of damage which has been repaired. This is the result of bombing in 1942 which damaged much of the Church and required repair.

(E) Church and neighbouring monuments

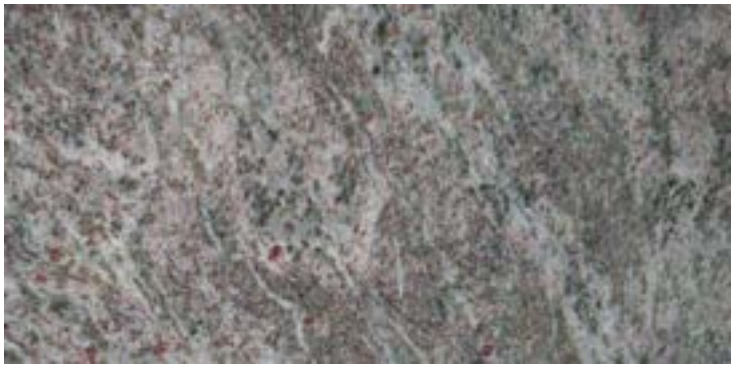
Approaching the church - formerly known as the Anglican Chapel - you will notice that the main door directly faces Central Avenue. This was designed to greet corteges arriving from railway sidings at the other end of Central Avenue, which was planned as the main transport link. It had been envisaged that most traffic would be by rail; however the railway link was never used due to pricing disputes. The Chapel similarly faces a route coming from the east side. Note: both the Church and Chapel are also visible down avenues leading from the main gates.

The Church itself is made of Kentish Rag walls and, according to City of London literature, Caen Stone, a Jurassic limestone from north-west France, was used for the finer work. There is an added complication of extensive repair work after the bomb damage, which includes the use of . Portland Stone for the spire.

Turning right at the Church there is an interesting row of older monuments in an arc on the right which are worthy of examination.

The next stop centres around the section of the Outer Circle to the north of the Church.

(F) The Outer Circle



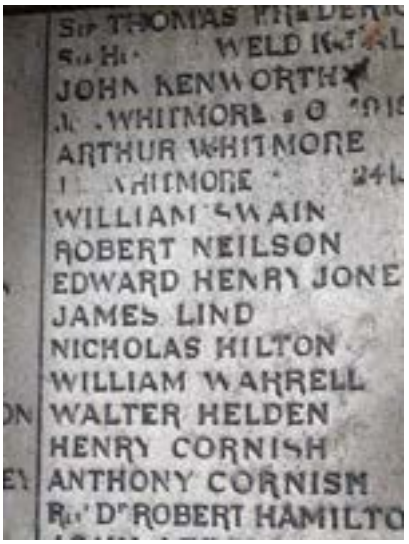
One of the most attractive of the newer stones is a **garnet gneiss** (Bahama Blue - from India), used in the beautiful memorial to Maureen Kelly (1946-2002). This is a metamorphic rock of much higher grade than slate. Formed under high pressures and temperatures during mountain-building episodes, large crystals known as porphyroblasts have formed in swirling patterns during metamorphism and large-scale folding. In this rock, the red porphyroblasts are garnet. In a way these could be viewed as the metamorphic equivalent of phenocrysts (large, well-shaped crystals found in igneous rocks); however porphyroblasts grow within solid metamorphic rock, whereas phenocrysts form from a liquid in igneous rocks.

Along the same row is a black **gabbro** (Belfast Black, from S. Africa) forming the main part of the memorial to Derek Hart (1930-2007). This is a popular dark stone, a strong contrast to the white of marbles. Unpolished, it has a grey appearance but when polished looks almost black, making a suitable contrast for lettering or decoration. The difference in stones when polished, unpolished or rough-cut is quite marked. It can be appreciated that polished stones offer us a good opportunity for really seeing the detail. This is similar to the enhanced appearance of pebbles found on beaches when wetted by sea or rain.

Opposite is slate headstone for the labour M.P. Lord Elwyn Jones (1909-1989), fine Welsh slate being popular among natives of that country. In this cemetery, it is much less common than limestone, granite or marble. Slate is a metamorphic rock formed by deep burial and heating of mudstones. New platy minerals such as micas align at right angles to the pressure from above and define a natural cleavage in the rock. We are used to seeing roofing slate with almost perfectly flat cleavage. It should be noted that not all slates are as even as this, only the best being used for good roofing tiles and monuments.

Next to this the memorial to Robert and Mary Cooke (d.1971 and 1983; is of a good example of bluish grey larvikite from Larvik in Norway. This popular stone is an igneous rock more restricted in composition and location than granites and gabbros; it contains many large feldspar crystals. This mineral has a characteristic sheen (called schiller) which, if viewed in good light at the back of the monument, shows a play of colours when viewed from different angles. Note the marked difference a polish makes to hard stones like this (also granites and gabbros), where unpolished areas are dull grey and quite unremarkable.

Take a short diversion down Forges Road to a monument commemorating St. Olave-Jewry and St Martin-Pomery.



This memorial commemorates those who were formerly buried in the churchyards of St Olave-Jewry and St Martin-Pomery. Altogether, remains from 38 City churchyards have been reinterred within the City of London Cemetery. Prior to the Great Fire of London in 1666, there were 107 churches within the city, of which 86 were destroyed in the fire, St Martin's being one. 51 of these were rebuilt under Sir Christopher Wren's direction. Remains from churchyards which came to the City of London Cemetery were sometimes united, as in this case.

Erosion of the stone has left lead letters proud of the surface, and in many cases they have fallen out. It is possible to determine an idea of the annual rate of weathering of the stone by measuring the distance between the surface of the stone and the lead letter, if the age of a memorial is known.

(G) Anchor Road to the Chapel and surroundings

Retrace your steps around the Outer Circle and turn left at Belfry Road. Turn right down Anchor Road to the Pedley Vaults. The pink granite is pocked-marked where the dark minerals containing iron and magnesium have been weathered out, leaving the light coloured quartz and feldspar untouched. Joshua Pedley was a wealthy solicitor and philanthropist. He lived for a time in White Hart lane in Tottenham, and stepped in to buy the manor house and estate at Bruce Castle in order to prevent its demolition. He then sold it to the Local Board of Health for less than he paid for it, and the grounds were opened to the public.

Continue along Anchor Road to the non-conformist Chapel, also known as the Dissenters Chapel. This is a Grade II listed building designed by Haywood in 1855, and like the Church, can be seen from the main gate along the drive of Chapel Avenue.

Walk round to the other side of the chapel and turn up North Boundary Road. Here there are many good examples of sandstone graves which have not withstood the test of time. Typically the sandstones flake in layers parallel to bedding, when water absorbed by the porous sandstones is frozen and the ice expands to break off layers. The damage can range from loss of lettering to severe erosion of large sections of the stone.

Weathering is often present at the bottom of stones where they are still in contact with wet earth even when the upper parts have dried. This can be seen throughout the cemetery and to some degree with other stones, especially limestones and marbles.



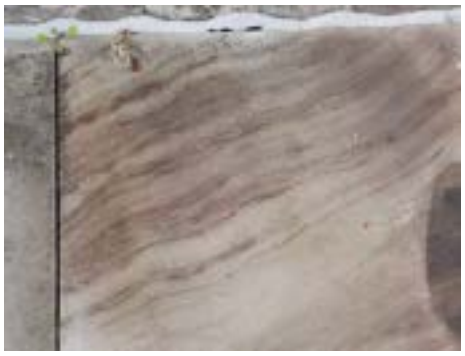
Continue along the road to the Catacombs.

(H) The Catacombs

The catacombs and ‘valley’ in front of it were the central piece of Haywood’s design. In the sixteenth century, the land was part of an estate including Aldersbrook House, which lay at the head of a large pond. By the mid eighteenth century, the estate was owned by Smart Lethieullier, who made the pond into an ornamental lake. Smart was a traveller and collector of antiquities and fossils, building a hermitage for his collections. The collections have long since disappeared, although a catalogue exists. The lake was still there when the land was purchased by the City of London, but was drained prior to the opening of the cemetery. As it happened, the use of catacombs had become less popular even by the time these were built, in 1855, and around two thirds remain unoccupied. Some parts have been converted to a columbarium for ashes. The terrace above provided good views over what would at the time have been open countryside or farmland.

(I) The Old Crematorium

The Old, or Traditional, Crematorium is a Grade II listed building. Built at a cost of £7000, it opened in 1904, the first municipal crematorium in London, and one of the first in the country. The first cremation took place the following year. It has now been decommissioned and the building used for services only.



It is built with Portland Stone, with blocks of Kentish Rag forming the walls. The Portland Stone shows a number of fossil shells (top). When weathered, the shells stand proud of the surface because the crystalline calcium carbonate of which they are made is more resistant to weathering than the limestone (calcium carbonate) grains in the surrounding rock. When such blocks are 'restored' the protruding surfaces of the shells tend to be taken back to become flush with the limestone surface. The Kentish Rag blocks sometimes show cross-bedding. The flagstones forming the pathway are probably "York Stone", a

hard-wearing sandstone, which displays a range of sedimentary structures including rippling.

Around the back is a pond surrounded by blocks of sandstone forming a rockery, and showing distinct bedding planes. You may see carp or terrapins in the pond, the latter particularly on a sunny day.

Return to the front of the Old Crematorium. If you look diagonally to the left, you can see a granite monolith in the distance commemorating the Hospital for poor French Protestants.

Walk down St. Dionis Road, passing the War Graves on the left in memory of those who died in the Second World war. These are usually made from Portland Stone, and the thickness of the particular bed used is indicated within the memorial cross, as the block between the bottom of the cross and the base of the arms of the cross is in one piece.

At the crossroads, turn right down Central Avenue unless you also wish to visit the 1914-18 War Graves a little further down St Dionis Road. The grave of Martin Lewis (see last stop) is past the end of St. Dionis Road, near the cemetery boundary fence.

(J) Central Avenue and beyond

The avenue contains several monuments commemorating reburials from churchyards of the City of London, for which this cemetery is well-known.

The monument shown on the left is to St Mary Somerset with St. Mary Mounthaw, a Wren church demolished in 1871 to make way for Queen Victoria Street. In the style of a gothic house, it is composed of several different igneous and sedimentary rocks. The names are engraved on a grey granitic tablet, and the columns are composed of fine red granite pillars. The whitish rock is again Portland Stone, showing blackening from atmospheric pollution. Below the limestone is a light red sandstone plinth. Careful observation shows that there are cross-bedding structures within the sandstone - look for faint diagonal markings cutting each other at an oblique angle. This indicates that the sand was deposited in a current. The lowermost plinth is of sandstone which has been screeded to inhibit weathering .

The memorial to the parishioners of St Martin Outwich and St. Helens, Bishopsgate is made of Portland stone with inset tablets of grey granite. As with other such limestone monuments, at least those which have not been recently restored, the fossils are standing proud of the rock and can be used to indicate the loss of material over the years. Another indication is the loss of detail in the carvings.

The important natural philosopher and scientist Robert Hooke, who also acted as Sir Christopher Wren's assistant, was buried at St Helen's after his death in 1703. His remains are now interred here. Hooke was a man of many talents, having built The Monument, and the double-vaulted dome of St. Pauls, and he is credited by some as being the first geologist.

St Antholin Watling Street was demolished in 1875, and the vault beneath this monument contains some of the remains. The rest are close to the former site of the church. Like many churches, it was destroyed during the Great Fire of London in 1666 and then rebuilt for the princely sum of £5864, following a design by Sir Christopher Wren. The obelisk is composed of marble, which would have been white when fresh, but is now a dull, yellowish grey, rough and knobbly to the touch. There is a hint of striping going diagonally across, indicating slight differences in composition or texture. The marble supports a growth of lichen, now more marked than shown in the photograph, which was taken in 2003. The basal plinth is sandstone.

The lead lettering of the memorial is standing proud, about 1 or 2 mm above the main marble, giving an idea of weathering rate. The steps behind the monument are starting to support a mossy growth.

The 1866 memorial to the deceased of St. Andrews Holborn and St. Sepulchre Holborn was designed by Haywood and is another Grade II Listed Building. Work on these two churchyards was the start of clearances to make way for redevelopment in the city. Prior to clearance, the churchyards were dreadfully overcrowded, particularly St Andrews, with the ground level within the churchyard having risen three or four metres above the road, because of all the burials taking place there. Between eleven and twelve thousand bodies were removed from St. Andrew's alone. In this case, removal was part of the Holborn Viaduct project, which Haywood also worked on.

The monument is a St Andrew's cross, with the base decorated in gothic style. The photograph was taken shortly after restoration in 2005-6, and the Portland limestone of which it is constructed has since blackened over a relatively short period. The greyish rock, set back between the columns, is of a light coloured igneous rock, perhaps granitic. The steps are of sandstone, now completely covered with ivy. The whole area is now surrounded by low railings.

Opposite St. Andrews is a Celtic Cross dedicated to the church of St. Mildred Poultry, which was demolished in 1872. Made of Carboniferous limestone, it is different from other limestones in the cemetery in containing the remains of another type of fossil, crinoids. These marine creatures are commonly known as sea lilies, although not a plant at all. In life they consisted of a 'stalk' similar in appearance to a column of polo mints, and would have had branching 'arms' at the end of the 'stalk'. Sections both parallel to the stalk and circular sections across it can easily be seen. Inscriptions are very weathered, and to varying degrees on different faces, indicating the importance of different microclimates and environmental influences in different orientations.

Turn left down Cheetham Avenue, passing the marble memorial to George Leslie Drewry. As a midshipman, he won the V.C. at the Dardanelles landing in 1915.

(K) Volcanic ash memorials

At the end, cross South Gate Road to find a greenish coloured memorial to James and Elsie Lewis, three rows back. This is a good example of a volcanic ash, or tuff, which was laid down in water. Sedimentary structures can sometimes be made out, such as loading of one layer down into the layer below during deposition, giving a wavy contact. The rock shows a cleavage, in other words it will tend to split in roughly parallel layers. This is because it was subjected to the effects of pressure (metamorphism) after formation. The stone comes from the Lake District, and from a group of rocks known as the Tilberthwaite Tuff. In the trade it is known as Westmorland Green Slate.

Their son, Martin Lewis, is also buried at the City of London Cemetery, close to the roundabout on South Gate Road, and adjacent to the boundary fence. His memorial is very similar in style, the particular slice of Borrowdale rock being selected by his parents from a quarry on Honister Pass.

Few memorials are made from this stone. Sometimes layers and lenses of ash which settled under water can be seen, with differences picked out to a degree by differences in growth of lichen. Such volcanic rocks weather to a distinct pale green which can be spotted from a distance with practice. This grey-green colour is different from the green seen on marbles during wet weather due to growth of algae, lichen or moss.

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