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Pulhamite Petrology: What is Pulhamite rockwork made from?

Pulhamite is a synthetic stone originally developed by James Pulham of Woodbridge in Suffolk. The material was referred to as Lockwood's Portland Stone Cement, Pulham's Stone Cement and Pulhamite. It was used to create natural-looking rocky outcrops in parks and gardens from 1830 through to 1945. An excellent history of James Pulham and his descendants and their business is provided by Hitching (2012). There are numerous examples of the use of Pulhamite in the British Isles which, again, are catalogued by Hitching (2012).

The Pulham family created rock garden landscapes which aimed to mimic natural outcrops with '*stratified rock, with some bold projections and recesses, fissures ,dip, cleavage, cracks, clefts, outliers, &c, so as to appear as if it had originally been naturally deposited ... some broken into fragments, some cropping up, or out at various angles, degrees of elevation, or dip, and shewing more or less of an escarpment in irregular, rugged, picturesque, romantic form ... [all] worked with numerous hollows between the strata, on the ledges, in the cracks and clefts of the rock, with plenty of space for soil, having good drainage for plants to grow freely about it* ...' (see Hitching 2012). These structures were based on careful geological observations.



One of the most spectacular examples of Pulhamite in London is in Battersea Park, where the outcrops apparently mimic the appearance of the Millstone Grit outcrops of the Peak District (left). A dislodged block shows that these 'outcrops' are in fact sculptures with a brick armature coated with mortar (right).

The Composition of Pulhamite



The outcrops were expertly modelled using a lime mortar render, applied to a brick core and, in the case of the examples at Battersea, were made to resemble Upper Carboniferous gritstone. Stone chips could be cemented into the structure for added effect. And this is the case at Battersea Park where pieces of flint from the Thames Gravel are pressed into the surface of the cement to resemble conglomerate layers (left).

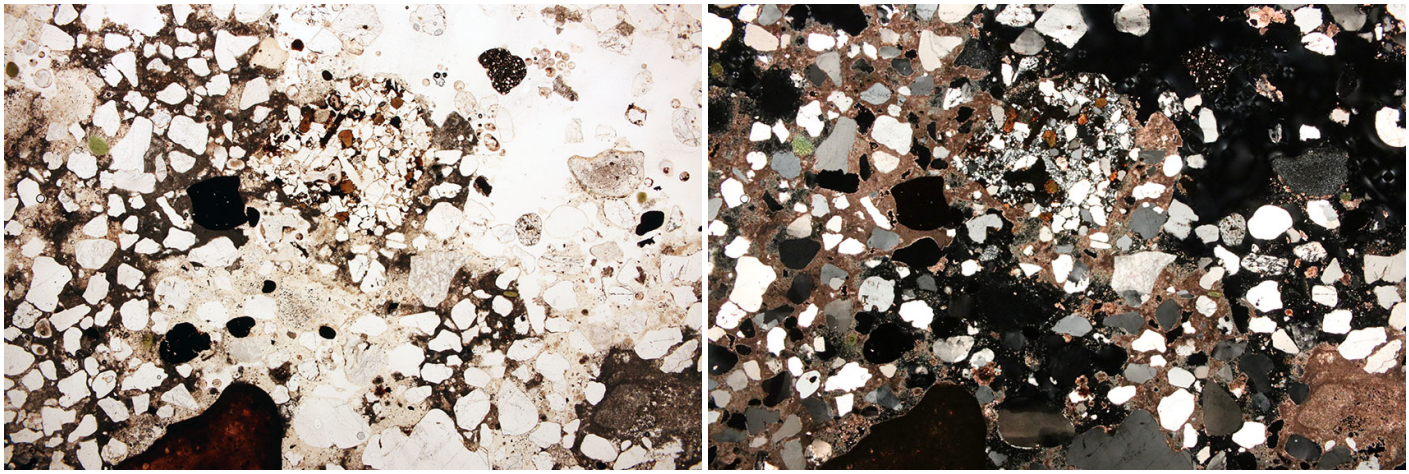
Analysis of a thin section of the mortar used to bind the bricks and to add render to the Pulhamite structures reveals the recipe of this material. The analytical technique of polarising light microscopy (PLM) is used to analyse rocks and minerals and also related materials including, bricks and other ceramics and also plasters, mortars and concretes. Using observations in plane-polarised light (PPL) and under crossed polars (XPL), mineral phases can be identified.

Analyses of the mortar used in Pulhamite using PLM reveals that the cement binder is a pure, lime cement. Under cross-polarised light it shows high birefringence which indicates that its composition is calcium carbonate. This has been produced by using a high purity lime, probably derived from calcining Chalk which has been well-slaked, allowing for complete carbonation of the lime whilst it was curing. The technique of using 'hot lime' leaves traces in the form of

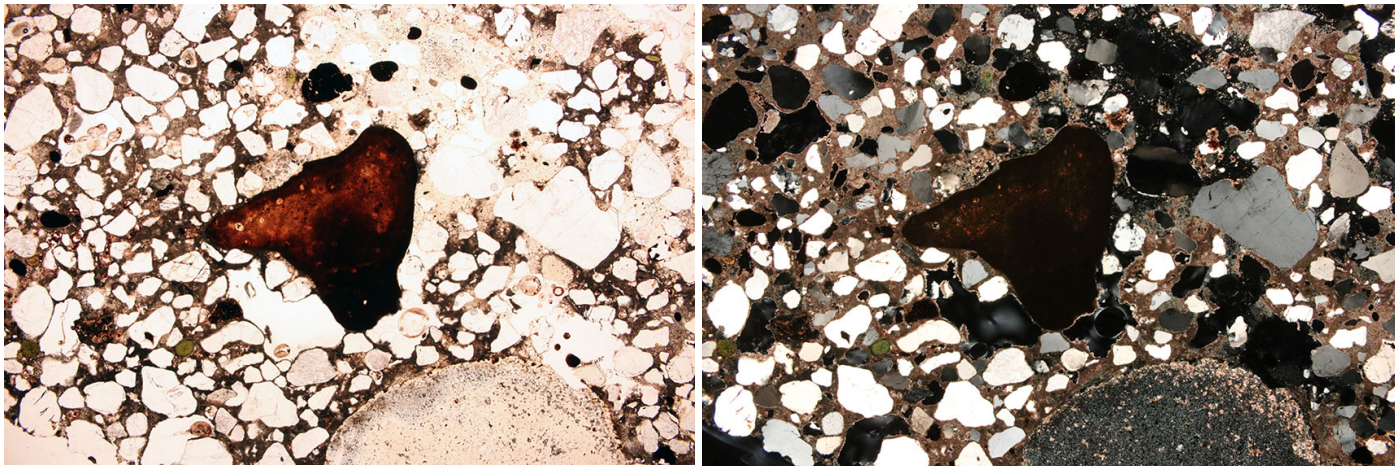
poorly slaked lime lumps in the cement binder which are very obvious, and these features are absent in the Pulhamite sample. It is likely that the Pulham's maintained long-term slaking pits to manufacture their lime.

To convert the slaked-lime putty into a mortar, an aggregate needs to be added. Rounded to sub-angular grains of quartz sand are the most abundant particles present, however there are also abundant pellets of the green (and brown) clay mineral glauconite present as well as some lithic particles which are composed of chalcedonic quartz or cryptocrystalline quartz. The lithics also contain fine grained quartz, glauconite and Y- or T-shaped fossilised sponge spicules. The latter are composed of opaline silica. A few fragments of over-fired brick clinker are also present in the aggregate. The geological component of the aggregate clearly indicates a provenance from the Upper Greensand Formation (Selbourne Group) which outcrops in the Wealden Basin, located between South London and the English Channel. The Upper Greensand is a glauconite-bearing, quartz rich sandstone which also contains cherts rich in sponge spicules. It was deposited in shallow seas during the middle Cretaceous. Pulverised greensand was and is commonly used as a cement aggregate.

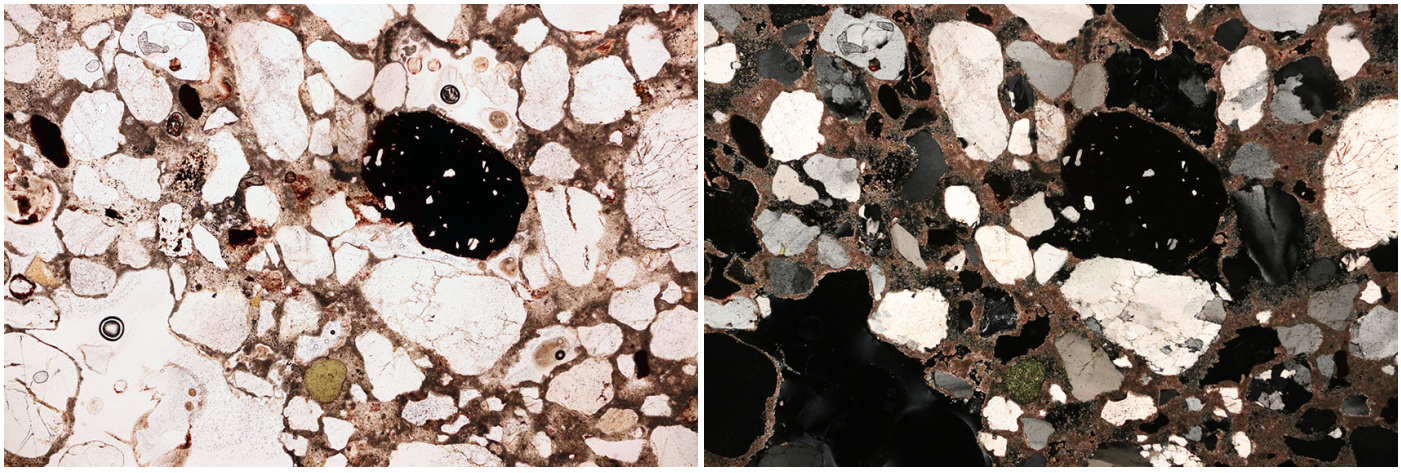
Below are some photomicrographs illustrating the composition of the Pulhamite cement. The image pairs show the same field of view, with the thin section viewed in PPL on the left and under XPL on the right.



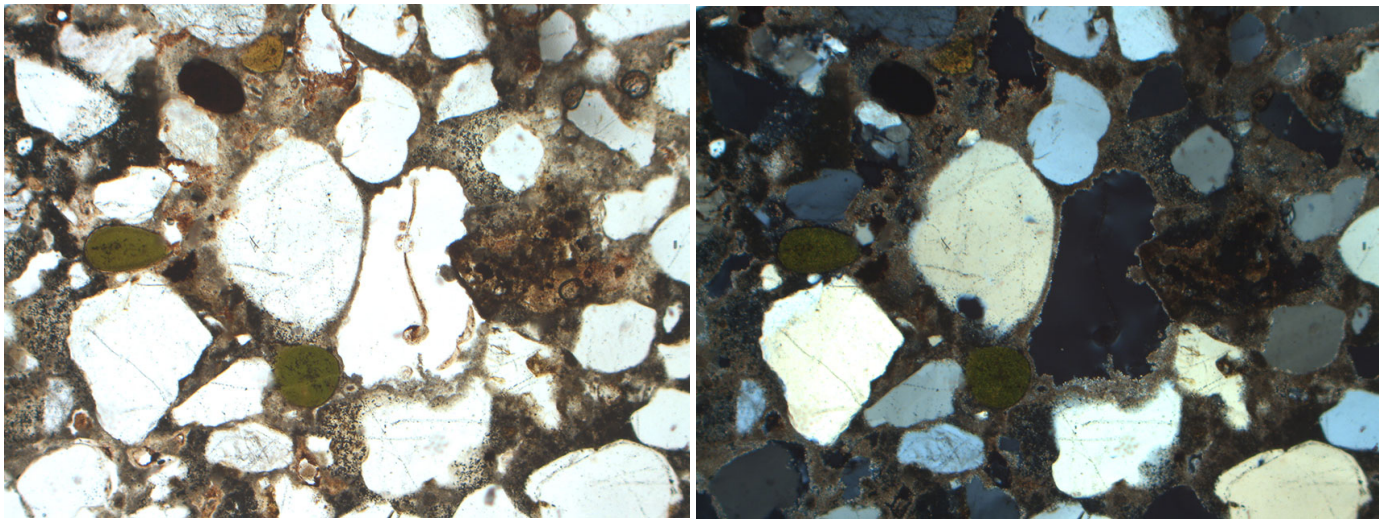
Above: An overview of the texture of the Pulhamite mortar. Particles of apple-green glauconite can be seen in both PPL and XPL (i.e. in the upper left corner of the image). The majority of the particles are quartz (white and shades of grey in XPL). The larger particle in the centre is a piece of cherty greensand containing quartz, glauconite (brown particles) and sponge spicules in a fine-grained silica matrix. The cement is highly birefringent in XPL. The area towards the upper right of the image is largely a void in the slide. x40 magnification, the field of view is ~ 3 mm



Above: The particle in the centre of the photomicrograph is a particle of overfired clay. Also visible on the bottom right edge of the image is part of a rounded pebble of flint. Other material is as described above with quartz and glauconite pellets in a lime cement binder. x160 magnification, the field of view is ~ 1 mm.



Above: Another view of the fabric of the mortar which is dominated by quartz grains and glauconite pellets. The black, rounded particle at the centre right is undetermined. It is possibly a rolled grain of overfired brick. x160 magnification, the field of view is ~ 1 mm.



Above; Quartz grains and pellets of green glauconite in a lime cement binder. The irregular shape at centre right is a void in the cement. x250, field of view is ~ 0.5 mm.

Further Reading

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