Final Conservation Report for

Churchyard Memorials

St John the Baptist Church - Bishops Castle - Shropshire

The Diocese of Hereford

On behalf of St John the Baptist Church P.C.C.

Caring for Gods Acre

Elliott Ryder Conservation

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The Works

Elliott Ryder Conservation were commissioned on behalf of St John the Baptist Church - Parochial Church Council by Contract Administrator - Mrs Harriet Carty to undertake conservation of the twelve memorials, in line with recommendations within our priced submission (not report) of July 2018.

There were no unexpected works additional to that of our original submission. Guidance was sought from the DAC Archaeological Consultant (Mr Andrew Pike) regarding the form and stratigraphy for backfilling a resultant void beneath a collapsed box-tomb (Toldervey). The Diocesan Architectural Consultant (Mr Andrew Arrol) and Committee members were consulted about leaving the composite, decorative urn / lid of one box-tomb undisturbed, in light of difficulties determined through treatment of a neighbouring urn / lid, for fear of avoidable damage.

Both queries were communicated to the Contract Administrator who convened meetings with the different Diocesan advisors quickly on our behalf.

Client

Harriet Carty - Caring for God's Acre, on behalf of St John the Baptist Church P.C.C.

Period of Works

Works were undertaken in two distinct phases with preliminary, emergency conservation taking place in November 2019 and the bulk of the work between 29th June – 17th December 2020. Work was initially sporadic due to difficulties procuring specialist materials (several of which came from the European Union) and engaging scaffolders to erect individual lifting rigs, due to an accumulated backlog of work, both issues a result of easing of lock-down restrictions during the pandemic.

Conservators/Assistants

Kieran Elliott ACR (Accredited Conservator/Restorer)
Susanne Ryder
Daniel Ryder
Paul Gough

Sequence of works

Memorials deemed most at risk (not all of them) had emergency treatments carried out before another winter. This involved tacking or sticking loose and/or delaminating sections or edges of stone, to prevent loss of original material. The spots of resin were to polymerise (harden) and secure vulnerable areas back to sound substrate and allow subsequent treatments (such as grouting and surface / sub-surface filling) when the risk of temperatures approaching freezing and the adverse effects on the required mortars had gone.

The Works

At its simplest, works involved removing expanded and actively corroding iron-fixings and replacing them with marine-grade stainless steel. Defective or missing pointing from joints was replaced with suitable mortars to slow-down the ingress of excess moisture into the different memorials. Four of the memorials were completely dismantled down to ground level, due to structural instability and three of the memorials were partially dismantled to replace corroding fixings. Areas of vulnerable delaminating stonework were grouted and/or surface filled to slow-down the ingress of rainwater.

Conventional cleaning was not deemed appropriate, as the memorials had achieved a patina commensurate with their age. The only elements that were cleaned were those sections of the Toldervey monument which had been buried beneath ground level and were encased with soil. Mosses (which were poorly bonded with the host stone) were removed from elements where encountered, but algae and lichens were left un-treated.

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Toldervey Memorial

1 Condition

1.1 The capstone and side elements of the collapsing memorial had been placed on top of one another approximately 25 – 30 years previously, such was the level of movement in the memorial. These had been stacked with little thought, with pointing-loading from heavy overlying elements having occurred. The elements (many of which were fractured) were moved away from the plinth beneath ground level and stacked against a nearby wall such that they could be rain-washed over the winter and dry-out slowly over the spring – summer.

2 Groundworks

2.1 Work was done to excavate soil from around the moulded plinth and crude sub-base, which had pitched into the ground at a roughly 45 degree angle. Excavated spoil was retained nearby for later inclusion into the resultant void. During excavation a small network of animal burrows above the top of the stone elements but well beneath ground level became clear. The soil, several feet beneath ground level was well compacted and removed in an archaeological manner, so as not to damage the aged stonework. Soil was carefully excavated from beneath the two now angled edges, such that lifting slings could be used to raise the plinth/base. The endless slings had to be a certain distance in from the outer edges to ensure a safe, strong lift.

2.2 A lifting scaffold was erected above the now square hole and the stone elements raised slowly out of the ground maintaining the 45 degree angle. The stone sections were positioned on a boarded platform within the scaffold. At this point the DAC archaeologist (Mr Andrew Pike) was consulted as how best to backfill the void without compromising the internment beneath, whilst providing suitable long-term bearing capacity for the re-built box-tomb and new re-enforced concrete raft.

2.3 This was completed by installing a separation layer of Terram® (a permeable, thick fibre membrane). Spoil was placed horizontally on top, into the angled void and carefully compacted in thin layers, to ensure the ground would be solid, not just tamping thick layers, where only the top is compacted. Another layer of Terram was placed on top of the compacted spoil at the correct height, before backfilling near the top of the void with clean, washed gravel 10-20mm in particle size. This was tamped thoroughly to give a solid uniform base on which to cast a re-enforced concrete pad.

2.4 As the ground was very uneven in this location a square hole was cut in the ground to receive timber shuttering for a new concrete pad of the correct proportions for the perimeter of the sub-base, the top bed of which finished just above ground level. The original stone sub-base is actually in two sections with a joint running north-south and had been placed directly into the ground. The bottom bed of the stone sub-base was irregular having a very roughly 'punched' surface, with a keel shape. This pointed ridge would have compressed into the soil when it was applied but was not flat enough for the new pad and would have caused point loading and meant massive joints between the top of the concrete and bottom of the sub-base.

2.5 Visqueen heavy-duty polythene (DPM) was placed at the bottom of the shuttering to ensure moisture-retention in the concrete and aid workability. Re-enforcing mesh cut to size so as 100mm back from the eventual edge of the concrete was placed on bricks to ensure it was midway vertically in the concrete. Concrete was poured and tamped with smooth edges applied around the perimeter. After several weeks the shuttering was removed and the strips where the timber was, backfilled and tamped with spoil.

2.6 As the combined weight of the sub-base and moulded plinth was in excess of 850kg, it had not been safe to reduce the keel shape from underneath. Fortunately when both sections were being lifted into position on the solid concrete pad the joint in the sub-base gave way despite having a ratchet strap applied spanning the two parallel sections to prevent this. One side of the pair fell on top of the concrete pad. Temporary supports were hastily applied and the top moulded section only, lifted away leaving the two sub-base sections on the pad. This enabled removal of historic bedding mortar and to reduce the raised point which would have given a joint height of 50-60mm. The very hard stone was reduced in height by cutting a series of parallel lines at right-angles along the length of the keel and pitching (chiselling) them out to create a much flatter, more stable surface.

2.7 When the sub-base and moulded plinth were removed they were immediately cleaned to remove the still soft soil. This was undertaken with a low-pressure cold-water, jet-washer. Care was taken not to over-clean the stone which was in a sound condition, as it shouldn’t look radically different to the overlying stone which had been stacked and was colonised with algaes and lichens giving it an achieved patina of age. The stone dried slowly whilst the void was backfilled over several days and the new concrete pad was allowed to reach full compressive strength.

2.8 Once the concrete padstone was hard enough, the process of re-building began. The two sub-base elements were bedded onto a coarse, screed type mix (semi-dry) with an NHL3.5 (natural hydraulic lime) binder, with a wider bed joint than the remainder of the memorial. This was allowed to harden before lowering down the single, moulded plinth block onto a finer, more traditional bedding mortar also based on NHL3.5. The mating surfaces were much flatter so a finer joint thickness was achievable.

3 Conservation

3.1 Insubstantial iron fixings were found in the top and bottom beds of the tall side panels. With substantial dowels between the capstone and the urn. These had expanded despite being securing in position with molten lead originally. This was evidenced by the angled (drilled) access point and the thin line of lead issuing from the dowel. Unsurprisingly the lead had survived well but the iron had corroded/expanded as it was not fully encapsulated. All corroded metal and lead was removed, much of it fell out or was easily removed but several sections which had expanded into the sockets had to be drilled out. This was slow work as the side panels were relatively thin and we could not risk bursting the stonework and damaging the edges which would be seen. All of the original fixing holes were widened/deepened to accommodate new more substantial stainless-steel fixings.

3.2 Several of the side elements had fractured into numerous pieces, the majority of which were discovered within the undergrowth. These pieces had been rain-washed over the course of the winter and were suitably dry to enable joining with an external grade epoxy-resin. The four main box (side) elements were not of uniform thickness and only 'finished' on the seen, outer surfaces. All break elements were cleaned with fresh water using nail-brushes to remove any organic material which might impair the joining process. The thinner elements were joined with resin only in small sections, before making whole panels. These sections were joined on a thick flat timber board to achieve correct alignment. Once the resin had polymerised and the joins effected, channels were cut into the rear surfaces at right-angle across the fractures, with an angle grinder. Stainless-steel flat bar was cut to a suitable length and set into the channels with epoxy resin to strengthen the fractures further. In the case of the thin elements the large panels could not have been manoeuvred without the fractures failing such was the weight involved. The resin within all joined surfaces and support fixings were allowed to polymerise fully before being handled/manoeuvred further.

4 Re-building

4.1 The lowest two horizontal joins between the concrete pad and the rough sub-base and moulded plinth were pointed with a conventional coarse mortar, with a NHL 3.5 binder. Once the mortar between the concrete and sub-base was solid, liquid grout was poured along the length and into the join. This would have spread outwards towards the bedding mortar, filling any voids, to provide a solid base, evenly supporting the sub-base across its footprint.

4.2 The box-tomb is top heavy, given the size and mass of the overlying capstone and urn. The fixings across the mitres of the four corners were too small and had corroded significantly. The four side elements were too thin and tall to support the capstone in the long-term if there were any signs of movement. There was no internal supporting core, usually constructed from brick. So the box-tomb was re-built with a new internal lightweight block core to support the capstone and urn and to secure the side panels against. Celcon Thin-bed® blocks were used with Celfix® mortar, which gives very fine joints and enables structures to be built and bear weight quicker than conventional blocks. Unfortunately the bottom-bed of the capstone was not remotely smooth and very irregular in texture. This meant slate shims where required in the joint between the top bed of the core and bottom bed of the capstone. This was to ensure the capstone was parallel with the four underlying panels and the core, took the weight of the capstone evenly.

4.3 It was established where new additional restraint fixings could and would be employed to secure the four side elements back to the core. Existing fixings sockets at the mitres were deepened and widened to ensure more solid fixings, with slots ground into the top-bed of the side panels. These were all de-dusted to ensure a solid bond with the resin employed. As there were no original dimensions the memorial having already been dismantled, the heavy fragile side elements were offered-up individually and secured temporarily with wedges against the core and a ratchet strap around the top to determine their locations. The side elements (which were not all the same height) were positioned on small stacks of lead shims to achieve correct alignment. Once this was achieved, bespoke stainless-steel restraint fixings were fabricated ready for final fixing.

4.4 Individual slabs were raised up on crowbars and a coarse bedding mortar applied beneath, the same height as the lead stacks, but kept back from the front face. Once all four sides were bedded on mortar and in correct alignment, the fixings were secured into position with an external grade epoxy-resin. Securing the four sides to one another and each panel back to the supporting core firmed everything up, whilst the bedding mortar hardened. The top bed of the internal core was built to be higher than the top-bed of the side elements such that it bore the considerable weight of the capstone and not the thin side elements, which must have contributed to some of the fracturing witnessed in the thin panels.

4.5 On the upper north-west side panel, a large-ish corner section was missing. Indenting new stone would have compromised the appearance of the memorial, removed unnecessary stone and been relatively expensive. The decision was taken to attach stainless-steel mesh to the rear surface of the side panel to exclude wildlife. This was attached by drilling into the rear surface of the panel and securing the over-size mesh with stainless-steel screws and penny-washers into shallow rawlplugs.

4.6 The sections of the composite urn were easily disassembled as the historic, lime-rich bedding mortar was saturated and seriously weakened as a result. The corroding iron dowels which had split the urn-lid into three pieces had been drilled out previously, leaving wider diameter holes to be filled. Threaded stainless-steel dowelling 12mm diameter was cut slightly shorter than the holes in the stone. The vertical dowel was secured into the diminishing base at the top of the capstone at a right-angle to the top bed. Given the weight of all the upper urn sections, resin securing the first dowel was allowed to harden fully over the course of a weekend. Once the dowel was firm the urn and lid sections were applied with resin in the corresponding dowel-holes with a thin layer of bedding mortar to provide a solid bed joint and exclude rain-water

4.7 Once the whole memorial was built, vulnerable edges/laminations had coloured mortar support fillings (Lithomix®) inserted along their lengths to provide strength to previously tacked (with resin) edges. On several wider laminations liquid grout was also introduced by mortar-gun, to fill the voids where mortar could not be packed deep enough. Such a grout is merely a filler and does not re-bond delaminating surfaces but fills gaps between the surfaces such that these areas can't be easily crushed. No attempt was made to recreate missing mouldings or areas of missing stonework.

4.8 After the internal core and external elements had settled into their new positions, the resulting joint lines were pointed. Demarcation lines (clean/dirty lines on the edges of stonework) indicated there had been relatively fine joint-lines between elements. This was borne out by nearby memorials of a similar age. A gunnable pointing mortar was applied into the joints, the horizontal bed joints which were kept consistent on the lead shims. This gunnable material is based on NHL3.5 being initially much more fluid than conventional mortar before hardening and achieving the same relative strengths as a conventional mortar. Traditional mortar applied by even the smallest spatulas into such thin joints cannot get back as far into the gap and therefore makes for a weaker surface or 'dummy' joint in the long-term.

5 Conservation Works

Cleaning

5.1 Wooden modelling tools were used to remove loose mosses. Flat scrapers and scalpels were employed to remove loose mortar and soil debris from the break edges and mating surfaces of joined elements. Exposed elements of the memorial were not cleaned, save for the bottom two courses, which had been below ground level and were covered in mud. This took place as soon as this section was excavated, whilst the soil was damp and therefore easier to remove.

5.2 Pointing/Mortars

5.2.1 The material employed for pointing the fine joints was Masons Mortars - Fine Ashlar Pointing Mortar® and was applied using a mortar-gun with different size needles, depending on the thickness of the degraded stone arrisses. The thixotropic mortar was inserted, excess material struck off level with the adjacent stonework and mortar was pressed home, both processes with a spatula.

5.2.2 The more traditional, coarse mortar for the bottom two horizontal joints was in the ratio of 3 : 1 (aggregate to binder) with local Bromsgrove Sharp and Bromsgrove Building sand (2 : 1) with an NHL3.5 binder.

Maintenance Considerations

6.1 The memorial is in its original location judging by the location of the angled plinth. It now sits atop a wide re-enforced base of the right proportions for the footprint of the sub-base. It also sits immediately beneath the canopy of several overlying mature trees. The trees will be a ready source of nutrients for biological growths and as such the memorial will re-colonise or continue to colonise quickly. Whilst this may look visually appealing to most, there was little point in wholesale cleaning for the reason above, the mortars employed will suffer at a faster rate given the level of poly-saccharides within the algaes acting upon an alkali mortar surface from rain washing over the surfaces. For this reason the mortars should be monitored on a quinquennial basis at least, to ensure they are performing their architectural function of slowing-down, <u>not preventing</u> the ingress of moisture into the architectural elements.

6.2 It is also worth noting that the outer nosing or extremity of the capstone is much eroded and had suffered some isolated physical damage during dismantling and stacking of the stone elements. As such the capstone is not shedding rainwater away from elements below as designed to do and is actually directing rainwater onto the aged stone in some areas. This was witnessed during/after several heavy rain-showers. That said the memorial as a whole is in a much better state of preservation than it was - stacked badly on an uneven surface and its re-erection/conservation has ensured its long-term future.

6.3 Elliott Ryder Conservation will monitor the condition of the memorial (free of charge) after twelve months, as part of our on-going maintenance commitment, and report back to the Town Council with any findings.

The box-tomb elements stacked haphazardly on top of each other with several of the side panels having fractured as a result of point-loading from uneven weight distribution. Note the extent of soil and debris on the upper surfaces and fractures through the urn-lid clearly visible.

The bottom side panel with fractured elements safely removed. Note the remains of very thick white mortar (indicated) which formed a joint between the bottom bed of the inscription panel and top bed of the plinth which you can just see beneath ground level. This indicates an overly wide joint, due to structural instability. The right-hand image shows some of the elements leaning against a nearby wall, to be rain-washed over the winter and the capstone and urn moved away to one side, to enable erection of a lifting scaffold.

The top of the moulded plinth once all the side elements were removed. It was not apparent at this stage the presence of a rough (uneven) sub-base beneath that.

Carefully excavating the moulded plinth and sub-base, note the remains of an animal hole/tunnel at the bottom right-hand corner.

Three sides have been excavated to allow lifting slings to be wrapped around the west and east elevations, to give an even, albeit angled lift. The bottom bed of the angled corner (lowest in the ground) is very close to the internment beneath, so this area was not excavated further.

The sub-base and plinth before and during lifting/manoeuvring. Note the front of the sub-base which is in two pieces was secured with a ratchet-strap horizontally prior to lifting, to prevent either side moving during the lifting process. Note also the uneven thickness of the sub-base which would simply have been laid directly on the ground. This unevenness likely contributed to the instability of the 'whole'.

It was not safe to attach a ratchet-strap (as applied to the front) to the rear edge, lowest in the ground, before or during the lift, which had to be done quickly and smoothly. The mass had to be lifted at an angle before being lowered onto thick rollers onto the boarded platform and into a horizontal position, safer for re-lifting into its final position. The red 'I' beam with girder-trolley was used for smoothly manoeuvring the total mass horizontally, which weighed in excess of 850kg.

Once removed from the ground, both stone elements were lightly cleaned using low-pressure washing, accumulated soil being much easier to remove when still damp. The resulting void has been backfilled in multiple layers, with each layer tamped, to be as firm as possible. Clean hardcore (from the Woolacott tomb) can be seen, prior to a layer of clean, washed, finer aggregate (agreed in consultation with the DAC Archaeologist) before the timber shuttering and concrete was applied.

Terram® permeable membrane above the compacted soil and prior to the penultimate layer of clean, washed aggregate. Another layer was also applied at the base of the void after removal of the sub-base/plinth to act as a separation layer.

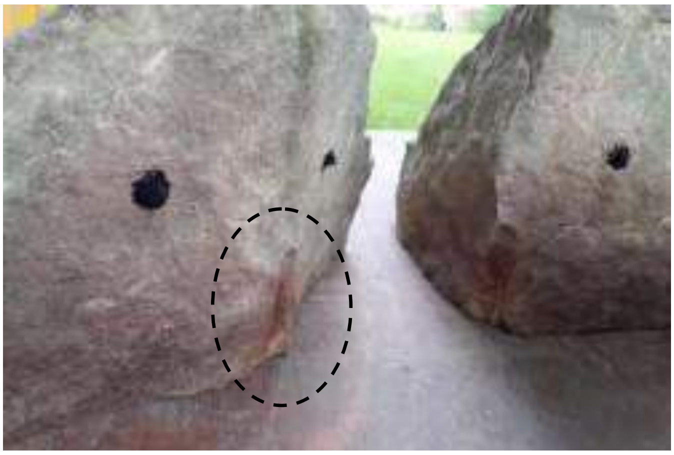
The compacted aggregate prior to application of the timber shuttering. Visqueen® DPM was placed on top of the aggregate within the timber former, to aid moisture retention of the concrete and therefore make workability longer/easier.

Timber shuttering in place with a tamped finish and smooth margins. Only the smooth margins will show, once the memorial is built.

The front inscription before and after re-joining broken sections. Resin was kept well-back from the front face so it was not visible and the effected joins look as 'natural' as possible. Note the loss of detail to both vertical, raised borders and the bottom right-hand corner, much of the carved upper surface has been lost from this very laminar stone type.

The front (viewer's left-hand side) and the rear (right-hand side) of the same panel showing the number of mechanical fixings to provide additional support in the side-to-side fractures. The slab was too thin to insert dowels in the centre, so 12 x 3mm stainless-steel flat-bar is inserted at right-angles across fractures, into cut channels and secured with epoxy-resin. The panel is upside down and stayed that way until re-building, so as not to stress the two horizontal joins unnecessarily, which could have failed given the overall weight/height of the slab.

The urn-lid which was fractured by the corroded, internal iron-dowel. Given the level of erosion to the arrisses and biological growths on the break-edges, this is judged to be a very old fracture.



Corresponding spots of paint indicating where stainless-steel dowels were to be inserted. Note the corresponding iron staining (indicated) where the expanded vertical iron-dowel has forced the stone apart.

Additional mechanical fixings set into the bottom bed of the stone. Mortar and other debris was removed from the mating surfaces, which enabled the previously poorly fitting sections to achieve a 'natural' fit once again, which will be better for excluding the ingress of moisture in the long-term. The ratchet-strap is to keep all elements tightly together whilst the resin is polymerising.

Slots being ground into the urn and afterwards with the flat-bar set-in with the now hard, external grade epoxy-resin.

Once the concrete padstone had reached compressive-strength, the sub-base and plinth were moved horizontally and lowered into position. Unfortunately whilst lowering the ‘whole’, the right-hand half of the sub-base fractured and detached from the moulded plinth, with only mortar between the two courses and no fixings.

Fortuitously the fracture allowed us to reduce the very uneven nature of the bottom bed, which had a keel like protrusion and would have produced an ugly, wide joint with the concrete pad.

Cutting the first layer of parallel slots along the length of the protrusion. These were pitched out with a chisel, so the repaired slab would sit much flatter against the concrete.

The broken slab had stainless-steel fixings secured with epoxy resin, spanning between the three sections to make it much more solid.

Three 12mm diameter, threaded stainless-steel dowels secured with epoxy-resin were employed to join the three sections as well as spots of resin on the mating break edges.

The newly joined section before bedding on mortar and slate packers. The whole perimeter was deep-tamped with mortar. Once this had hardened sufficiently liquid grout (based on NHL3.5) was introduced into the join from front to back, to provide additional support once hardened.

The expanded dowel spanning vertically between the capstone and the bottom bed of the It had split the thin base into four sections but luckily not disrupted the capstone. Note the actual size of the original dowel, which was secured with molten lead and the expanded size of the corroded metal (both indicated).

Drilling around the lead 'encased' iron-dowel to release it, which was completely ineffective and didn't prevent delamination of the ferrous metal. Note the route of the molten lead (indicated) introduced into an oversize vertical hole, but ineffective once excess moisture gets into the joint, when pointing fails. Original holes were re-used where appropriate, often needing to make them deeper, to accommodate longer stainless-steel dowels which will not corrode.

The repaired sub-base with preliminary pointing and grouting completed.

The bottom bed of the moulded plinth (to be applied) had been worked flat so a uniform coarse mortar bed was applied, to allow the endless slings to be removed without fouling the mortar. Note the blue chalk lines denote exactly where the plinth is to be placed.

The moulded plinth being lowered into position. The girder-trolley above, allowed exact placement of this heavy section, without need for adjustments when grounded and disrupting the mortar bed.

The internal core after completion and prior to fixing the side panels. All four panels were fixed 'dry' to achieve correct alignment as none of the panels were the same size each being of different heights. This discrepancy was rectified by introducing lead shims to achieve the correct height/alignment.

The corner of this block was missing, indenting new stone would have necessitated removing even more sound stone, therefore discreet stainless-steel mesh was secured on two elevations to prevent entry for birds or other mammals. The heavy fractured and repaired slabs were moved as little as possible to save the repaired joins from unnecessary stresses.

Three of the original corner fixings were re-used after enlarging the holes. The bottom right-hand corner was missing. The outer top light-weight blocks had vertical fixings securing them deep into the course below. All four panels were secured to the core to give far greater structural stability.

The joint between the capstone and front inscription panel. The areas of loss from the break edge were not filled as it would have been visually jarring. Coloured mortar within the void was angled such that rain on this surface would flow downwards and not into the core. The much eroded nosing of the overlying capstone is designed to shed water away from the four side panels, but does that far less effectively now given the levels of erosion and deterioration witnessed.

The different joints and mortars to the sub-base/moulded-plinth and inscription panel. The bottom two mortars are traditional, coarse, mortars the two joints above are a gunnable mortar for fine joints both with the same binder (NHL3.5) but in a different ratio with aggregate of a much finer particle size. A gunnable medium enables mortar to reach much further back into a joint. Note the thickness of the bottom joint, despite removing a lot of stone from a pointed ridge running back to front across the sub-base.

The capstone being lowered into position. Slate shims were required on the top-bed of the core to make it level, as the bottom-bed of the capstone was so uneven. The right-hand image shows mortar repairs (indicated) inserted into vulnerable areas previously tacked with epoxy-resin spots to prevent further damage/loss. Much of the original carved surface has been lost from this very laminar local sandstone.

The thin square-base beneath the urn split into four sections by the force of the previous corroded iron-fixing. Lead shims are incorporated to create a uniform joint which isn't often possible when bedding a heavy stone element on a small footprint of mortar. The repaired urn-lid which was split into three sections by the dowel spanning between the two upper elements. The resultant joints lines were filled to slow-down (not prevent) the ingress of moisture.


On the left, the dismantled box-tomb prior to any treatments. On the right, the extant elements moved to allow rain-washing and slow drying over the winter. Note the proximity of the mature over-hanging tree, which will contribute significantly to the colonisation of stone, mortars and concrete with biological growths which are not benign.


The re-built box-tomb on its new concrete pad. Note the eroded and physically damaged nosing (outer edge) of the capstone which casts biological rich water directly onto the moulded stone plinth beneath. Despite the architectural detailing and proximity of the over-hanging tree, the long-term integrity of this beautifully proportioned and decorated memorial is now assured.

Woolacott Memorial

1 Condition

1.1 The tomb-chest was in a chronic condition due largely to the poor quality of individual stone elements, poor stone selection and architectural detailing and the insidious long-term effect of ivy growing through the tombchest, left un-checked or maintained. The majority of the plinth blocks are edge-bedded (at right-angle to its natural sedimentary bedding-plane) and as a result have delaminated severely, which appears to be common for the local stone employed in fabrication of this memorial and many of the others reported on.

1.2 The majority of ivy growth and visible roots were removed from the tombchest before the winter of 2019. The newly revealed tombchest lid was covered in soil debris from leaf break-down over many years, which would have been difficult (and pointless) to remove. Over the course of the winter the surfaces were rain-washed to reveal the full extent of stone delamination in the Spring of 2020.

1.3 At the time of our tender and even after removal of ivy growth it was thought possible that the seriously delaminated lid might be conserved. It quickly became clear that the lid was beyond practicable/economic repair, given the levels of chronic disruption witnessed. This was conveyed immediately to the Project Manager and the decision was taken to seek comparable prices for replacement of the slab, in a similar stone type. This was duly done and the option considered most prudent was selected between ERC and Project Manager – Harriet Carty. A local stonemasonry firm - Mc Millan Masonry was selected as having provided the most sensible geological options as well as being the most competitive in terms of price.

1.4 The ivy was seen to have grown through vertical joints in the tombchest, forcing some of the corners out of alignment by nearly 100mm. The main roots/tendrils had exploited weaknesses in the delaminating stone slab and completely forced their way through a weak area to the west of the lid. Smaller tendrils had grown through horizontal bedding planes to such an extent that the stone would not have provided an effective lid/covering for the tomb-chest beneath and would have let water in through multiple repairs, requiring resin, fixings and mortar. The relatively poor-quality, local, laminar stone slab, was too thin and long to perform its architectural function in the long-term.

2 Dismantling

2.1 Once the decision was taken to replace the lid the memorial was dismantled. Even thought the tomb-chest was so out of original alignment, critical dimensions were recorded to give an indication of alignment for re-building. In reality the existing clean/dirty demarcations lines on edges were of far more use, as these indicated where the tomb chest had been assembled originally, long before it was so out of alignment.

2.2 The delaminated lid was removed in large sections and it quickly became apparent that even in a museum environment the lid would never have gone back together satisfactorily. The fragmented sections were smashed into smaller pieces and retained for use as hardcore in later concrete pads. Details of the moulding and external mitre were retained for Mc Millan Masonry to replicate.

2.3 Despite the extremely poor condition of the lid and plinth elements there was very little structural instability in the tombchest. With the plinth elements sitting largely flat and level in the ground upon solid flat, stone fragments. There was no point disrupting the compacted ground to install a new concrete pad, which is always a last resort. The ground level in the churchyard has risen upwards, slowly covering the plinth, due to the annual deposition of leaves and grass etc which create soil. The 'short-side' of the plinth on the west elevation (as opposed to the long sides) was level from side to side – front to back. As it was solid and level in both planes, the decision was taken to leave this as a datum and build the other removed elements (which required conservation) against this block.

2.4 Once the lid was removed it became clear why the tomb chest was so badly disrupted, being full with ivy roots and tendrils, some of which were up to 100mm/4" thick. The pernicious growths had forced apart the south-west and east corners causing uneven loading of the lid which had in turn been exploited by the ivy. The tomb chest was poorly constructed with only eight side elements supported at the opposing short sides with a pair of crude, angled, random-rubble supporting walls, or rather forcing the short sides outwards. As the iron cramps were so insubstantial they were easily displaced and therefore must have stopped performing their intended function fairly quickly.

2.5 The majority of extant sections of the much delaminated plinth were accounted for and smaller elements were moved inside the church to dry, before conservation treatments. The dismantled elements were dry-cleaned as far as possible during dismantling to stop the transfer of dirt into the building. The two long panels were too large and heavy to be stored in the church, so were stored safely outside, as were the three plinth blocks, such that they could be rain washed.

3 Ivy Removal & Treatment

3.1 During dismantling it was easier to remove the ivy roots from around the aged stonework, without disrupting the arises when it was a built structure. Much of the ivy growth within the tomb chest was historic and dead, however there were five main healthy roots with smaller satellite roots, much thinner in diameter than above ground level, which were cut off several inches above ground level. As it was not desirable to dig the roots out and disrupt the layers of compacted stone sub-base unnecessarily, frill girdles were cut around the protruding woody stems, that is scoring and peeling-back the fibrous outer root layer to reveal the inner stem.

3.2 A thick paste of Ammonium Sulphamate crystals mixed with de-ionised water was applied directly to the revealed inner stem. These areas were then covered with small plastic bags tied with string, so wild or domestic animals could not get to the toxic areas, plus it helps focus the efficacy of the herbicide on the root. This system will kill the root system below ground-level.

3.3 A one-ton dump-sack was half filled with roots and tendrils just from inside the tomb chest, such was the extent of current and historic growth.

4 Re-building

4.1 After the three plinth elements were re-joined, they were built against the short block that was not removed, incorporating new bespoke, stainless-steel 'dog-cramps' to restrain them to one another. After the epoxy-resin had cured, a ratchet strap was secured around the perimeter of the plinth to prevent any movement during the next process. A Visqueen® DPM and separation layer was applied inside the void created by the deep plinth blocks. Limecrete built up in layers but in a continuous phase, was then applied to fill the void to the same plane as the top-bed of the blocks. Water-proof protections were applied over this and it was allowed to harden sufficiently over a number of weeks. Given the thin internal diameter between the rear of the blocks there was no need for inclusion of steel re-enforcing mesh.

4.2 The use of a solid Limecrete sub-base was because the rear vertical surfaces of the plinth blocks were so uneven and the tombchest was to have an internal supporting core for the new, tomb-chest lid. A solid base the same height as the stone blocks allowed lightweight blocks to be built off that single plane and be wider than if built within the stone plinth, therefore giving greater stability and spreading the eventual imposed load over the stone plinth and Limecrete plane. The added benefit of a DPM membrane/separation layer within the plinth blocks was that any new ivy roots could not penetrate the thick plastic layer.

5 Conservation

5.1 Once again insubstantial iron fixings were found in the top bed of the plinth and tomb-chest courses. Many fixings had expanded or ivy growth had moved blocks so much, the turn-downs were not engaged and so providing no restraint/support. All corroded iron was removed, much of it fell out. All of the original fixing holes were widened/deepened to accommodate new more substantial stainless-steel fixings, which were made on-site as the majority of turn-downs (holes) were of different widths

5.2 The long-sides of the plinth in particular has suffered serious delamination, due to the laminar nature of the variable-quality building stone. The majority of fragments were recovered within the nearby grass, however numerous sections of the tomb chest, the south-east corner in particular were missing and not found, which detracted from the final overall appearance of the tomb chest.

5.3 The two opposing plinth blocks were equally as delaminated which also served to make their conservation a little easier. As many of the laminations were old, the break edges were not a natural fit and/or material was missing, necessitating mortar repairs. It was possible to rejoin fragments in layers and once resin had cured, stainless-steel dowels were secured into layers beneath the upper layer at a 45 degree angle, using a gunnable, liquid-resin, effectively hanging the layers beneath and making separation again impossible. These mechanical fixings would never be seen, hidden by the final layer of stone, instead of drilling through the front face, which is against conservation ethics – wilfully drilling/damaging an original upper surface.

5.4 Once the repaired sections were re-built, mortar support fillings were inserted into the sky faces to slow-down not prevent the ingress of moisture.

4 Re-building

4.1 Once the Limecrete within the tall plinth blocks was hard enough, a new supporting core of light-weight Celcon® blocks was built on top. This was built slightly higher than the eight tomb chest elements, such that the new core took the considerable weight of the new moulded stone slab evenly.

4.2 The use of Celcon Thin-bed® blocks with Celfix® mortar enables structures to be built and bear weight quicker than conventional blocks. Once the core had hardened over the course of a weekend, work began on rebuilding the tomb chest elements. The stone elements were bedded onto a building mortar with an NHL3.5 binder, mortar was kept back from the front faces as all joints were to be pointed after the lid had been installed in case there was any settlement from the final imposed load.

4.3 Existing fixings sockets at the mitres were deepened and widened to ensure more solid fixings. Several of the corner blocks displayed significant fractures in the top beds that had not yet delaminated. Rather than drilling through the front face to secure against possible movement in the future, slots cut at right-angles to the fracture were ground into the top beds and flat stainless-steel fixings were secured with epoxy-resin to prevent movement in the future. All slots/channels and holes de-dusted to ensure a solid bond with the resin employed.

4.4 The rear mitres and horizontal joins with the plinth were packed with the bedding mortar to provide additional support and filling.

4.5 Once the whole memorial was built, vulnerable edges/laminations had coloured mortar support fillings (Lithomix®) inserted along their lengths to provide strength to previously delaminated sections bonded with resin. On several wider laminations liquid grout was also introduced by mortar-gun prior to inserting support fillings. No attempt was made to recreate missing mouldings or areas of missing stonework.

4.6 When the new tomb chest lid was ready for delivery to site, it was installed onto the tomb chest core. A layer of bedding mortar was applied on the top bed of the tomb chest elements (but kept back from the front face) so there was something solid to point against later.

4.7 Once the new lid had been allowed to settle over the course of a weekend, the whole memorial was pointed with a gunnable liquid mortar. This material is also based on NHL3.5 being initially much more fluid than conventional mortar before hardening and achieving the same relative strengths/qualities as a conventional mortar. Traditional mortar applied by even the smallest spatulas into thin joints cannot get back as far into the gap and therefore makes for a weaker surface or 'dummy' joint in the long-term. With this monument as with all the others it is important to minimise (not prevent) the ingress of excess moisture.

4.8 After the internal core and external elements had settled into their new positions, the resulting joint lines were pointed. Demarcation lines (clean/dirty lines on the edges of stonework) indicated there had been relatively fine joint-lines between elements. This was borne out by nearby memorials of a similar age. A gunnable pointing mortar was applied into the joints, the horizontal bed joints which were kept consistent on the lead shims.

5 Conservation Works

Cleaning

5.1 The only cleaning that took place on this memorial was removing debris from break edges with soft bristle brushes and wet-cleaning break edges where there were algae, which would adversely affect the bond between stone surfaces with the resin employed.

5.2 Pointing/Mortars

5.2.1 The material employed for pointing the fine joints was Masons Mortars - Fine Ashlar Pointing Mortar® and was applied using a mortar-gun with different size needles, depending on the thickness of the degraded stone arrisses. The thixotropic mortar was inserted, excess material struck off level with the adjacent stonework and mortar was pressed home, both processes with a spatula.

5.2.2 The more traditional, coarse mortar for bedding the plinth, tomb chest elements and lid was in the ratio of 3 : 1 (aggregate to binder) with local Bromsgrove Sharp and Bromsgrove Building sand (2 : 1) with an NHL3.5 binder.

6 Maintenance Considerations

6.1 Grass grows directly against the plinth as the level of the churchyard has risen over the decades and is a source of nutrients for the biological growths witnessed over the lower elements. Whilst such levels of colonisation may look visually appealing to most, giving the memorial an achieved patina of age, the mortars employed will suffer at a faster rate given the level of poly-saccharides within the algaes acting upon an alkali mortar surface from rain washing over the surfaces. For this reason the mortars should be monitored on a quinquennial basis at least, to ensure they are performing their architectural function of slowing-down, not preventing the ingress of moisture into the architectural elements.

6.2 The new tomb chest lid will perform its architectural function (that is shedding rainwater away from the elements beneath) much more effectively than the previously eroded slab, which in turn will ensure the long-term integrity of the whole.

6.3 Elliott Ryder Conservation will monitor the condition of the memorial (free of charge) and the appearance of any ivy near the plinth after twelve months, as part of our on-going maintenance commitment, and report back to the PCC with any findings.

A general view of the memorial before any treatments. Note thankfully none of the neighbouring memorials are afflicted in the same way with the insidious effects of ivy growth.

The much de-laminated upper surface of the tomb chest lid, which the ivy stems had exploited, puncturing through the weakened sandstone in the area indicated. Growths can clearly be seen issuing from the horizontal and vertical joints.

The tomb chest after being rain-washed clean over the course of a winter. Despite the level of disruption witnessed, the memorial plinth blocks are still largely level, which was a factor in determining not to dismantle the sub-base, which is always a last resort.

During removal of ivy growths, which couldn't be removed properly until the tomb chest was dismantled fully. Note the extent of soil debris on the top-bed of the slab from the breakdown of ivy-leaves over many years.

The ivy tendrils had exploited the laminations of this weak laminar stone, growing along bedding planes and forcing layers apart.

The ivy roots had forced apart many large, heavy sections but kept this dog-cramp (double turn-down) in place, by growth around it. The thick stems had forced these large stone blocks apart horizontally.

The extent of the stem expansion, compromising the load-bearing capacity of the tomb chest itself. The right-hand image highlights the weak, laminar nature of this local building stone, when looking at the moulded corner detail of the slab. Note no attempt was made to clean the memorial with the yellow, green and white lichens providing a visually pleasing patina of age.

On the left, the south-west corner block having been forced off, on the right, vertical fractures through one of the plinth blocks. The ivy had grown the same width as the joint before widening back out within the tomb chest.

The maze of ivy growths within the tomb chest, once the lid was removed in sections. Much of the growth was dead but some was still healthy. Note the new green leaves in the foreground, even after removing the majority of the growth on top of the lid.

Having cut back much of the growths where possible. The stems were within the supporting sections of walling and would have to be removed once these sections were dismantled. Once the lid was removed several of the smaller side elements became unstable, as all the fixings had failed, which required the use of a ratchet strap to keep other sections in place.

The rear of the west elevation and the random nature of the initially supporting core. Once the fixings are compromised it creates instability, with an angled mass leaning against the short panels. Built with thick mortar, both cores had absorbed and retained moisture from the compromised, much wider open joints, with easy access for rainwater and all its associated problems.

The extent of delamination in the plinth block, which has obviously been an historic problem judging by the extent of established plant growths within the laminations. The stone is edge bedded, that is rotated 90 degrees from its original sedimentary bedding plane, with weather better able to exploit the weak laminar stone.

The smaller, carved corner blocks which join the short and long sides together. Note the three right-hand blocks and how severely delaminated they are, with the middle of the three having lost all carved detail.

The east elevation after removal of the short panel, highlighting the extensive roots within the core structure and the small mass of roots within the joint between the north long panel and where the corner block was (indicated). The chamfered plinth (short) block in the foreground is in its natural bedding plane and is in a much better state of preservation as a result, bedding planes constantly in compression therefore unable to be exploited.

All of the side panels removed leaving the angled 'supporting' core and ivy stems, which appear to have grown out of the corners, most likely the points of least resistance. The front plane of the long (south) plinth block, should be behind the outer edge of the short blocks (indicated) but has delaminated/moved to such an extent.

The extent of aged ivy roots at the south-east corner, showing some small healthy leaves, indicating the plant stem was alive.

The plant stems removed as far as possible before removing three of the four plinth blocks. The opposite (north) plinth block showing an equal amount of disruption, with an inherent delamination about to be exploited (indicated).

The extant sections were wet-cleaned and allowed to dry before being re-joined. The white accretion on the surfaces is efflorescence from soluble salts, caused by soil and organic materials.

Especially because of the presence of efflorescence, spots of epoxy-resin are employed rather than a continuous layer of resin, to re-bond the delaminated layers. Spots allow the movement of moisture and with it soluble salts around and without disrupting the external-grade resin. A layer of resin effectively creates a vapour-barrier and efflorescence on a microscopic level would exert considerable pressure, eventually forcing off such a layer.

A hole about to be drilled at a 45 degree angle. The drill has to start vertically before lowering and continuing at the correct angle. The angled stainless-steel fixing secured with a gunnable resin is to effectively hang the delaminated layers, such that they can't delaminate even if the resin failed.

A pair of fixing entry points on both long plinth blocks, before re-fixing the thin outer layers. There is no point drilling through a thin outer layer and drilling into a front surface is against conservation ethics, causing avoidable damage to any object.

The completed front of one of the long plinth blocks showing the thin delaminated outer section adhered to the substrate again. The darker (lower) demarcation line shows where the plinth is now below ground level, with the level of the churchyard rising over the decades.

The rear of one of the 'short' tomb chest panels, using the same system of spots, not a continuous layer. Note the rough 'punched finish' that is a surface left from a punch chisel, which has a blunt point. All 'finished' surfaces start like this moving through to the claw and flat chisels, to give a smooth surface. The carving process imparts significant shock into the stone surface, creating micro-fissures below the surface, which are exploited by weathering over the decades. This is a more significant problem on a poor-quality building stone such as this.

During the dismantling process, note how little gap there is between the long panels. In the right-hand image, tied plastic bags (indicated) can be seen on frill-girdles cut into the ivy stems. This was treated with a toxic, Potassium Sulphamate paste which will kill the roots system below ground level. The compacted stone base did not require lifting/dismantling, which was wider than the outer footprint.

In the left image, Limecrete (concreting aggregates with a lime-binder instead of cement) was used to fill the void within the plinth. A thick plastic, Visqueen® (DPM) was used as a separation layer so as not to saturate the plinth blocks, given the amount of water required in the Limecrete mix. The right image shows the first course of the supporting internal core, which spanned across the stone plinth and Limecrete base. Note also the conserved 'long' plinth blocks set back in their intended planes.

Building of the core in progress, using Celfix® mortar to create tight, uniform joints. The completed core in the right image. The top-bed of the core was built too high for the tomb chest elements (intentionally) and 'dragged' back to give the correct height and uniform joint between the tomb chest and new lid.

Fixing of the new Woodkirk - Sandstone (Building Quality as opposed to Monumental Quality) being slid into position. The small amount of bedding mortar on the top-bed of the plinth is to give something solid against which the gunnable pointing mortar can be forced against, thus ensuring a solid joint from back to front, which is not achievable when just pointing from the front face using a traditional, coarse mortar. There was no need to secure the tomb chest panels back to the core as the fixings between themselves were so solid. The original lid appeared to have been completely flat, shallow angled 'weatherings' were incorporated into the new slab to shed rainwater more effectively and prevent water pooling on the surface.

The tomb chest elements during fixing with bespoke stainless-steel dog-cramps, which were fabricated next to the memorial. All existing sockets were re-used after deepening and widening, and secured into position with an external-grade epoxy-resin, not mortar, which was the case previously.

Coloured support fillings were inserted into vulnerable areas to help shed rain-water. The mortar was selected as being the same colour as the substrate and not the aged surfaces covered with algae's and lichens. Fills were not applied to re-create missing detail or over colonised surfaces. Bigger fillings serve to draw attention and the stone is stronger than the mortar, by design.

The new joint between the plinth and the tomb chest elements from a gunnable mortar. The direction of the bedding plane can clearly be seen in the different elements (indicated). The clean/dirty demarcation on the plinth is where the plinth has been covered with soil by the rising ground-level.

The tomb chest before any treatments, highlighting the extent of well-established ivy growth, which disguises the extent of structural damage to the memorial.

After removal of the surface growths, with stems still growing through the joints. Note the upward plane of the tomb chest lid in the foreground and the horizontal fracture through the slab as a result.

The tomb chest after all treatments, note the colour of the lid is because the stone is bone-dry, having been under-cover for many weeks. The three small, square, stone samples on the lid of the memorial in the background, is the true colour of the lid, with the samples having been outside for weeks.

Another view of the tomb chest prior to any treatments. Ivy is well-established and a memorial enjoying a Grade 2 listing for so long, should not have been allowed to reach such a perilous condition.

The majority of the ivy growths removed and the lid having been left to be rain-washed over the course of a winter. The full extent of disruption and de-lamination, now apparent over the whole tomb chest lid.

Another angle of the conserved/re-built tomb chest, with the new lid now able to properly shed rainwater away from the aged, side panels beneath. The over-hang is minimal (the same proportions as the original) and could have been even wider in both planes to fully protect the tomb chest. The lid was a like-for-like replacement.

The African's Grave 1801

1 Condition

1.1 The gravestone offered a rather unkempt appearance. Its close proximity to the trunk of a nearby Yew tree contributing significantly to the levels of algae witnessed and lichen to a lesser extent.

1.2 The gravestone underwent detailed conservation to make the surfaces more legible for digital scanning and ensure its future integrity. The digital scan undertaken by Scan to Plan ensures the condition of the object is preserved in time and a facsimile could be created at a future date, if needs be.

1.3 The slab is beautifully designed/carved with florid detailing and tooled edges in the same rather poor-quality, local stone, which is a very laminar sandstone - that is bedding planes are easily exploited by weathering even in a relatively sheltered churchyard location, judging by nearby gravestones of a similar age.

1.4 The slab is face-bedded, which is not unusual in a good-quality freestone which this particular slab is not. The carved surface gave cause for concern when tapped as it sounded as if the stone had delaminated behind the front carved face. Despite the weakly bonded bedding planes, the stone takes a very good edge evidenced by the well-executed low-relief foliate carving at the top of the slab. The lettering and flourishes to the second and fourth lines of the inscription also lay testament to this anomaly. It is worth remembering the carving process imparts a high degree of localised shock into the stone, which creates micro-fissures, which are subsequently exploited by weathering over many decades/centuries from wetting/drying – freeze/thaw cycles.

2 Conservation

Cleaning

2.1 The carved surfaces were assessed with a finger-tip survey to ensure it was up to even gentle cleaning, which it was. This is the only memorial that had above ground surfaces cleaned, as it was to be digitally scanned after conservation. The level of image-capture is so great, the surface accretions would disguise much of that detail so it was important to clean the slab first, so able record as much detail as possible.

2.2 All surfaces were pre-wetted with tap-water applied by hand-spray, before a compress of paper-towelling was dampened using a weak (5% v/v) solution of Synperonic A7 surfactant in de-ionised water, applied by brush. The dampened paper holds the active ingredient at the surface. This material is mildly antiseptic and intended to make removal of the algae easier without disrupting the lichens, which it did successfully. The compress was rolled back horizontally and pre-softened dirt and biological growths were agitated and reduced with soft stencil brushes. A two bucket system was employed so as not to re-distribute the biological rich/dirty water, with paper towelling used to remove dirty water from the surface.

2.3 Once cleaned, the gravestone was allowed to dry before proceeding further.

3 Grouting

3.1 A missing blister gave access above the hollow sounding area on the carved face. The likely void was irrigated with clean water applied by syringe to allow greater penetration of the subsequent liquid grout. A fine liquid-grout compatible with the host stone was introduced with a low-pressure gun. This had limited penetration after two cycles indicating that the hollow sounding delamination was not as bad as first feared. Even tapping the surface and using a flexible spatula within the blister did not encourage the grout to penetrate further. At this point grouting stopped.

3.2 The material employed for grouting was Masons Mortars - Limited Flow Grout® applied using a mortar-gun with small-diameter needle.

3.3 Several days after grouting when it had hardened sufficiently, a coloured repair mortar was pack into and around the circumference of the blister to prevent the further loss of surface material. The same mortar was also applied to the edge of the scalloped margin and the tooled or 'batted' edge on the viewer's left-hand side. The mortar was applied discreetly to slow-down the ingress of moisture into the laminations and not replicate missing carved detail. The blister itself was filled to the same plane as the inscription and textured to mimic the adjacent degraded surface.

4 Maintenance / Protections

4.1 Given the location of the slab beneath a mature over-hanging tree and splash-back from the ground, the stone will always be colonised by algae. A masonry specific biocide Wykabor Microtech (advocated by Historic England) was applied to the carved surface only, wet-on-wet until refusal. This will slow-down not stop the inevitable re-colonisation and make the dedication and low-relief carving more legible, which it was not before conservation. The carving of which was largely obscured by well-established algaes and mould.

4.2 A temporary cover had been applied to afford protection during winter months. This well-meaning shelter was of poor-quality using inappropriate materials and had direct contact with the stone, which it shouldn't. Subsequently a new winter cover was made from hardwood with guidance from ERC. This was applied over the graveslab at the beginning of winter and I'm sure will be very effective in keeping the worst of winter weather from impacting the aged surfaces over the coming years.

4.3 Considerable work was done to clear the area around the footprint of the memorial of wrong plants in the wrong place, before we could start work. The memorial is likely to be overwhelmed by such growths again if an annual maintenance plan is not put in place. This is important not just because of the considerable amount of money having been expended in their conservation, but to ensure the long-term stability of the memorial. More pernicious weeds such as bramble and ivy should be removed at the end of the growing season. Caring for Gods Acre offer a very useful information pack about seasonal growth and when best to tackle it. Ground Elder is less of a problem as is far less invasive for the memorials and this area of the churchyard is covered with it, making piecemeal, localised removal rather pointless.

4.4 Elliott Ryder Conservation will monitor the condition of this memorial (free of charge) after twelve months, as part of our on-going maintenance commitment, and report back to the PCC with any findings.

The over-exposed grave-slab before any treatments. This front surface is completely colonised with bright-green algae, with a small amount of light-grey lichen at the top. Bird guano was visible down the centre of this face. Note how the extent of finely carved, low-relief detail is lost visually on the semi-circular head.

The front elevation after cleaning. Disfiguring biological growths were pre-softened with paper-towelling compresses and a weak surfactant solution, before being reduced with soft bristle-brushes and changing clean-water. This is the most gentle form of wet-cleaning and could not be taken any further, as particles of stone were observed in the beakers. Cleaning stopped after two cycles of this method.

The rear surface of the graveslab seen from the adjacent path and grassed area. You have to stand beneath the tree to see the dedication and carved detail. Note the greater levels of white/grey lichens, due to greater in-direct light-levels. This surface is protected somewhat from direct sun-light, due to numerous mature trees in the foreground, but must receive weaker sunlight earlier in the morning.

The warm colour and carved detail at the head of the slab, much more apparent after cleaning. More tenacious green alage at the intersection with the ground could not be removed further due to disaggregation of the stone in this area. This deterioration is not serious enough to warrant consolidation yet, which would be problematic, as the object cannot be isolated from moisture. Removing it from the ground for treatment would present ethical conservation issues.

Detail of the quality of setting-out/lettering and the only blister on the carved surface. A large area around it (above and below) sounded hollow when tapped, caused by delamination of the now face-bedded slab.   A fine, free-flowing liquid grout was injected behind the pre-wetted substrate in two cycles and surprisingly little was absorbed, indicating the lamination is not as bad as first thought.

Once the grout had settled and hardened a coloured repair-mortar was carefully packed into and around the diameter of the blister with a small spatula, before building up from the substrate to the upper carved-surface. The void was over-filled, left for several hours to go leather-hard then pared back with a busk, to give the desired final texture. The mortar is designed to be softer than the host stone.

The north side of the slab before and after treatment, the stone is spalling not delaminating, as it at 90 degrees to the bedding-plane partly as a result of the force/shock required to produce the tooled or 'batted' surface on the edge of the slab. The darker area on the now exposed substrate is an inherent ferrous mineral, which is another point of weakness and reason for localised failure. Coloured repair mortar was packed up into the vulnerable edge as far as possible.

The Chestnut (hard-wood) protective covering, which is designed to shed rain-water, is clear of the stone inside and well-ventilated. All factors that will ensure the long-term preservation of this important Grade 2 listed memorial.

Thomas Memorial 1846

1 Condition

1.1 This box tomb is another interesting design and situated in free space. The ground is rising to cover the plinth which is now largely obscured by grasses.

1.2 There is a tall, mature tree in close proximity to the north-east of the memorial, which affords a degree of protection from weather in that direction.

1.3 There are some nice design details which are now largely obscured visually, given the level of biological growths over the surfaces. The ornate, low-relief frieze beneath the capstone in particular is all but lost. Foliate decoration to the lower half of the colonettes is now difficult to make out.

1.4 De-lamination of the sandstone is concentrated on the flat-panels of the box-tomb and the lower half of the ball-finial. The ball finial in particular required rationalisation to remove loose flaking stone beyond practicable repair.

1.5 The projection of the moulding above the frieze isn't huge but does seem to be performing its architectural purpose in shedding water away from underlying elements, as they are in a relatively sound state of preservation. It is the bottom bed upwards on the four flat, side-panels that have suffered most from delamination. This is most likely to be caused by water pooling on the fairly deep skyface of the plinth and wicking back into the panels by capillary action.

2 Dismantling – Re-joining

2.1 The memorial is level, with joints uniform and parallel. There were no signs of jacking or iron-staining from internal fixings, therefore there was no need to dismantle this monument and it could be treated in-situ.

2.2 The ball-final has been re-fixed badly in the past and is now at a jaunty angle. Although the cementicious repair would now be deemed inappropriate material, the crude and ugly repair to the diminishing urn-neck showing no signs of breakdown, or splitting and is colonised with well-established lichens and algae, indicating it is an old repair.

2.3 Cementicious mortar has been smeared over the stone beneath and is well-bonded. Its removal, no matter how careful would pull off weaker, underlying stone, causing avoidable damage and it is for that reason, with no evidence of structural breakdown that the decision was taken to leave the urn for the future.

2.4 Removing cementicious mortar would damage the underlying stone unacceptably let alone the harm in removing the likely iron dowel, which was significantly lengthy in another nearby urn/ball-finial fixing arrangement. This would create issues as to what material(s) should be used for a replacement and what extent of repair/replacement would be reasonable, all of which incur costs outside this project.

3 Conservation

3.1 The stonework of the four side panels and the lower half of the ball-finial was rationalised. Degraded, loosely bonded substrate was removed with the aid of a spatula until back to sound stone. Degraded stone near carved stone or upper surface was removed carefully, so as not to jeopardise original surface material.

3.2 The previous Autumn, several sections of worked upper-surface were observed to be actively loose/springing, due to delaminating. These had been tacked along their open edges with epoxy-resin to prevent them moving. It is almost impossible to grout upwards, especially with a liquid, free-flowing grout. You can drill a series of holes at different sized centres above a filled fracture, but this would have meant drilling into carved/lettered stone which were not prepared to do. It was felt the previously springing edges were now sufficiently well-held by the epoxy resin and strong enough to pack mortar in as far as possible from the deformed, open lamination. Support fillings were mostly underlying (sound material above) so were kept as discreet as possible visually, so as not visually intrusive.

4 Cleaning

4.1 No cleaning took place on this memorial, rationalising defective stone removed the majority of colonised material which would have an adverse effect on the bond of the repair mortars.

5 Pointing Mortars / Grout

5.1 Masons Mortars - coloured Repair Mortar was used for support fillings.

5.2 The existing mortar is a fine very-fat, lime-rich mix, which with current-thinking would be considered incompatible with sandstone, but is preserved fairly-well, largely because of such fine joints, with less opportunity for lime-rich water to impact neighbouring, poor-quality sandstone.

6 Maintenance Considerations

6.1 This area appears to be scythed fairly regularly by a volunteer group during the growing season. Scything cannot get as close to stonework by its very nature, but strimming against the stone plinth should be discouraged as the cumulative abrasion of this process will accelerate deterioration to the stone in these areas.

6.2 Elliott Ryder Conservation will monitor the condition of this memorial and the urn-neck in particular after twelve months (free of charge) as part of our on-going maintenance commitment, and report back to the PCC with any findings.

The Thomas memorial in the centre of the image, with a protective tree in the background, to the north-east. Note the extent of grass growth around the memorial with the moulded plinth all but obscured.

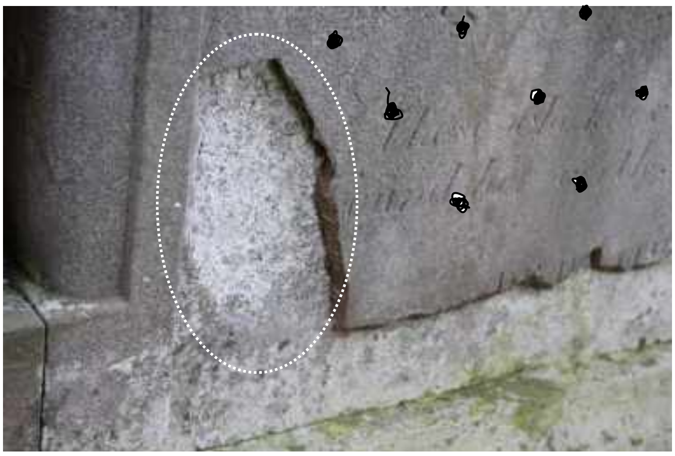
The ball-finial with crude cementicious repair around its diminishing neck. The ball is carved in one piece, which is made more difficult given the raised fluting around the centre, requiring the use of two reverse templates instead of one. Perhaps unsurprising the ball is so deteriorated given the amount of chiselling required for the numerous, decreasing chamfers, to create the curve – semi-spheres.

A detail of the crude repair to the neck. It is so big and clumsy, most likely to replace missing detail and create a sound base/stooling for the stone-ball which is significantly weighty. Note how the cementicious mortar (more alkaline than the sandstone) has colonised with the same lichens, indicating it is an old repair. As the repair was sound, the decision was taken to leave it unmolested.


The north elevation of the Thomas memorial before and after all treatments. Delaminated stone along the bottom bed of the box-tomb was rationalised back to sound substrate, with support fillings inserted along the length of the previously tacked edges. Note the poor angle of the ball-finial. Low-relief, foliate-decoration to the frieze (indicated) beneath the capstone is all but lost visually.


The west elevation of the Thomas memorial before and after all treatments. Delaminated stone along the bottom bed of this elevation was also rationalised back to sound substrate, with support fillings inserted along the length of the previously tacked edges. Carved detail to the frieze is a little easier to determine on this elevation.

Extensive rationalisation was undertaken to the ball-final which had delaminated significantly, given the poor-quality sandstone and amount of carving and therefore shock imparted into the weak, laminar material. Perhaps surprising that the fluting within the horizontal band isn't more disrupted, given the work involved in its execution. Note the large support filling packed into the previously tacked laminations. Mortar colour is selected as the colour of the host stone/substrate and <u>not</u> the colonised surfaces.



The lamination at the base of the inscription was tacked with resin previously and therefore was strong enough to pack repair mortar in, as far as possible. Grouting uphill is all but impossible so was discounted. Grouting could only be successfully achieved by filling the lamination and drilling into the carved surface at centres (indicated) to create a series of needle entry-points. This risks shattering the brittle, weakened layer and compromising the historic dedication, both of which are against conservation ethics.

Support filling in progress, with mortar being packed into the previously open lamination. The upper carved, inscribed surface has deformed/curled outwards somewhat. Note the amount of material that has been lost, back to the revealed substrate. The white zone (indicated above) is efflorescence (soluble-salt crystals) of which exerts pressure on weak laminations when moving in and out of solution – re-crystallising, exploiting weak laminations or poor-quality stone.

Medlicott Memorial 1838

1 Condition

1.1 This box tomb is an interesting design and is largely unseen, situated under the canopy of a large mature-tree and nearly overgrown by vigorous perennial plants at the time of work. The ground appears to be subsuming the moulded plinth which now looks out of proportion, with annual leaf and plant debris decaying down to soil, over the course of many decades.

1.2 Despite its position under and tree canopy and the tree roots beneath or around the likely internment below ground-level. There are no real signs of heave/subsidence or misalignment in the memorial, the joints of which are exceptionally fine, almost stone-to-stone, indicating high-quality workmanship of the memorial and it being constructed well.

1.3 The same local stone as employed for the majority of headstones and memorials in the churchyard has been used again and has suffered more than most on this memorial. The four box panels in particular display what can only be considered as chronic delamination and scaling of the revealed substrate. The four colonettes have also suffered badly in random, isolated areas and now also display serious delamination on a round surface. It is not clear if these colonettes have been turned on a lathe or have been cut by-hand using chisels, with a rubbed finish. Even experienced, modern stone-lathe operators, have a high failure rate on good quality stone, which this is not.

1.4 The stone of the box panels was so delaminated much of it required rationalisation that is to remove loose, exposed sub-surface material which is well-beyond practical repair. Carved detail and original upper surfaces were retained as far as possible. If this was a museum object it would be dismantled and deep-consolidated to restore physical cohesion back in the weakened, aged stone, which is obviously not an option in this instance.

1.5 The design of the memorial is such that it should easily shed rain-water away from underlying element by means of the relatively steeply pitched, four-sided lid and thick nosing, which is well-forward of the box panels. It is curious as to how and why this stonework has suffered to the extent it has.

1.6 Straightforward annual maintenance from unskilled volunteers would prevent this memorial from being obscured for much of the year by vigorous perennial plant growths.

2 Dismantling – Re-joining

2.1 The memorial was level and joints uniform and parallel, therefore there was no need to dismantle this monument and it could be treated in-situ.

2.2 The only area that was loose was the north-west corner colonette, which spun freely on the plinth-stooling (base) with the dowel in the top-bed long since deteriorated, due to the pointing having been lost and the ingress of moisture initiating the deterioration processes for the iron.

2.3 All opposing surfaces were removed of dead-metal and degraded mortar. The bottom bed had three small lead shims to give the correct height and even joints in the top and bottom beds, with bedding mortar between. As the colonettes are largely decorative and not functional, weight-bearing elements, the decision was taken not to incorporate a new stainless-steel dowel, which is difficult to achieve with an already fixed capstone. You have to drill a hole long enough into the capstone to receive the full length of the replacement dowel. It is difficult to get a dowel (tied with string) into the lower dowel-hole, filled with adhesive. Far easier to use lead shims on top of one another with the top shim folded in half, which is then gently beaten in, until the joint is firm from the tight lead joints, which is what we did. The top and bottom joints were then filled with a fluid, gunnable pointing mortar, which fills the thin joints as far as possible from back to front.

3 Conservation

3.1 The stonework of the four side panels mainly, but also including isolated areas of the colonettes was rationalised. Degraded, loosely bonded substrate was removed with the aid of a spatula until back to sound stone, to a depth of 5 – 10mm in places. Degraded stone near carved stone or upper surface was carefully removed so as not to lose original surface material.

3.2 The previous Autumn, several sections of worked upper-surface were observed to be actively loose/springing, due to delaminating. These had been tacked along their open edges with epoxy-resin to prevent them moving. None of the laminations under repair were big enough to necessitate grouting. Support fillings were inserted to direct rain-water down and away and prevent pooling.

4 Cleaning

4.1 No cleaning took place on this memorial, rationalising defective stone removed the majority of colonised material which would have an adverse effect on the bond of the repair mortar.

5 Pointing Mortars / Grout

5.1 Masons Mortars - Fine Ashlar Pointing Mortar® was used for pointing all joints on this memorial being applied using a mortar-gun with different diameter needles, depending on the thickness of the degraded stone arrisses/access points,. The fluid gunnable mortar was inserted from back to front, excess material struck off level with adjacent undulating stonework and mortar pressed home.

5.2 The existing mortar is a fine very-fat, lime-rich mix, which with current-thinking would be considered incompatible with sandstone, but is preserved fairly-well, largely because of such fine joints, with less opportunity for lime-rich water to impact neighbouring, poor-quality sandstone.

6 Maintenance Considerations

6.1 Work was done by us to reduce the amount of perennial growth around the memorial, which was understandably significant.

This could be done by volunteers prior to the growing season, such that the memorial is not lost visually and plants do not keep the stonework unnecessarily damp or actually touch the stonework. Again, conditions in this area of the churchyard in particular are perfect for alages in which to thrive – that being tree-cover and therefore limited direct-sunlight or UVA wavelength light in particular, elevated moisture levels (rain) damp-conditions and a ready source of nutrients, outlined previously.

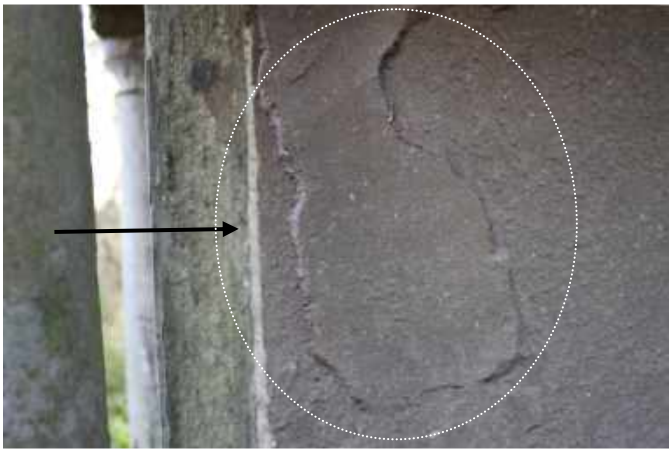
6.2 Elliott Ryder Conservation will monitor the condition of this memorial (free of charge) and the appearance of any ivy near the plinth after twelve months, as part of our on-going maintenance commitment, and report back to the PCC with any findings.

The east elevation of the Medlicott memorial before any treatments, highlighting the extent of perennial weeds and their proximity to the aged stonework. The memorial is also over-hung by a mature Yew tree. Both the weeds and tree keep ambient moisture levels high and provide a ready source of nutrients for the biological growths witnessed.

The memorial after weeds had been removed, to give unfettered access to all four sides. Note how the memorial appears to be out of proportion with the moulded-base now partially obscured, due to ground-level having risen significantly over the decades - from soil created by decomposing broad-leaf weeds and Yew needles. The ‘short’ box-panel on this elevation has been re-pointed the same colour as the remains of very-fine, failed joints.

The fat-lime-rich mortar visible in the horizontal joint between the ‘short’ side-panel and capstone above. The joints are so fine on this memorial, indicating good-quality workmanship during its manufacture/erection and latterly, lack of movement in the structure, which has a relatively small footprint and obviously has well-established tree roots beneath it, as well as the likely internment below ground-level.

The south-west corner in the foreground. Note how the capstone (steeply angled on four elevations) is doing a good job of shedding nutrient-rich rainwater away from the colonettes and box-tomb beneath, which all appear drier after removal of significant weeds adjacent to it. The skyfaces of the capstone all display significant lichen growths, most notably the very tenacious white/grey genus.



New vertical pointing between the long and short box-tomb panels (indicated). The island of original upper surface (indicated) has had coloured support fillings inserted into its perimeter, to minimise the risk of further loss of material. The adjacent substrate has been rationalised, that is loose, flaking stone beyond practicable repair removed. Flaking stone (not delaminating) harbours water more readily with all the attendant erosion problems, leading to accelerated deterioration.

The colonettes displayed random areas of deep material loss, due to delamination. Loose stone was rationalised and support fillings packed into vulnerable edges that had been tacked with resin previously. It was not clear if the colonettes were turned on an early lathe or cut with chisels and finished by hand.

Drew Memorial 1821

1 Condition

1.1 The tomb-chest gives a rather sad, neglected appearance, especially with its much broken wrought-iron railings and was almost completely covered in ivy growth. Luckily this hadn't penetrated the tomb chest or grown up through it, to be determined at a later date.

1.2 The majority of extensive ivy and bramble growths were removed from the tombchest before the winter of 2019. The corroding iron railings leaning against it were also re-positioned away from the aged stone work. This was to allow easier, safe access and to remove all plant-forms as much as anything.

1.3 Once revealed, the tomb chest lid (which is naturally bedded) displayed numerous fractures, with the stone having 'sprung' in several areas - that is surfaces have fractured/moved along inherent geological weaknesses and not returned to their previous natural position. This attributed to the ingress of moisture along laminar weaknesses and repeated wetting/drying – freezing/thawing cycles over many decades.

1.4 An inspection under low x10 magnification on break edges of this stone and other conserved memorials, shows there does not appear to be a visible clay component in this local stone type, which often contributes to such dramatic movement/delamination, caused by clay plates swelling and shrinking from repeated wetting and drying over many years. Only thin-section geological analysis would determine if, and what type of clay is present. This is beyond the scope of this project, but the local stone that has been used for the majority of memorials for this project appears to be of poor and variable quality. It is a natural material after-all and would have been the cheapest most readily available material for local memorial makers.

1.5 This memorial was in one of the worst conditions of all under consideration because it has been so neglected, again a situation that should not happen on a memorial befitting Grade 2 listing status. Straightforward annual maintenance from unskilled volunteers would prevent this memorial from deteriorating more rapidly.

2 Dismantling – Re-joining

2.1 Given the extent of laminar disruption witnessed at both ends of the double-pitched tomb chest lid, it was decided prudent not to dismantle it completely for fear of avoidable damage. This was conveyed to the Project Manager after partial dismantling of the east elevation and the problems encountered and the combined decision taken not to dismantle the whole lid, which was considerable in terms of scale/weight and the likelihood of damage during the process, was real. There were no signs of jacking from other corroding fixings, manifested by upward movement/misalignment or dovetailed not parallel joints.

2.2 During partial dismantling, the iron fixing exposed on the north-east corner, was found to be in a sound, albeit lightly-corroded condition. The mortar used to secure the fixing was now dust and the fixing sound, with modern type depths of turn-down (much deeper than others subsequently dismantled) for the fixing.

2.3 Removal of loose fractured lid elements at the east elevation, gave visual access to the inside of the tomb chest with the aid of a strong light. The tomb chest interior was free of any significant plant growths and luckily those that were visible were at the east end and easily removed. This was surprising given the extent of bramble, ivy and ground elder around the footprint of the memorial.

2.4 The already loose sections of the lid were gently eased apart without further damage to adjacent break edges. The mating surfaces were wet cleaned to remove biological growths and soil debris (indicating a prolonged fault or fissure) which could have disrupted the bond with the resin to be employed. All cleaned surfaces were allowed to dry thoroughly before re-joining.

2.5 After the stone sections were dry, the dismantled elements were offered up 'dry' to see where best to apply resin. Fortunately most of the fragments overlapped creating a strong bond with the aid of the external-grade epoxy-resin.

2.6 Despite going together naturally and using thin 'mating' layers of epoxy-resin, the stones had sprung and did not go back together perfectly, but as well as possible. The next day once the resin was observed to have fully cured on the tile, a fluid liquid grout was introduced into areas where stone had not re-united fully or there was missing material. It was important to fill these areas with a relatively weak, inert, hydraulic-lime based grout, to exclude rainwater and all its attendant problems. The grout which was applied under low-pressure using a mortar gun was left to settle and re-filled until the liquid material was below the surface.

3 Re-building

3.1 The small amount of re-building that took place employed a coarse bedding mortar beneath the sections of dismantled lid, where in contact with the tomb chest elements beneath. The surface joint was then pointed using a gunnable mortar.

4 Conservation

4.1 As the existing iron dog-cramps were in such a good condition they were re-used. Firstly they were gently abraded with a high-speed (rotary) steel-mop to remove loose corrosion, they were then painted with two coats of Jenolite®, which contains Orthophosphoric acid. This was allowed to dry over-night before two brush applications of a 10% w/v solution of Paraloid B72 (acrylic-resin) in Acetone : Industrial Methylated Spirits 50 : 50 was applied to protect the corrosion inhibitor. Once the final protective resin-coating had dried, the cramps were secured in the previous holes and slots with epoxy-resin, which was allowed to cure overnight.

4.2 The previous Autumn, several large sections of original worked upper-surface were observed to be actively loose/springing, due to delaminating. These had been tacked along their open edges with an epoxy-resin to prevent them moving and the loss of large sections of stone. These areas had surface-filling medium packed in as far as possible in several sections. After each vertical section had hardened they were grouted with the free-flowing liquid grout, which filled the void behind each lamination. The grout cannot re-bond delaminated surfaces but is merely an inert filler, which prevents stone from being crushed at the surface if there is free-space behind. Once the grout had hardened, more support filling was applied vertically until the laminations where filled with grout and support filling along the exposed edge. On the top horizontal edge these were finished to direct rain-water away and prevent pooling.

4.3 Cleaning

4.3.1 The only cleaning that took place on this memorial was to the dismantled lid sections to ensure a good a bond as possible between the resin and the stone. The presence of biological growths otherwise makes for a far weaker chemical bond between the different materials.

4.4 Pointing Mortars / Grout

4.4.1 The materials employed for grouting and pointing the fine joints were both from Masons Mortars - Limited Flow Grout® and Fine Ashlar Pointing Mortar® both applied using a mortar-gun with different diameter needles, depending on the thickness of the degraded stone arrisses/access points. The liquid grout was applied and allowed to settle, before topping-up, staying well-back from the vulnerable edges, then thixotropic mortar was inserted, excess material struck off level with the adjacent stonework and mortar pressed home, both pointing processes with a spatula.

4.2.2 The more traditional, coarse mortar for bedding the lid sections was in the ratio of 3 : 1 (aggregate to binder) with local Bromsgrove Sharp and Bromsgrove Building sand (2 : 1) with an NHL3.5 binder.

4.2.3 Once the grout had hardened, coloured mortars (the same colour as the substrate not the colour of aged stone colonised with biological growths) were inserted to fill the joint lines and deter the ingress of moisture. Mortars were applied/angled to prevent water from pooling in the repairs.

5 Maintenance Considerations

5.1 Work was done by us to reduce the amount of overhanging Yew tree which would have directly impacted the re-built Toldervey box-tomb and was also directly above the Drew memorial. A memorial beneath any sort of tree will suffer more from biological growths due to the constant source of nutrients provided by the tree during and after rain and this memorial will always be bright-green as a result. Conditions in this area of the churchyard in particular are perfect for alages in which to thrive – that being tree-cover and therefore limited direct-sunlight or UVA wavelength light in particular, elevated moisture levels (rain) damp-conditions and a ready source of nutrients, outlined previously.

5.2 Considerable work was done to clear the area around the footprint of the memorial of wrong plants in the wrong place, before we could start work. The memorial is likely to be overwhelmed by such growths again if an annual maintenance plan is not put in place. This is important not just because of the considerable amount of money having been expended in their conservation, but to ensure the long-term stability of the memorial. More pernicious weeds such as bramble and ivy should be removed at the end of the growing season. Caring for Gods Acre offer a very useful information pack about seasonal growth and when best to tackle it. Ground Elder is less of a problem as is far less invasive for the memorials and this area of the churchyard is covered with it, making piecemeal, localised removal rather pointless.

5.3 Elliott Ryder Conservation will monitor the condition of this memorial (free of charge) and the appearance of any ivy near the plinth after twelve months, as part of our on-going maintenance commitment, and report back to the PCC with any findings.

The Drew memorial before any treatments, note the broken and corroding wrought-iron railings resting against the stonework. Ivy was attached to the rear of the tomb chest and the railing had to be cut free to gain free access to the ivy. The ivy and bramble growths were removed in the Autumn of 2019 as well as emergency consolidation to vulnerable areas of delaminating stone.

The east elevation, note the lamination in the lid, which was not caused by corroding fixings, which were in a sound condition. The lamination was caused by inherent weakness in the stone lid being exploited by weathering over a prolonged period.

The lamination in the foreground (indicated) is where the stone has 'sprung' or deformed and is not attributable to ivy stems (of which there were none) or expanding iron fixings.

The amount of perennial plant growth that greeted us after cutting ivy and bramble growth back hard, to ground level not six months previously. Many of the plants are touching the stonework. Out of the shot above, is an over-hanging mature Yew tree, both plants and tree are a ready source of nutrients for biological growths visible over the whole memorial.

Vertical and horizontal fractures to the lid, the most significant of which follow bedding planes within the stone block. There is a shallow double-pitch to the lid meaning a lot of stone has been removed by chisel – punch, claw and flat chisels. The carving process of 'wasting' or removing stone will have imparted a significant amount of shock into the weak, poor-quality local material. Note how much of the outer moulding/nosing is now lost, despite searching in nearby undergrowth.

From the east elevation, the apex of the lid is more obvious. It is no coincidence that the east-end has been worked (chiselled) in two planes where the large section of stone is now detached.

Emergency consolidation was carried-out by us in 2019 to the section of carved surface which was springing. Spots of resin were inserted along its length, to bond it back to the substrate and prevent un-wanted movement. Small sections had repair mortar packed in as far as possible, and then liquid grout was introduced to fill the void horizontally. This process was repeated until the void was filled vertically from the bottom to top of the lamination.

Iron fixings were found to be in a sound condition on the north-east and south-east corners. They were removed (easily) and abraded with a steel polishing-mop, then treated with coats of corrosion inhibitor (on the left). Once dry this was protected by two applications of a water-clear acrylic-resin (on the right). Once the coating was dry the fixings were secured into position with an epoxy-resin.

This section was loose, largely due to easy access for moisture, which exploits such laminations by repeated wetting/drying – freeze/thaw cycles. Soil debris has penetrated deep into the lamination indicating a long-standing problem for the weak building stone.

The delaminated sections were poorly bonded and therefore easily removed. All break-edges were wet-cleaned with clean water and stiff nylon bristle (nail) brushes to remove as much organic material as possible. Fragments were protected and allowed to dry thoroughly before re-bonding the extant sections.

The removed fragment shows how random the delamination is in this weak material, following the bedding plane and not the worked surfaces.

Luckily the laminations were overlapping, which makes for a much stronger long-term bond, as overlying fragments lock into place, with the aid of an external-grade resin. The hole in the bottom bed of the lid allowed sight into the core, which was largely free from plant growth and objects of any archaeological interest.

The different fragments were marked up dry and re-instated in reverse sequence to their removal. The two dog-cramps in the tomb chest beneath are just about to be secured with epoxy-resin. Note the true colour of the stone (indicated) in the parallel break edges, being a pinky-grey, not green, which is from almost complete algae colonisation.

The last section of the lid about to be applied. Note the missing lower left-hand corner does not allow the lid to perform its architectural function in this area, and has been directing rainwater into the fluted corner and the adjacent section of previously loose upper surface.

The final section about to be adhered. Again spots of resin allow the movement of moisture, which is inevitable. Despite the sections going back as well as possible there were still resultant gaps, as the breaks were old and the laminar stone had sprung.

Once the resin had cured, joint lines were packed with repair mortar in small sections and allowed to harden, grout was then injected into the top of the repairs, this process was repeated until the voids were filled. This process slows-down (not prevents) the ingress of moisture, with the hard grout (liquid mortar) filling the small gaps at depth, such that rain-water cannot penetrate and freeze. The repairs were applied to prevent water pooling on their surface.

The tomb chest after all treatments. Note the kerb-set, which is the same material as the memorial and is much delaminated due to being poor-quality stone edge-bedded and expanding, corroding wrought-iron within it. Loose sections of railing had previously been removed and placed carefully within the remaining railings.

The amount of perennial growth that can occur in one growing season. This should be kept back and away from the conserved memorial. If this area has to be strimmed, it should not be against the stonework, which is vulnerable to physical damage.

The undecorated north elevation of the tombchest covered with white/grey lichens which are particularly tenacious and difficult to remove, if you wanted to do so.

The more protected south elevation which displays the beautifully carved inscription on the viewer's left-hand panel, between the fluted colonettes. This side displays few lichens, as on the opposite elevation, but a well-established bright-green alage. This elevation was completely covered with thick ivy and bramble within the railings, keeping the little daylight available from the surface.

Thomas Memorial 1792

1 Condition

1.1 Although the ground around the box-tomb rises up slightly and it is located in amongst mature trees, the base/plinth is largely level, with joints lines still tight and parallel. This is despite the main fixings securing the box having all but disintegrated, determined upon its dismantling.

1.2 The carved, diminishing neck had fractured and is long-since gone, the capstone had fractured into 4 pieces and the moulded entablature has collapsed in on itself. Damage to the urn-neck and capstone largely attributable to the corroding (expanding) iron of the long vertical dowel spanning between the elliptical finial and the capstone. We searched in nearby undergrowth for extant fragments but could find nothing. The relevant break-edges were well weathered indicating this was an historic fracture.

1.3 When the upper elements were removed for repair, the extent of jacking or movement in the corners became apparent with the 4 corner fixings extremely delaminated and now much thinner than they were originally, as the corroded material was virtually lost.

2 Partial Dismantling

2.1 A lifting scaffold was erected above the box-tomb to enable the heavy component sections to be removed safely down to ground level for treatment, but also make precise placement of heavy sections much easier during re-building. The ball-finial, capstone and entablature had the remains of cramps removed and were lowered down and away from the working-area. This was done with the aid of Lewis-pins, which negates the need for lifting slings, meaning items can be lowered precisely into position onto a bed of mortar, without the need to remove slings and disrupting mortar. This operation required a single 20mm diameter hole to be drilled into the centre of each block. All blocks were assessed visually and 'rung' with a chisel (rather like a tuning-fork) beforehand, to ensure there were no inherent geological faults which could be exploited during lifting, such as pulling apart weak laminar layers.

2.2 The compromised sections were removed to reveal the top-bed of the box-tomb, with several of the fixings completely delaminated, doing nothing. Prior to dismantling, a ratchet strap was placed around the box panels to prevent any unwanted movement, which is just as well as after un-weighting the box, it became clear none of the fixings were effective.

2.3 All 'dead-metal' was removed from sockets, many of which were free of securing mortar. The lengthy iron dowel which had caused such problems on the urn-neck and capstone was cut at ground-level to make it less unwieldy and the metal still in the stone (one side of which had been set-in/encased in molten-lead) was drilled out, by drilling a series of holes around the perimeter of the expanded iron and lead. The length of iron into the elliptical finial was minimal, owing to the original hole having likely been 'drilled' with a star-shaped 'jumper' chisel, turned small increments after each hammer strike. The drill-hole was made longer, to allow for deeper embedment of the new stainless-steel fixing.

2.4 Several old wasp nests were noted within the now empty joints, allowing easy access for insects.

3 Conservation

3.1 Insubstantial iron fixings were found in the top bed of the tall, side panels. With substantial dowels between the capstone and the urn. These had expanded despite being secured in position with molten lead originally. All corroded metal and lead was removed, much of it fell out or was easily removed.

3.2 Mating surfaces of stonework layers were dry-brushed to remove loose mortar and metal, but no surfaces required wet-cleaning.

3.3 The north (rear) panel had de-laminated badly, inside the box. Stainless-steel flat bar was cut to a suitable length and set at right-angles to the laminations and secured with epoxy-resin to strengthen the fractures further. The resin within all joined surfaces and support fixings was allowed to polymerise fully before being handled/manoeuvred further.

3.4 The capstone was too heavy to risk joining at ground level and then hoisting, even with mechanical fixings spanning the break. So opposing holes were drilled at ground level and the two main sections joined with a pair of stainless-steel dowels plus spots of resin in the mating surfaces, when on top of the moulded entablature. This join was secured with a ratchet-strap around its perimeter whilst the resin cured over-night.

4 Re-building

4.1 There was no supporting core inside the box-tomb, and as the memorial only required partial dismantling, as the four side panels were suitably thick and with new solid fixings, a supporting core was not required.

4.2 The two entablature sections were raised into position and wedged vertically in the centre joint, so the top-bed was flat and level again, where it had previously been forced-up at the corners, creating a large gap at the centre of the top-bed and causing point-loading on the north and south panels beneath. Lead shims (of differing stack heights) were incorporated around the top bed of the four panels to provide additional uniform support before the joint line was pointed and the mortar hardened to provide all round uniform bearing. A new pair of stainless-steel dog cramps were set-in with epoxy resin, which means the blocks can’t fall inwards again, even if the lead and mortar wasn’t there.

4.3 The fractured capstone was joined on a pair of timber battens which enabled the pre-drilled sections to be slid together and bonded with a pair of horizontal threaded, stainless-steel dowels, secured with epoxy resin. This was secured with a ratchet strap to prevent movement during curing of the resin, which occurred overnight, before applying mortar beneath the bottom-bed and manoeuvring the now solid block down into position using a pair of crow-bars on each elevation.

4.4 At the same time as above, 12mm diameter threaded, stainless-steel dowelling was secured plumb into the bottom-bed of the elliptical urn, this was allowed to cure before handling. Once hard, the urn complete with protruding dowel (cut to the correct length) was raised-up and lowered into position on the capstone. It was left the same height as the urn was before dismantling with the corroding metal, despite having a gap due to the missing stone urn-neck. No attempt was made to recreate missing areas of lost stonework.

4.5 Once the whole memorial was built, vulnerable edges/laminations had coloured mortar support fillings (Lithomix®) inserted along their lengths to provide strength to previously tacked (with resin) edges.

4.6 After the re-built elements had settled into their new positions, the resulting joint lines were pointed. A gunnable pointing mortar was applied into the joints, the horizontal bed joints which were kept consistent on the lead shims. This gunnable material is based on NHL3.5 being initially much more fluid before hardening and achieving the same relative strengths as a conventional mortar. Traditional mortar applied by even the smallest spatulas into such thin joints cannot get back as far into the gap and therefore makes for a weaker surface or 'dummy' joint in the long-term.

5 Conservation Works

Pointing/Mortars

5.1 The material employed for pointing the fine joints was Masons Mortars - Fine Ashlar Pointing Mortar® and was applied using a mortar-gun with different size needles, depending on the thickness of the degraded stone arrisses. The thixotropic mortar was inserted, excess material struck off level with the adjacent stonework and mortar was pressed home, both processes with a spatula.

5.2 The more traditional, coarse mortar for the bottom two bed-joints was in the ratio of 3 : 1 (aggregate to binder) with local Bromsgrove Sharp and Bromsgrove Building sand (2 : 1) with an NHL3.5 binder.

6 Maintenance Considerations

6.1 The memorial sits immediately beneath the canopy of several mature trees. Such trees are a ready source of nutrients for biological growths and as such the memorial will continue to colonise. Whilst such accretions may look appealing to most, the mortars employed will suffer at a faster rate given the level of poly-saccharides within the algaes, acting upon an alkali mortar surface from rain-washing over the surfaces. For this reason the mortars should be monitored on a quinquennial basis at least, to ensure they are performing their architectural function of slowing-down, <u>not preventing</u> the ingress of moisture into the architectural elements. The use of Marine–grade 316 stainless-steel fixings throughout, means the fixings cannot corrode as that grade of steel is for use in saline environments, over-specified but what Historic England (and other conservation bodies) insist on when re-building historic buildings and monuments.

6.2 Elliott Ryder Conservation will monitor the condition of the memorial (free of charge) after twelve months, as part of our on-going maintenance commitment, and report back to the PCC with any findings.

The memorial to William Thomas before (left) and after treatments. Outwardly there appears to be very little difference, however before treatment the memorial could have been pushed-over with a concerted effort, given its top-heavy design and failure of corroded iron-fixings. Note the greater level of colonisation with black biological growths to the ovoid ball-finial between July and December. No cleaning took place on this object.

The rear, north elevation before (left) and after all treatments. Note how the moulded entablature (indicated) shows a dovetailed, vertical, central-joint, due to failed fixings - causing point-loading on the 'short' box panels beneath, at the front and back. That situation was significant on this elevation, contributing to the inside of the panel delaminating in half and being substantially weaker as a result. The resultant joints lines have all been pointed from back to front, with a fluid, gunnable mortar.

The capstone having been fractured into 2 larger sections with a thin slither, also fractured on the north fall of the block. Iron staining is visible in/on the vertical dowel-hole, with delaminated dead-metal collected at the bottom of the hole. The capstone is naturally bedded (as it should be) note the horizontal lamination (indicated) which had to be taken into account when manoeuvring the sections down and back up.

It was easier to separate the compromised sections at ground-level as well as making lifting easier. Note the section of missing neck, which was forced off at an earlier date. On the right, the underside of the expanded dowel which split the capstone. Expanding iron can exert huge forces on a strong albeit natural material.

The missing section of the stone neck before dismantling. On the right, the new threaded stainless-steel dowel, secured plumb into a now deeper hole in the ball-finial with epoxy-resin. Drilling-out the corroded dowel from the ball was difficult as it had been set in with lead and there very little room between the edge of the lead and the small diameter of the carved stiff-leaf detail.

One of the heavy entablature sections being lowered down with the aid of the Lewis-pins. This made things much easier when re-building, as the heavy units could be lowered exactly into position without having to remove thick slings. On the right, one of the seriously expanded corner cramps, which had caused delamination of the already thin 'short' side-panel. The remains of several wasp nests were discovered in the by now wide joints, not in the box-tomb itself.

A ‘punched’ surface on the central joint between the two blocks. The tooling is to provide a better key for mortar, when the two blocks are butted against each other. The orange ratchet strap was necessary to prevent the 4 side panels moving once they were un-weighted as all the fixings had failed.

A birds-eye view inside the box-tomb. Note the north and south ‘short’ panels are much thinner than the thicker ‘long-sides’. The lamination is in the north panel, caused by face-bedding, expanding cramp in a laminar stone and point-loading from the overlying entablature blocks.

One of the corner cramps which initially had expanded, significantly - causing upward movement in the heavy entablature (jacking) and is now a thin delaminated fixing with only one, fairly useless turn-down, the other having disintegrated. The new stainless-steel cramp in the foreground. Note the laminations in the thicker stone panel follow the carved surface, with the slab being face-bedded.

The top-bed of the entablature after removal of the capstone. Note the amount of debris in there, which is introduced by water, from defective/empty joints due to lack of maintenance.

After brushing to removed defective bedding mortar and debris. The two fixings have failed, allowing the joint to collapse in on itself. It would have been better to include slate in the joint so they couldn't rotate, causing the point-loading they did, in the 'short' box-panels.

The turn-downs were filled with lime mortar, which is a soft material anyway but didn't stand a chance once excess water had got in and was allowed to sit there, due to defective pointing. The fixings were simply lifted out with a chisel. The central joint was stone to stone and it shouldn't be. We used new stainless-steel cramps secured with epoxy-resin and lead shims in the central joint, so the blocks can't move again.

Drilling out the remains of the expanded iron-fixing from the urn-base. The right-hand image highlights the extent to which iron expands and it was lucky not to fracture this much smaller block. Great care is taken when drilling around expanded metal to remove it. A third of the way around the perimeter is usually enough to free such fixings.

The re-built memorial after all remedial treatments. The new stainless-steel dowel was cut to give the same gap between the broken sections, as was the case before dismantling.

The south elevation of the memorial after all treatments and re-building has taken place. The fracture in the capstone was a natural fit and went back together tightly. Note the green colonisation already in a matter of months, on the new vertical joint in the entablature.

On the left, a three-quarter view of the south-west corner, looking like nothing has happened, except all the horizontal joints are now parallel and you couldn't push it over. On the right, the north-east corner shows the nearly white, new mortar (the same colour as the original mortar) is already colonised and doesn't stand out, due to the location of the memorial beneath trees and that it wasn't cleaned.

Memorial to John Home 1797

1 Condition

1.1 This memorial despite probably being older in manufacture than its stylistically similar neighbours and being directly affect by the nearby tree, retains its bedding mortar beneath the capstone and joints in the box-tomb are intact with very-fine, surviving, fat-lime joints. The box displays no structural movement in itself with no dove-tailed joints, but it is at a precarious looking angle, entering the ground at the north-west corner at a greater rate than others. In spite of its perhaps alarming appearance, it is currently in good condition structurally, which is why it did not require partial dismantling, with such an intervention always a last resort.

1.2 The side panels of the box-tomb are all face-bedded and have suffered as a result. Each elevation displays a shallow sunken-panel which will have received additional tooling (and therefore percussive shock) to make the sinking flat, being lower than the plain borders.

1.3 The lower sections of the panels have suffered from delamination to a greater extent as this is a damp-zone, with water wicking up from ground-level, migrating upwards due to capillarity, taking with it minerals and soluble-salts in solution. These have crystallised at the surfaces, exploiting laminations in the face-bedded stone, leading to the chronic levels of delamination witnessed. This will be become worse if the angle of collapse continues and the damp-zone moves upwards.

1.4 The stone of the box-tomb in particular is very red in colour compared to the other two memorials, despite this it displays virtually the same decay mechanisms and is performing or rather aging/deteriorating in a similar manner to the others. As a rule of thumb, the redder the (sedimentary) stone, the greater the ferrous mineral component, which effectively corrodes on a micro-scopic scale, leading to disaggregation – textural-breakdown and accelerated decay as witnessed.

1.5 This memorial is situated closer to the mature Yew tree than the other two. Not only has the churchyard grown upwards to virtually cover the moulded plinth, but the angle of sinking at the north-west corner means even more of the memorial is beneath ground level. Work was done in the winter of 2019 to remove lower branches that were physically touching the urn, which should be done as a matter of course annually. Further reduction was required during scaffold erection to remove branches close to the urn. Both phases were done sensitively, with branches cut back neatly to a joint.

1.6 Red berries from the Yew tree were observed over the top-bed of this and the other two memorials to a lesser extent. The fructose in such decomposing berries are a perfect nutrient source for biological growths, which must be considered chronic on the skyface of this memorial. The level of growths visible would now be difficult to remove without fairly harsh cleaning techniques, but there is little point doing that.

1.7 The composite urn on this memorial had suffered differently to that of its neighbours, with branches physically touching the upper elements of the urn-lid, which were found to be off-set and actively loose on top of the draped-urn section as a result.

1.8 The diminishing fluted urn-base beneath the draped section had fractured in two, due to the expanding internal, iron-dowel. Luckily the delicately proportioned diminishing neck was intact (which could act as template in the future for the crudely repaired neighbour) despite a heavily expanded dowel passing through it and on downwards, beyond the bottom-bed of the capstone such was the length of the dowel.

1.9 On this urn we had no option but to remove the corroding iron-work as it was likely to have fractured the supporting neck in the near future as there was free moisture access, this would have destabilised the heavy overlying composite urn and likely fallen to the ground because of the angle of the box-tomb.

1.10 There was no access point for horizontal sawing to cut-through the dowel horizontally. The horizontal joints on this urn were easily broken despite them being almost stone to stone, luckily they were bedded on what appeared to be either a fat-lime or casting plaster, such was the ease of their separation. This was achieved by inserting 3 broad, flat-scrapers around the perimeter of the joints and tapping in succession, like plugs & feathers. This process popped the joints without any damage to the stonework. Luckily there were no internal iron fixings in the upper urn elements, which would have made this process much more difficult.

2 Dismantling

2.1 A lifting scaffold had been erected above the three box-tombs in a row, to enable safe removal and subsequent replacement of 2 of the 3 capstones. This was boarded temporarily at capstone level to enable safe working.

2.2 Dismantling the urn was all done by hand, as the component elements were just manageable in terms of weight and did not require lifting equipment.

2.3 Despite the alarming fractures on two faces though the diminishing lower-urn, a core-bit was required to release the stone from the dowel which had corroded to fill the original drill-hole. Great care was taken drilling around and down through the corroded dowel in the urn-neck for fear of shattering it, which we didn't. The core bit used above was too wide for the neck as it would have weakened it at its smallest diameter. The dowel it turned out had a combined length of nearly 60cm before we cut it. It extended beyond the bottom bed of the capstone, which made inserting resin at depth challenging.

2.4 The fractured lower section had the break edges wet-cleaned with nail-brushes and clean water and was allowed to dry inside the church over the course of a weekend. It was a tight natural fit and bonded together using Akepox 5010 an external grade epoxy-resin without aggregate extenders, which enables very thin layers to be made. When this was fully cured after 24 hours a pair of parallel holes were drilled of suitable depth and channel cut with a Dremel between the holes. A pair of 6mm diameter stainless-steel dog-cramps were fabricated and set into the slots so the fixings and resin were below the top plane of the stone. This ensured the fracture was bonded as well as possible, as it bears a large amount of combined weight.

2.5 The thin break-edges were filled with a coloured mortar filling (Lithomix) to minimise the ingress of water, even though it is an external-grade resin.

3 Conservation

3.1 The vulnerable delaminating edges of actively springing stone had been tacked along their length with spots of epoxy-resin during the winter of 2019 which had worked well in arresting delamination and further unnecessary loss of material.

3.2 Vulnerable edges/laminations on the box-tomb panels and the urn components had coloured mortar support fillings (Lithomix®) inserted along their lengths to provide strength to previously tacked (with resin) edges. On several wider laminations and blisters, liquid grout was also introduced by mortar-gun, to fill the voids where mortar could not be packed deep enough. Such a grout is merely a filler and does not re-bond delaminating surfaces but fills gaps between the surfaces such that these areas can't be easily crushed. No attempt was made to recreate missing mouldings or areas of missing stonework.

4 Urn Re-assembly

4.1 The drill hole through to the capstone was packed with tin-foil at depth and a two-part, epoxy anchor-grout poured in. A pre-cut length of threaded stainless-steel dowel was secured into the correct depth and the material allowed to cure overnight. Its position was fixed using a bolt and washer to ensure it was at 90 degrees to the top-bed of the neck and the urn would be in the correct (albeit angled) alignment, with no point-loading.

4.2 The next day the composite urn was built on top of the now secure stainless-steel fixing. The urn was bedded on lead shims, to create access for anyone in the future that needs to saw through the dowel without damaging the stonework.

4.3 The next day the urn-lid sections which had been removed for safety, were re-bedded into position, using the fine pointing-mortar, as the previous joints had been so fine. The upper sections were applied to the lower and mortar squeezed out from the joints to ensure a uniform, consistent bed/outer joint. These were manageable by hand.

5 Conservation Works

Cleaning

5.1 No cleaning took place on this memorial as many of the surfaces were simply not up to even the gentlest cleaning.

5.2 Pointing/Mortars

5.2.1 The material employed for pointing the horizontal and vertical joints was Masons Mortars - Fine Ashlar Pointing Mortar® and was applied using a mortar-gun with different size needles, depending on the thickness of the degraded stone arrisses. The thixotropic mortar was inserted, excess material struck off level with the adjacent stonework and mortar was pressed home, both processes with a spatula.

6 Maintenance Considerations

6.1 The stone of the side-panels in particular have suffered from extensive delamination and surface scaling/flaking. The substrate was rationalised hard previously by us to remove loose, degraded substrate beyond practicable repair, prior to emergency consolidation in the form of tacking with spots of resin. Much of the weakened flaking stone that retained moisture has been removed. The decay mechanisms present are progressive, due to the local conditions and the stone being poor-quality to start with, very little can be done to slow it down, without isolating it from its surroundings. If it were a museum object, it would have been completely dismantled, then dried and delaminating side panels deep-consolidated, to restore physical cohesion.

6.2 This is obviously not practical or economically viable on such a degraded churchyard memorial and we have slowed down the previous rates of deterioration as far as possible, short of over-wintering the memorial and applying soft, breathable protections to it over winter months, which again is perhaps not practical.

6.3 There are no excuses for branches to be physically damaging a listed memorial (for what appeared to be a prolonged period) it was quite obvious and nothing had been done to mitigate this. It is basic maintenance. With an English Heritage listing comes certain safeguards for such memorials, to ensure their long-term integrity and this had been ignored by their custodians.

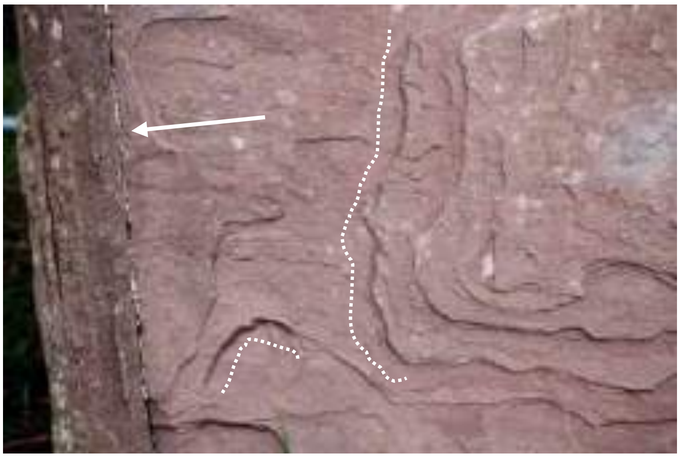
6.4 We (ERC) appreciate a once in a generation funding opportunity has slowed down the previous rate of deterioration, however a monument listed by English Heritage over 40 years ago should not have been allowed to reach such a perilous condition and could have been flagged-up requiring work sooner by an Inspecting Church Architect or local interest group.

6.5 Elliott Ryder Conservation will monitor the condition of the memorial (free of charge) after twelve months, as part of our on-going maintenance commitment, and report back to the PCC with any findings.

The memorial before any treatments, note on the left the branches are actually touching the upper sections of the urn. This shouldn't have been happening to a listed memorial. The left image highlights the angle of subsidence, whilst the right shows the amount of the moulded plinth that is now below ground level.

After our initial removal of over-hanging branches, showing the now off-set positioning of the upper urn sections, which were loose and could have been dislodged/damaged during high winds, with the tree moving enough. Despite the perhaps alarming stance of the memorial, the joints are parallel and tight with no signs of separation. The bed joint beneath the capstone was in a relatively sound condition.

The three strikingly similar box-tombs next to one another. Note how vividly red the sandstone panels are to the Home memorial. All three memorials have been completed in this image.



Classic contour scaling/delamination on one of the elevations to the memorial. The panels were all rationalised to remove loose, de-laminating areas of substrate (not upper carved surface) beyond practicable repair. Getting back to sound stone, but delamination is progressive. Note coloured support fillings applied into vulnerable edges (some indicated). And the fine, vertical, white, fat-lime joint between the adjacent 'long' panel.

Three of the coloured Lithomix repair mortars used for support fillings, to slow-down the ingress of moisture into areas of weakness.

On the left, the urn prior to dismantling, note the lid above the swag or draped layer is loose and could have been dislodged in high winds, causing damage to these carved elements. On the right, the top-bed of the diminishing lower-urn during removal of the expanded iron-dowel. The existing fracture, both sides were full of organic debris and insects.

On the left, after removal of the fractured lower section, see how the delaminating iron-dowel had expanded into the available space before forcing the stone apart, exerting huge pressure to split the block. On the right, the repaired lower urn section with new, threaded stainless-steel dowel issuing from the top. The drill-hole between the steel (which cannot corrode) was filled with a pourable anchor grout used in civil engineering.

Support fillings being inserted/packed into laminating areas. The stone was so delaminated it was difficult to know where to stop. The area indicated was grouted because it can cause more damage trying to pack in repair mortar to deep voids. The corner on this memorial has suffered particularly badly as corners are points of greatest evaporation, taking harmful minerals and soluble-salts in and out of solution.

The laminations are pre-damped with water applied by brush, such that the dry stone doesn't pull the moisture from the repair mortar, which makes for a weaker eventual repair.

After application of the support fillings, which have to be particularly discreet visually so as not to distract from the carved decoration/dedication. This upper carved stone containing the historical information is of utmost importance culturally, but treated in the same way as the delaminating substrate.

The diminishing base to the urn after being re-joined and before the new cramps are secured into position, to strengthen the bond further.

Coloured support fillings were inserted into vulnerable delaminating areas to slow down the previous rates of deterioration. The vertical break-edge on this side was not filled, as fills so thin never penetrate the break edge, and are doomed to failure as there is too little body of repair binding medium.

The threaded stainless-steel dowel secured into position with an epoxy anchor-grout, that penetrates deeper holes even further than gunnable resin. This material was used because of the length of the dowel hole, which was only secured with mortar previously. The urn is heavy, on a leaning capstone and therefore needs to be solid. Three smaller strips of Code 4 lead were used to create a stable, parallel bed (plus the pointing mortar after) and facilitate cutting the dowel if needs be, in the future. All resins employed are water-proof in the long-term.

On the left, the urn-base bedded into position and a length of dowelling used to determine the exact length required. It extends down to where indicated. On the right, the diminishing lower-urn and draped/swag level, secured into position with the anchor grout. There were no fixings above the lid, historically, just bedded into position.

On the left, the whole urn before any treatments, note how the top two courses are stepped over, being loose. On the right, the restored urn after all treatments. Note the extent of carved detail missing from the faintly fluted-base prior to treatments as opposed to carved elements above. The diminishing neck could be used as a template for the neighbouring crudely repaired neck/base, if needs be in the future.

Memorial to Mary Hughes 1804

1 Condition

1.1 Once again the capstone which is substantial had raised clear of the underlying box-tomb, forced upwards by expanding iron-cramps at the corners. It was possible to see through the memorial, with pointing beneath the capstone long gone.

1.2 The side panels of the box-tomb are all face-bedded and have suffered as a result. Each elevation displays a shallow sunken-panel which will have received additional tooling (and therefore percussive shock) to make the sinking flat, being lower than the plain borders.

1.3 The lower sections of the panels have suffered from delamination to a greater extent as this is a damp-zone, with water wicking up from ground-level, migrating upwards due to capillarity, taking with it minerals and soluble-salts in solution, which have crystallised at the surfaces, exploiting laminations in the face-bedded stone, leading to the chronic levels of delamination witnessed.

1.4 This memorial sits further beneath a nearby mature Yew tree and the churchyard has grown upwards to virtually cover the moulded plinth, with the 'whole' now looking out of proportion as a result. Work was done to reduce tree branches during the scaffold erection that were closely overhanging the top of the urn. This was done sensitively, with branches cut back neatly to a joint.

1.5 The composite urn on top of the capstone has suffered more than its neighbours, judging by the crude historic repair to the urn-base and neck. The base has obviously been fractured into four pieces and displays wide joints on all four elevations, leaving the urn-base sitting beyond the stooling beneath, when it should be stepped-in to form a neat rebate. The round moulding and neck have been crudely repaired with a cementicious mortar. Despite it looking unattractive and been in a material now deemed inappropriate (due to it being too hard) there were no signs of material or structural breakdown, or staining from the likely still ferrous dowelling within.

1.6 We deemed it would cause avoidable damage to the historically, repaired surfaces if we sought to remove and replace the likely iron fixing, especially in light of our experiences with the urn on the neighbouring box-tomb to William & Ann Hughes, where the dowel was nearly 400mm long. The decision to leave the urn alone was at odds with our initial assessment at time of tender, which was conveyed to the Project Manager (Mrs Harriet Carty). The PM convened a meeting with the DAC secretary and its Architectural and Archaeological Consultants - Mr Andrew Arrol and Mr Andrew Pike respectively. The issue and options raised were discussed on-site between all parties involved and the unanimous decision was taken to leave the urn un-molested and monitor its condition.

1.7 There was no access point for horizontal sawing to cut-through the dowel, as the cementicious mortar had been slathered over the base of the stone urn. Cement becomes increasingly brittle with age and would have damaged the already repaired square-section base in its removal and likely the base of the finely carved urn. This would have meant repairing the original elements with avoidable damage OR more likely, replacing the diminishing urn base with a new carved or turned neck, of which there was no contingency sum for.

2 Dismantling

2.1 A lifting scaffold had been erected above the three box-tombs in a row, to enable safe removal and subsequent replacement of 2 of the 3 capstones. This was boarded temporarily at capstone level to enable safe slinging and lifting.

2.2 The upper two sections of urn-lid were noted as being loose, due to degraded mortar and were removed and set aside safely for later re-fixing. This was fortuitous as the angle of the lifting slings (with the urn still in place) would have caused point-loading on the outer rim, even with a spreader-bar. The lift was complicated by the urn remaining insitu, creating a considerable weight focused in the centre of the square-section capstone, which could exploit any unseen/heard weaknesses, due to the lifting slings having to be positioned in, a particular distance from the outer edges to ensure a strong lift. The lift was carefully planned and executed without any surprises.

2.3 The capstone was assessed visually and audibly and it was deemed safe to lift without risk of damage from weaknesses being exploited during lifting. A ratchet strap was secured horizontally around the top of the box-tomb in the anticipation of the four sides moving once being un-weighted, which proved fortunate. The cap was raised incrementally using wide crow-bars, enough to insert a pair of timber battens and enable positioning of the soft, endless slings. It was raised slightly, moved horizontally and lowered onto timber bearers on the turntable truck.

2.4 After removal of the capstone it became clear the four iron-cramps at the corners were providing no restraint, as they had either failed or were delaminated. Despite the restraining ratchet strap the west elevation panel was actively loose. The fixings were easily removed with chisels and the sockets removed of dead-metal whilst deepened to provide additional support. Fortunately there were no side studs in the centres of the panels, which we had been expecting after the previous memorial. The sockets and channels were enlarged to receive new stainless-steel fixings which were fabricated next to the memorial.

2.5 The sockets and channels were thoroughly de-dusted and new bespoke fixings secured into position with epoxy-resin and allowed to cure.

3 Conservation

3.1 The vulnerable delaminating edges of actively springing stone had been tacked along their length with spots of epoxy-resin during the winter of 2019 which had worked well in arresting delamination and further unnecessary loss of material.

3.2 Vulnerable edges/laminations had coloured mortar support fillings (Lithomix®) inserted along their lengths to provide strength to previously tacked (with resin) edges. On several wider laminations and blisters, liquid grout was also introduced by mortar-gun, to fill the voids where mortar could not be packed deep enough. Such a grout is merely a filler and does not re-bond delaminating surfaces but fills gaps between the surfaces such that these areas can’t be easily crushed. No attempt was made to recreate missing mouldings or areas of missing stonework.

3.3 Once the box-tomb was secure with the new fixings, the internal mitres inside the box were removed of old, degraded mortar. The vertical joints were then dampened with water and coarse bedding-mortar packed deep into the wide joints to give more rigidity, provide something against which to point against from the front and ensure a water-proof joint at depth.

4 Re-assembly

4.1 During dismantling, once again the bottom-bed of the capstone was observed not to be flat side to side, with only the outer edges or margins worked flat and a raised, 'punched' surface in between. The bottom of the dowel securing the urn could not be seen either. Stacks of lead shims were applied on the top-bed of the side-panels to the required joint thickness. A layer of coarse bedding mortar was applied at the pre-dampened rear of the panels, to the same approximate height as the lead.

4.2 The capstone/urn was re-slung and hoisted up and over, back into position onto a pair of timber battens to enable the slings to be removed. The capstone was then raised on crow-bars a side at a time, to remove the battens and downward onto the lead shims and mortar. As neither the underside of the capstone or the top-bed of the side panels were level, shims were added/removed until there was a consistent parallel joint and the shim stacks were all engaged, or bearing the weight uniformly.

4.3 The next day the urn-lid sections which had been removed for safety, were re-bedded into position, using the fine pointing-mortar, as the previous joints had been so fine. The upper section was applied to the lower and mortar squeezed out from the joint to ensure a uniform, consistent bed/outer joint. These were manageable by hand.

5 Conservation Works

Cleaning

5.1 No cleaning took place on this memorial as many of the surfaces were simply not up to even the gentlest cleaning.

5.2 Pointing/Mortars

5.2.1 The material employed for pointing the horizontal and joints was Masons Mortars - Fine Ashlar Pointing Mortar® and was applied using a mortar-gun with different size needles, depending on the thickness of the degraded stone arrisses. The thixotropic mortar was inserted, excess material struck off level with the adjacent stonework and mortar was pressed home, both processes with a spatula.

5.2.2 The more traditional, coarse mortar for the internal vertical mitres and the single bed-joint was in the ratio of 3 : 1 (aggregate to binder) with local Bromsgrove Sharp and Bromsgrove Building sand (2 : 1) with an NHL3.5 binder.

6 Maintenance Considerations

6.1 The stone of the side-panels in particular have suffered from extensive delamination and surface scaling/flaking. The substrate was rationalised hard previously by us to remove loose, degraded substrate beyond practicable repair, prior to emergency consolidation in the form of tacking with spots of resin. Much of the weakened flaking stone that retained moisture has been removed. The decay mechanisms present are progressive, due to the local conditions and the stone being poor-quality to start with, very little can be done to slow it down, without isolating it from its surroundings. If it were a museum object, it would have been completely dismantled, then dried and delaminating side panels deep-consolidated, not just surface consolidated.

6.2 This is obviously not practical or economically viable on such a degraded memorial and we have slowed down the previous rates of deterioration as far as possible, short of over-wintering the memorial and applying soft, breathable protections to it over winter months, which again is perhaps not practical.

6.3 We (ERC) appreciate a once in a generation funding opportunity has slowed down the previous rate of deterioration, however a monument listed by English Heritage over 40 years ago should not have been allowed to reach such a perilous condition and could have been flagged-up requiring work sooner by an Inspecting Church Architect or local interest group.

6.4 Elliott Ryder Conservation will monitor the condition of the memorial (free of charge) after twelve months, as part of our on-going maintenance commitment, and report back to the PCC with any findings.

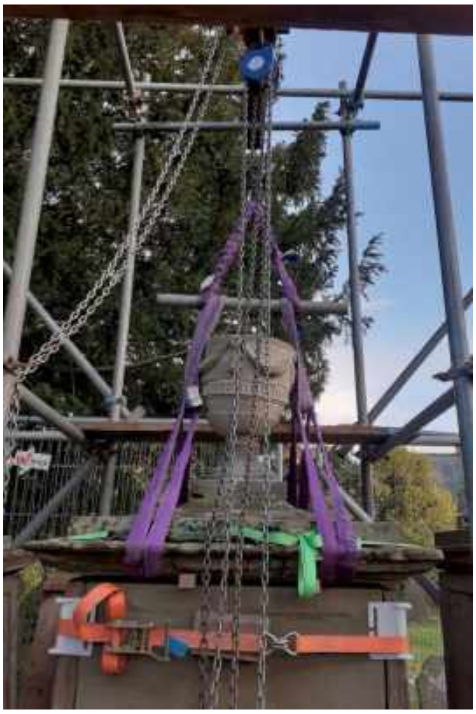
The memorial to Mary Hughes before and after all treatments. On the left, the Yew tree branches brushing the urn, prior to being pruned back. The box panel on this elevation was actively loose when the capstone and urn were lifted off. The new pointing mortar is the same colour as the original fat-lime mix.

On the left, the south elevation highlighting the simple border in the foreground (indicated) has delaminated and detached from this 'long' side. This side was rationalised hard prior to inserting support fillings. On the right, support fillings being inserted into vulnerable edges, before the capstone is removed/replaced. Note the plinth is not visible on these two elevations with ground level having risen to cover it.

The square base and diminishing neck look nice from far but are far from nice. The base sits over the underlying stooling, where there should be a rebate in the other direction. From the lid upwards was dismantled, so these elements weren't damaged during the lifting process.

A detail of the crude cementicious repair, with a wide join on each elevation of the base (indicated) where there should be no join. Despite looking ugly, the repair shows no signs of iron-staining or any structural breakdown. A unanimous decision was taken in consultation with members of the DAC, not to dismantle this section and monitor its condition going forward. Note the extent of biological colonisation on the repair medium, indicating it has been there for a long time.

The same detail as above but stone, from the neighbouring Home memorial, which is intact despite of corroding iron. See how the square base sits within the stooling beneath.




On the left, the urn-lid having been removed. A spreader bar was still required to prevent the slings pinching the weak, carved swag details. The lift was difficult as the weight of the whole urn was focused on a small footprint at the centre of the wider capstone, meaning the slings had to move inwards to overcome this. Note the rough-nature of the bottom-bed of the capstone when in mid-air.


When the capstone was removed the stone panel in the foreground, closest to the chain, moved forward against the ratchet-strap. If the strap hadn't been there it would likely have fallen against the capstone being lowered. On the right, the inside of the box-tomb after the internal mitres have been removed of defective mortar and new mortar packed in, to increase rigidity and prevent moisture entering the structure. There was no plant-growth of any kind in either of the partially dismantled box-chests.

On the left, the remains of a laminated iron-cramp. One of the turn-downs is now missing but had forced off the outer corner due to its expansion. Note how small the remaining turn-down is (indicated) and the depth of the new stainless-steel turn-downs, with holes drilled deeper. As the corner was lost a new socket was created diagonally across the mitre, so that the cramp wouldn't be seen. On the right, one of the laminations filled partially with a coloured support filling then grouted before more filling, protecting the smooth, carved upper-surface to the right.

Memorial to William & Ann Hughes 1847

1 Condition

1.1 The capstone which is substantial in terms of weight had raised clear of the underlying box-tomb, forced upwards by expanding iron cramps at the corners. It was possible to see from one side of the memorial to the other, with pointing beneath the capstone long gone.

1.2 The side panels of the box tomb are all face-bedded and have suffered as a result. Each elevation displays a shallow sunken-panel which has likely received additional tooling (and therefore percussive shock) to make the sinking flat, being lower than the plain borders. The lower sections of the panels have suffered from delamination to greater a extent as this is a damp-zone, with water wicking up from the raised ground-level, migrating upwards due to capillarity, taking with it minerals and soluble-salts in solution, which have crystallised at the surfaces, exploiting laminations in the face-bedded stone, leading to the level of chronic delamination witnessed.

1.3 This memorial sits beneath a mature Yew tree and the churchyard has grown upwards to virtually cover the moulded plinth, with the 'whole' now looking out of proportion as a result.

1.4 The composite urn on top of the capstone has suffered from the expanding, internal iron-dowel which joins the elements together. The carved decorative top above the urn lid, visible on its neighbour is missing on this memorial and leaves an iron dowel (separate to that below) corroding, despite being encased in lead. Even thought the main dowel has corroded the urn as a whole is relatively vertical.

2 Dismantling

2.1 A lifting scaffold was erected above the three box-tombs in a row, to enable safe removal and subsequent replacement of 2 of the 3 capstones. This was boarded temporarily at capstone level to enable separation of the urn, to remove the corroding dowel.

2.2 Lifting equipment was placed centrally above the urn and slack taken up by means of a pair of endless-slings and a block and tackle. The 15mm thick dowel was cut-through via the thin bed-joint, using numerous hacksaw blades. Once the dowel was cut, the heavy urn was raised slightly and moved away before being lowered down to the turntable truck with softening.

2.3 The dowel had to be removed from the stone urn-neck, by drilling around the perimeter of the expanded iron. The dowel extended vertically all the way through the neck, on past the bottom-bed of the capstone. This required our longest, small diameter drill-bit, to drill around half the perimeter of the dowel before it was released. The iron had expanded into the historic drill-hole, but luckily hadn't fractured the urn-neck or capstone as witnessed on other memorials.

2.4 The dowel in the urn had been set-in with molten lead and luckily wasn't drilled that deep into the urn-base. This was eventually released by drilling around the perimeter of the fixing. As there was very little embedment, the hole was deepened to receive the new, threaded stainless-steel dowel and ensure a stronger long-term fixing.

2.5 The capstone was assessed visually and audibly and it was deemed safe to lift without risk of damage from weaknesses being exploited during lifting. A ratchet strap was secured horizontally around the top of the box-tomb in the anticipation of the four sides moving once being un-weighted, which proved fortunate. The cap was raised incrementally using wide crow-bars, enough to insert a pair of timber battens and enable positioning of the soft, endless slings. It was raised slightly, moved horizontally and lowered onto timber bearers on the turntable truck.

2.6 Once removed, it became clear the four iron-cramps at the corners were providing very little restraint, as they had either failed or were delaminated significantly. The fixings were easily removed with chisels and the sockets removed of dead-metal whilst deepened to provide additional support. Four additional iron studs, extending up and down vertically through the bed-joint, set in with molten-lead were also drilled out to release them. This was difficult given the thin nature of two of the side panels and there was the risk of bursting-off the front or rear surface as a result. Fortunately the stone was sound in these areas and there was no physical loss of material. The sockets and channels were enlarged to receive new stainless-steel fixings which were fabricated next to the memorial. The iron-fixing in the top of the urn was also drilled-out, ready to be filled with repair mortar.

2.7 The sockets and channels were thoroughly de-dusted and new bespoke fixings secured into position with epoxy-resin and allowed to cure.

3 Conservation

3.1 The vulnerable delaminating edges of actively springing stone had been tacked along their length with spots of epoxy-resin during the winter of 2019 which had worked well in arresting delamination and further unnecessary loss of material.

3.2 Vulnerable edges/laminations had coloured mortar support fillings (Lithomix®) inserted along their lengths to provide strength to previously tacked (with resin) edges. On several wider laminations and blisters, liquid grout was also introduced by mortar-gun, to fill the voids where mortar could not be packed deep enough. Such a grout is merely a filler and does not re-bond delaminating surfaces but fills gaps between the surfaces such that these areas can’t be easily crushed. No attempt was made to recreate missing mouldings or areas of missing stonework.

3.3 Once the box-tomb was secure the internal mitres inside the box were removed of old, degraded mortar. The vertical joints were then dampened with water and coarse bedding-mortar packed deep into the wide joints to give more rigidity, provide something against which to point against from the front and ensure a water-proof joint at depth.

4 Re-assembly

4.1 During dismantling, the bottom-bed of the capstone was observed not to be flat side to side, with only the outer edges or margins worked flat and a raised, ‘punched’ surface in between. Stacks of lead shims were applied on the top-bed of the side-panels to the required joint thickness. A layer of coarse bedding mortar was applied at the pre-dampened rear of the panels, to the same approximate height as the lead.

4.2 The capstone was re-slung and hoisted up and over back into position, onto a pair of timber battens to enable the nylon slings to be removed. The capstone was then raised on crow-bars a side at a time to remove the battens and downward onto the lead shims and mortar. As neither the underside of the capstone or the top-bed of the side panels were level, shims were added/removed until there was a consistent parallel joint and the shim stacks were all engaged, or bearing the weight uniformly.

4.3 New threaded stainless-steel dowelling was cut to the correct length and secured into the capstone with a gunnable epoxy-resin and allowed to cure overnight.

4.4 The next day the urn was manoeuvred into position and the dowel hole filled with a slow-curing thixotropic epoxy-resin, it was then slung and raised up above the capstone, before being lowered onto the new steel dowel that had been covered with the same resin to ensure a good bond between the metal and the drill-hole. The urn was in the same alignment as before dismantling from the stepped mortar left in position and was stable on this stooling.

5 Conservation Works

Cleaning

5.1 No cleaning took place on this memorial as many of the surfaces were simply not up to even the most gentle cleaning.

5.2 Pointing/Mortars

5.2.1 The material employed for pointing the horizontal and joints was Masons Mortars - Fine Ashlar Pointing Mortar® and was applied using a mortar-gun with different size needles, depending on the thickness of the degraded stone arrisses. The thixotropic mortar was inserted, excess material struck off level with the adjacent stonework and mortar was pressed home, both processes with a spatula.

5.2.2 The more traditional, coarse mortar for the internal vertical mitres and the single bed-joint was in the ratio of 3 : 1 (aggregate to binder) with local Bromsgrove Sharp and Bromsgrove Building sand (2 : 1) with an NHL3.5 binder.

5.2.3 A coloured Lithomix mortar was employed for filling the now empty drill-hole in the top of the urn, after the lead and iron-fixing had been removed.

6 Maintenance Considerations

6.1 The stone of the side-panels in particular have suffered from extensive delamination and surface scaling/flaking. The substrate was rationalised hard previously by us, to remove loose, degraded substrate beyond practicable repair, prior to emergency consolidation in the form of tacking with spots of resin. Much of the weakened flaking stone that retained moisture has been removed. The decay mechanisms present are progressive, due to the local conditions and the stone being poor-quality to start with, very little can be done to slow it down, without isolating it from its surroundings. If it were a museum object, it would have been completely dismantled, then dried and delaminating side panels deep-consolidated not surface consolidated.

This is obviously not practical or economically viable on such a degraded memorial and we have slowed down the previous rates of deterioration as far as possible, short of over-wintering the memorial and applying soft, breathable protections to it over winter months, which again is not practical.

6.2 We (ERC) appreciate a once in a generation funding opportunity has slowed down the previous rate of deterioration, however a monument listed by English Heritage over 40 years ago should not have been allowed to reach such a perilous condition and could have been flagged-up requiring work sooner by an inspecting Church Architect or local interest group.

6.3 Elliott Ryder Conservation will monitor the condition of the memorial (free of charge) after twelve months, as part of our on-going maintenance commitment, and report back to the PCC with any findings.

The south elevation of the memorial to William & Ann Hughes before and after all treatments. Note the parallel joint between the capstone and the box-panels, pointed on the right image. The shallow, moulded plinth and sub-base is just visible through the grass on this elevation.

Once the urn was removed, which was also lifted using the block and tackle given its combined weight, the capstone and urn-base was raised slightly, moved horizontally on the girder-trolley before lowering onto the turn-table truck below and away from the area of work. Note the very uneven nature of the bottom-bed of the capstone, with the surface having a rough 'punched' finish from the workshop.

The poor condition of the urn showing laminations concentrated around the moulded and high-relief carved areas. The stone obviously takes carving well given the sharp detail, but weathers poorly, something the masons of that period were probably unaware of. Note the resin behind the laminations carried out as part of the emergency consolidation, in advance of surface filling.

The dowel in the bottom bed of the urn, which had expanded to fill the hole and fortunately was not that deep. We lengthened the hole to given deeper embedment for the new stainless-steel fixing. Note the laminations (following sedimentary bedding planes) horizontally through the fluted decoration.

The urn before its removal. Note the thin, stone neck remained intact despite having to drill a series of holes around the perimeter of the embedded iron dowel to release it, which was over 50cm long. The hole in the urn was extended to below the horizontal fluted decoration, to make it more solid. The iron dowel from the lid (indicated) was removed and resultant void filled with repair mortar.

The top-bed of the box-tomb, showing the much more substantial fixings at the corners. Threaded locating studs leaded into position were also incorporated in the top bed, making this memorial seem much more sturdy – that is until the iron starts delaminating and expanding, causing structural issues. There were no plant growths inside this box-tomb.

This cramp from above, has forced off stone on two elevations and raised upwards, forcing the capstone up. The broken stone has been long gone judging by the biological growths on the break edge, in the foreground.

The same iron-cramp from the front. As the corrosion product slowly formed the large increase in volume has raised the fixing upwards. The smoother surfaces would have had the same flaky appearance but have detached once exposed to the elements, when the stone was forced off.

One of the threaded iron locating lugs, which we didn't see in any of the other memorials dismantled. There was one in the centre of each elevation and weren't replaced, as there was no need for them. A support filling can just be seen beneath the hole for the stud (indicated).

Another corroding fixing that has corroded to fill the sockets and joining channel, with corrosion product on its top surface. All the fixings were set in with mortar. Note the internal mitres have been filled (indicated) with the same fat-lime, pointing mortar. This was all removed and replaced with new mortar to provide additional support.

The top bed of the box-tomb showing all the iron fixings and locating bolts removed and new stainless-steel cramps about to be secured into position with epoxy-resin. This box was of much sturdier construction compared the memorial to Mary Hughes. The four slabs were much thicker and the fixings of a bigger scale to start with.

Lead shims in place over the epoxy-resin (to ensure a parallel joint) prior to dampening the stone and applying a thin mortar-bed at the rear of the panels, so there was something to point against, when introducing mortar through the front joint. On the right a sliding bevel to take into account the weathering of the capstone and ensure the capstone was located centrally side to side in both axis's, when coming down off the timber battens.

On the left, the 15mm diameter, threaded stainless-steel dowel secured temporarily at right angles, to the stooling on the urn-neck (whilst the resin within cures) as the capstone was not level. On the right, the completed urn in position. Note the depth of embedment of the new dowel (indicated).

The dedication to William Hughes on the south elevation prior to any treatments. The stone is face-bedded and delaminating and risks losing even more carved detail. The sinking which is beneath the now raised border has undergone additional tooling to make it flat, then smooth and then the surface is lettered with the dedication. All these processes impart significant percussive-shock, creating micro-fissures in this poor quality stone.

Discreet support fillings were inserted into and behind laminations to slow-down the ingress of moisture and all its attendant problems. Note the horizontal pointing (indicated) the same colour as the original fat-lime, but with a hydraulic lime NHL3.5 binder which is compatible with this stone type.

An island of surviving upper carved detail which was filled and grouted to prevent entry points for water and slow down the rate of deterioration. The stone on this elevation is so weak due to its lithology. You can see the depth of the substrate that has been lost, making the island of surviving stone all the more remarkable. Note the extent of white lichens to the right of the surviving inscription.

Powell Memorial 1834

1 Condition

1.1 The tomb-chest was in an extremely unstable condition having sunk into the ground at an alarming angle at the west elevation closest to the path. The stone of this memorial, is the same poor-quality, laminar stone type to the majority in this project. Stone elements displayed significant delamination and loss of material, with individual blocks much thinner in scale and the lid being too thin for its length again.

1.2 There was no sub-base to speak of, save for two thick recycled tomb chest panels below ground-level at the east end, which is why the memorial displayed little movement in this area.

1.3 There were no signs of ivy or other higher-plant forms, with the deformation witnessed attributed to poor build-quality, insubstantial fixings and lack of any real foundations.

1.4 The shallow, double-pitched tomb chest lid has slightly more overhang than its neighbour, but as the moulding beneath the now rounded nosing is shallow, water is likely to simply run down around the moulding, directing water into the core and front face of the tomb chest panels, as the horizontal joint line is missing and was open for nearly the whole of the lid/tomb chest interface.

1.5 The tomb chest elements display significant loss due to the poor quality stone, incorrect bedding of slabs, but also point-loading from uneven settlement, due to lack of any real foundation.

2 Dismantling

2.1 Even thought the tomb chest was so out of original alignment, critical dimensions were still recorded to give an indication of alignment for re-building. Once again the existing clean/dirty demarcations lines on edges were of far more use, as these indicated where the tomb chest had been assembled originally.

2.2 The nearby tarmac path is a relatively recent addition with the angle of the slope and camber of the path directing rainwater from the path onto/into the ground surrounding the plinth, contributing to the extent of settlement witnessed. Despite the angle of settlement, the ground immediately adjacent to the memorial is flatter than its neighbour west-east. It was decided to lower the finished concrete level, just below path level and incorporate clean aggregate at the west end which rainwater would drain through, instead of saturating the west plinth block.

2.3 Because the whole memorial was much less substantial and the lid was in such a poor condition, there was no need for a lifting scaffold, with movement of the heaviest blocks done with the aid of shear-legs. The lid was simply rolled off (and on) the tombchest using timber rollers onto a turn-table truck with timber board at the required height. The tombchest was dismantled in a numbered sequence, to facilitate re-building and stored nearby on pallets so the stone was off the ground and grass was protected as far as possible.

2.4 Once the lid was removed it became clear there were no plant remains within the core and that the tomb chest panels and corners were much thinner/in-substantial than anticipated. The decision was taken at this point that a supporting internal core would be required against which to secure the side panels, but more importantly to bear the weight of the lid.

2.5 The lid displayed several significant laminations concentrated at the west end. The loose sections had been held in place by being packed from beneath with roofing slates between the top bed of the tomb chest and bottom bed of the lid. The loose sections were separated prior to dismantling so as to avoid further damage. It was clear these were historic laminations given the extent of dirt/debris and lichen within the break edges. The mating surfaces only were cleaned using scalpels to remove lichens from within the break edges and high-pressure cold-water to jet wash the surfaces. These were allowed to dry thoroughly before the re-building process.

2.6 With the carved elements safely out of the way, we were able to assess the integrity of the sub-base, which was virtually non-existent save for a pair of recycled, broken tomb chest panels at the west end . The few stone slabs were removed to the depth required for a new re-enforced concrete pad.

2.7 The small amount of dead metal from historic fixings was removed with the aid of small chisels, again having been secured with lime-mortar, which was long gone.

3 Lichen Removal

3.1 Once the component elements were stored off the ground on timber pallets, all joints and sockets and break edges on the lid were cleaned with high-pressure, cold-water, to remove biological growths that could later interfere with bedding and pointing mortars.

4 Concrete Base

4.1 The ground is more or less level in this location, so a larger rectangular aperture was cut in the ground to receive timber shuttering for a new concrete pad of the correct proportions for the sub-base, the top bed of which finished below ground level to the west (the tarmac path). Visqueen heavy-duty polythene (DPM) was placed at the bottom of the shuttering to ensure moisture-retention in the concrete and aid workability. Re-enforcing mesh cut to size so as 100mm back from the eventual edge of the concrete was placed on bricks to ensure it was midway vertically in the concrete. Concrete was poured and tamped with smooth edges applied around the perimeter. After several weeks the shuttering was removed and the strips where the timber was, backfilled and tamped with spoil on three elevations and clean, washed aggregate on the elevation closest to the path.

4.2 This memorial sits centrally in both axis’s (north-south / west-east).

5 Conservation

5.1 The corroded iron fixings in this memorial were too small even for the diminutive component elements. The majority of fixings had disintegrated with turn-downs too small and were not engaged, therefore providing no restraint/support. All corroded iron was removed with original fixing holes deepened to accommodate new stainless-steel fixings, which were made on-site.

5.2 No attempt was made to clean the outer exposed surfaces which are all well colonised with biological growths, giving the memorial a pleasing patina and the surfaces were too fragile, even after tacking with epoxy-resin. Only the break edges and fixing sockets were cleaned.

6 Re-building

6.1 Once the concrete had reached compressive strength, re-building of the plinth commenced. This was in reverse sequence to dismantling with all elements built level and plumb. Once the plinth course was completed new stainless-steel fixings were secured into place (in the old sockets) in the top-bed, with epoxy-resin. The plinth was covered with protections for a weekend, and the resin employed allowed to cure fully before filling with Limecrete.

6.2 The bottom bed of the plinth blocks were roughly finished (not worked) flat which made for an uneven joint between the concrete and the bottom-bed.

6.3 After the plinth blocks were bedded new fixings incorporated and resin employed cured, a ratchet-strap was secured around the perimeter of the plinth to prevent any movement during the next process. A Visqueen® DPM and separation layer was applied inside the void created by the deep plinth blocks. Limecrete built up in layers but in a continuous phase, was then applied to fill the void to the same plane as the top-bed of the blocks. Water-proof protections were applied over this and it was allowed to harden sufficiently over a number of weeks. Given the thin internal diameter between the rear of the blocks, there was no need for inclusion of steel re-enforcing mesh.

6.4 The use of a solid Limecrete infill was because the rear vertical surfaces of the plinth blocks were so uneven and the tombchest was to have an internal supporting core for the new, tomb-chest lid. A solid base the same height as the stone blocks allowed lightweight blocks to be built off that single plane and be wider than if built within the stone plinth, therefore giving greater stability and spreading the eventual imposed load over a wider surface. The added benefit of a DPM membrane/separation layer within the plinth blocks was that any new ivy roots could not penetrate the thick plastic layer, it also prevents the stone blocks being saturated by the water used in the mix.

6.5 Once the Limecrete within the plinth blocks was hard enough, a new supporting core of light-weight Celcon® blocks was built on top. This was built slightly higher than the eight tomb chest elements, such that the new core took the weight of the moulded slab evenly.

6.6 The use of Celcon Thin-bed® blocks with Celfix® mortar enables structures to be built and bear weight quicker than conventional blocks. Once the core had hardened over the course of a weekend, work began on rebuilding the tomb chest elements.

The stone elements were bedded onto a building mortar with an NHL3.5 binder, mortar was kept back from the front faces as all joints were to be pointed after the lid had been installed, in case there was any settlement from the final imposed load.

6.7 Existing fixings sockets at the mitres had previously been deepened and widened to ensure more solid fixings. Several of the corner blocks displayed significant fractures in the top beds that had not yet delaminated. Rather than drilling through the front face to secure against possible movement in the future, slots cut at right-angles to the fracture were ground into the top beds and flat stainless-steel fixings were secured with epoxy-resin to prevent movement in the future. All slots/channels and holes de-dusted to ensure a solid bond with the resin employed.

6.8 The rear mitres and horizontal joins of the tombchest were packed with the bedding mortar to provide additional support and filling (as were the tomb chest elements) and something against which to point against at a later date, with the gunnable pointing mortar.

6.9 Once the tomb chest was built, the resin employed in the restraint fixings was allowed to fully cure before reintroducing the lid. A uniform layer of coarse mortar was applied to the top-bed of the tomb chest elements where possible, the top-bed of the north elevation in particular being only 10-15mm wide with a void behind it horizontally. The lid was manoeuvred into position on the path and above the height of the tomb chest in a west-east orientation. It was then rolled back into position until central in both axis's, before being lowered down onto the tomb chest into its final resting position.

6.10 Once the majority of the lid was installed the loose fragments were offered-up dry, to establish exactly where to put resin for the strongest bond. The laminations were so weak that extant sections were not up to drilling and pinning, which risked delaminating the already laminar stone further. Luckily the sections over-lapped one another making for a stronger bond with the addition of epoxy-resin and once all the debris and lichen had been removed from the mating surfaces the loose sections went together naturally, with no real signs of 'springing' or deformation as witnessed on other memorials.

6.11 Spots of resin were used to secure the fragments and produce a strong long-term bond. The large island of thick white lichen precluded the use of a support filling which would have failed, as repair mortar does not bond to lichen material and the poly-saccharides from the lichen at such close quarters would weaken it almost immediately. Free-flowing liquid grout was introduced into the very fine joint lines which had minimal penetration, indicating the join is very tight and water percolation won't be such an issue. The joint lines that are there are diagonal, meaning any water that does penetrate will migrate through the lamination. Using spots of resin as opposed to a solid layer ensures moisture in gas, liquid, vapour phases can move freely through the porous stone. The hydrophobic lichen is likely to grow over the surface fissure and prevent the ingress of moisture in the short-medium term.

6.12 Once the lid had been allowed to settle over the course of a weekend, the whole memorial was pointed with a gunnable liquid mortar. This material is based on NHL3.5, being initially much more fluid than conventional mortar before hardening and achieving the same relative strengths/qualities as a conventional mortar. Traditional mortar applied by even the smallest spatulas into thin joints cannot get back as far into the gap and therefore makes for a weaker surface or 'dummy' joint in the long-term.

6.13 The north 'long' panel is so laminated and thin there is only 10-15mm bearing on its top-bed for approximately one third of its length, with a void behind - back to the tomb chest core. A pocket had to be created using expanding epoxy-foam and tin-foil so the initially liquid foam did not have contact with any stonework. Once the foam had cured it was cut back to create a channel using a Stanley knife and we were able to fill the resultant joint or pocket in the same manner as the rest of the joints.

6.14 With this memorial as with all the others, it is important to minimise (not prevent) the ingress of excess moisture. The more fluid mortar ensures the bed joints in particular are filled from back to front, plus giving uniform support in the long-term.

7 Conservation Works

Cleaning

7.1 The only cleaning that took place on this memorial was removing biological growths from joint edges and the break edges of the delaminated lid, all with high-pressure cold-water. This ensures a good long-term, chemical-bond between the cleaned (dried) stone and the epoxy-resin, which would otherwise be compromised if biological growths or other accretions were still in place.

7.2 As the dismantled elements were all so vulnerable, before re-building edges/laminations had coloured mortar support fillings (Lithomix®) inserted and packed-in along their lengths, to restore strength back to previously delaminated sections, tacked with resin. On several wider laminations, liquid grout was also introduced by mortar-gun prior to inserting support fillings. No attempt was made to recreate missing mouldings or areas of missing stonework.

8 Pointing/Mortars

8.1 The material employed for pointing the joints was Masons Mortars - Fine Ashlar Pointing Mortar® and was built up in layers using a mortar-gun with different size needles, depending on the thickness of the degraded stone arrisses. The thixotropic mortar was inserted, excess material struck off level with the adjacent stonework and mortar pressed home, both processes with a spatula.

8.2 The more traditional, coarse mortar for bedding the plinth, tomb chest elements and lid was in the ratio of 3 : 1 (aggregate to binder) with local Bromsgrove Sharp and Bromsgrove Building sand (2 : 1) with an NHL3.5 binder.

9 Maintenance Considerations

9.1 Grass grows directly against the plinth as the level of the churchyard has risen over the decades and is a source of nutrients for the biological growths witnessed over the lower elements. Whilst such levels of colonisation may look visually appealing to most, the mortars employed will suffer at a faster rate, given the level of poly-saccharides within the algaes acting upon an alkali mortar surface, from rain-washing over the surfaces. For this reason the mortars should be monitored on a quinquennial basis at least, to ensure they are performing their architectural function of slowing-down, not preventing the ingress of moisture into the architectural elements.

The concrete pad will prevent grasses growing too close to a certain extent, but it is difficult to strim in such areas. Strimming should not be carried out against aged stonework which will abrade the weakened surfaces.

9.2 The tarmac path will continue to direct rainwater toward the west elevation of the plinth. The aggregate spanning between the path and the plinth should be monitored to see if it gets silted-up in the medium-term. It is does it should be replaced with something similarly free-draining such that saturated soil does not sit against the stone of the plinth and cause damage from frost. That situation is likely to be a long way off.

9.3 Elliott Ryder Conservation will monitor the condition of the memorial (free of charge) and the appearance of any ivy near the plinth after twelve months, as part of our on-going maintenance commitment, and report back to the PCC with any findings.

The memorial to William Powell before any treatments. Note the plinths proximity to the path, the degree of subsidence in the foreground, disruption/misalignment of the lid corner and delamination in the pilaster beneath that corner.

The west elevation of the memorial, highlighting subsidence in two planes east – west and north – south. The laminations in the lid can be seen more clearly in this image, largely attributable to the level of deformation witnessed in the underlying tomb chest.

The north elevation of the memorial highlighting the extent of subsidence and the proximity of the path. The iron railings in the foreground are more or less level across their top.

On the left, the south-west corner shows a transverse fracture through the lid and the extent of material loss to the main dedication panel, with the top quarter now lost horizontally, the exposed substrate is very fragile and displays extensive flaking. On the right, the north-east corner, carved detail is completely lost from the curved corner block.

The south-west corner on the left isn't just a wide joint. The left-hand corner block should have a rebate which sits over the dedication panel, but is long-gone. The island of aged, white lichen where the carved detail has been lost and rounded stone indicates this has been missing for a long time. The right image highlights the extent of delamination and flaking to this poor-quality, laminar stone.

The transverse fracture is inherent within the laminar stone; the vertical fracture is a result of point-loading. Note the vertical joints in the tomb chest are still largely parallel, indicating the tombchest is subsiding as a whole.

The remains of debris from within the lamination, indicating it has been allowing the ingress of moisture for a prolonged period. Fortunately the different layers are overlapping making for a stronger bond, when adhering the fragments in stages.

The remains of the lid being rolled off the tomb chest, after the fragments have been moved for storage. Because of other inherent weaknesses still in the slab it was not up to lifting, which risked pulling it apart. The slab was successfully moved off and back on without compromising the existing geological faults.

The tomb chest once the lid was removed. On the left, note the thin nature of the bedding surface (indicated) the rear of which slopes away, leaving only 10-15mm of bearing. On the right, detritus on the inside of the chest. The west elevation, 'short' side shows where (white) liquid plaster has been poured in historically, in a vain attempt at consolidation.

Iron cramps in the top-bed of the tomb chest secured with sound, lime-mortar and square-section studs in the bottom bed of the tomb chest, which weren't replaced. The studs prevented even more movement in the subsiding memorial. These weren't replaced as the memorial will be stable on its new re-enforced concrete sub-base.


On the left the plinth showing how much subsidence has taken place and how much the churchyard has risen over the 186 years since it was likely built. On the right, the plinth blocks have been moved. There were only two re-cycled tomb chest slabs at the far, east end, providing any sort of sub-base. Note the proximity of the railings and underlying kerb-set to the north.


On the left the new re-enforced sub-base in position with the plinth blocks having been bedded into position. On the right, the void within the plinth has been filled with Limecrete, on top of a Visqueen DPM/separation layer. Celcon blocks being laid to create a supporting internal core.


The top outer blocks at either end, had long dowels secured with gunnable epoxy-resin, deep into the course beneath, such that the two opposing blocks could not be pulled outwards by the slabs being restrained. The central fixings on the long panels were in the same block, so were pulling against one another. On the left, the top quarter of the panel has been lost through delamination, with an angled support filling inserted along the length of the vulnerable edge.


On the left, all restraint fixings are in place and stone elements are kept plumb with wedges and a ratchet-strap, whilst the epoxy-resin cures. On the right, one of the corner blocks displaying the extent of loss of carved detail and coloured support fillings to protect edges, previously tacked with epoxy-resin (by us) to prevent further loss.

A new stainless-steel fixing to replace the thin-section cramp, which would have been visible due to the loss of material (indicated). These were all secured with an external-grade epoxy-resin.

A restraint fixing in one of the 'long' panels. The core was built slightly higher than the tombchest panels, such that it bore the weight of the restored lid and not the fragile side panels. A thin layer of mortar was applied to the top-bed of the panels at their rear, so there was something to point against, with the gunnable pointing mortar.

On the north elevation the 'long' panel was so thin on the top bed, with a void behind back to the core. Because of this there was nothing to point against and so a pocket was created using expanding epoxy foam. The tin-foil and timber is to stop any foam coming into contact with the stone. When it had cured it was cut back to create a solid backing against which to apply the initially fluid pointing mortar.

The cleaned lid, marked out dry where sections would sit and where to apply spots of epoxy to ensure the strongest bond. Note stacks of lead-shims on the tomb chest panels, which was easier than applying mortar and taking the sections on and off, which could have been messy and caused lime-staining.

Resin is applied one side, the fragment applied to see where the corresponding spots will be on the lid, then the fragment is removed, with resin applied evenly to both faces. This gives a much stronger long-term bond than merely applying resin to one face only. Note resin is kept well back from break-edges.

The fragments locked together in a natural, tight-fit after they had been removed of all organic material. It is hoped the extensive, aged white lichen will cover over the laminations eventually, sealing the moisture entry points. These lines were not filled as they are doomed to failure in such proximity to thick lichens, which secrete weak organic acid.

The Powell memorial before any treatments. Note the proximity of the grass around its perimeter, which obscures the plinth. In this image water would be running down the path and transferred into the plinth, which was saturated, being below ground-level.

The memorial after nearly all treatments. The joint between the concrete sub-base and bottom bed of the plinth has yet to be pointed with a traditional mortar, such is the level of undulation, due to roughly shaped not worked blocks, which would have contributed initially to less than perfect transfer of weight. The plinth is well-bedded just not surface pointed.

The coloured support filling (that is dry due to being covered) which ran nearly the entire length of the south long panel, to protect the carved upper-surface below, which contained the dedication. Note the poor condition of the flaking substrate above, the loosest stone and other areas beyond practicable repair were rationalised to prevent loss and retention of excess water.

The extent of subsidence prior to dismantling. Note again the proximity of the nearby path and adjacent railings.

The memorial after nearly all treatments. Note the concrete sub-base is just below ground level and the path but the void between both is filled with free-draining aggregate, which will prevent water pooling in this location. The plinth will dry slowly in time, having been below ground-level for so long.

The west elevation of the memorial showing the relation between the neighbouring kerb set/railings and Griffithes memorial to the right. The gap between the two memorials is a mown path and we didn't want to create a trip-hazard on the corners of either sub-base. Note the inner mouldings or rebates on the two, rounded corner-blocks (indicated) is largely missing and why the joints look so wide.

Griffithes Memorial 1837

1 Condition

1.1 The tomb-chest was in an unstable condition due to the insidious long-term effect of ivy growing through the tombchest left un-checked or maintained and the make-up of the sub-base. The stone of this memorial is a different stone to the majority in this project, being a blonde, medium-coarse grained sandstone. Stone elements display virtually no delamination with individual blocks much larger/thicker in scale, making the whole memorial much heavier.

1.2 The sub-base beneath ground level was poorly constructed despite being quite deep. Made-up of small flaggy slabs laid with little or no mortar, rather like a wide, drystone wall, top. As the sub-base was made-up of lots of poorly-bonded individual slabs instead of one single homogenous unit, differential movement was inevitable, leading to uneven settlement and movement in the memorial witnessed before dismantling.

1.3 Ivy stems had forced apart huge sections of stone historically and work was done in the winter of 2019 to reduce visible ivy growth. Growth appeared to be far less vigorous, with very little leaf-growth outside or within the tomb chest after our return in the summer and during dismantling.

1.4 The double-pitched tomb chest lid has very little overhang and was observed to direct water onto the plinth beneath during heavy rain, surely an architectural oversight. Despite this anomaly, the lower elements are in a relatively good state of preservation, which is fortunate given the soaking this plinth must endure at times.

1.5 Ivy was seen to have grown through vertical joints in the tombchest, forcing some of the corners out of alignment by nearly 125mm. Because the lid was so thick, luckily this point-loading did not cause any further issues as witnessed on the Woolacott Memorial where differential loading led to delamination of the much thinner slab.

2 Dismantling

2.1 Even thought the tomb chest was so out of original alignment, critical dimensions were recorded to give an indication of alignment for re-building. In reality the existing clean/dirty demarcations lines on edges were of far more use, as these indicated where the tomb chest had been assembled originally, long before it was so disrupted.

2.2 The nearby tarmac path is a relatively recent addition with the camber and being at the bottom of a gentle slope, directing rainwater from the path onto/into the plinth. It was decided to compromise on the finished level of the new re-enforced concrete slab. If it had been at the same height or slightly above the path, it would have meant a huge expanse of concrete at the opposite east-end as the churchyard continues to slope away and the memorial sloped downwards at the east prior to dismantling. It was decided to lower the finished concrete level, below path level and incorporate clean aggregate at the west end which rainwater would drain through, instead of saturating the plinth block.

2.3 A scaffold was erected above and away from the memorial to enable lifting and manoeuvring of the heavy component sections. The memorial was dismantled in a numbered sequence, to facilitate re-building and stored nearby on pallets so the stone was off the ground and grass was protected as far as possible.

2.4 Once the lid was removed it became clear there were few ivy remains within the core and that the tomb chest panels and corners were much thicker than anticipated. The decision was taken at this point that there was no need for a supporting core because of this massive construction.

2.5 With the carved elements safely out of the way, we were able to assess the integrity of the sub-base, which was extremely poor as outlined previously. The randomly placed stone slabs were removed to the depth required for a new re-enforced concrete pad.

2.6 All dead metal from historic fixings was removed with the aid of small chisels, again, having been secured with lime-mortar, which was well past its usefulness.

3 Ivy and Lichen Removal

3.1 During dismantling it was easier to remove the aged ivy roots from around the thick stonework, without disrupting the arrisses when it was a built structure. The majority of the ivy growth within the tomb chest was historic and dead, however there were several healthy roots, much thinner in diameter than above ground level, which were pulled outwards and cut-off several inches above ground level. As they would be outside the footprint of the concrete slab, they were cut back as they cannot grow through thick concrete, but had grown through randomly placed slabs with little bedding mortar.

3.2 Once the component elements were stored off the ground on timber pallets, all joints and sockets were cleaned with high-pressure, cold-water, to remove biological growths that could later interfere with bedding and pointing mortars.

4 Concrete Base

4.1 As the ground was not level in this location a larger rectangular aperture was cut in the ground to receive timber shuttering for a new concrete pad of the correct proportions for the sub-base, the top bed of which finished below ground level to the west (the tarmac path). Visqueen heavy-duty polythene (DPM) was placed at the bottom of the shuttering to ensure moisture-retention in the concrete and aid workability. Re-enforcing mesh cut to size so as 100mm back from the eventual edge of the concrete was placed on bricks to ensure it was midway vertically in the concrete. Concrete was poured and tamped with smooth edges applied around the perimeter. After several weeks the shuttering was removed and the strips where the timber was, backfilled and tamped with spoil on three elevations and clean, washed aggregate on the elevation closest to the path.

4.2 The length of the padstone was hampered by the proximity beneath ground-level at the east elevation, of a supporting granite-plinth for an adjacent headstone and the tarmac footpath to the west. Meaning it couldn't be as long as it needed to be. The memorial sits centrally in both axis's (north-south / west-east) with the short side having the correct amount of projection for the depth of concrete 150mm/6". The re-enforced pad is suitably thick and strong, so this will not to be an issue in the long-run, more of an aesthetic issue.

5 Conservation

5.1 The corroded iron fixings in this memorial were of the right size for the scale of the component elements. Many fixings had expanded or ivy growth had moved blocks so much that the turn-downs were not engaged and so providing no restraint/support. All corroded iron was removed with original fixing holes deepened to accommodate new stainless-steel fixings, which were made on-site.

5.2 No attempt was made to clean the outer exposed surfaces which are all well colonised with biological growths, giving the memorial a pleasing patina. Only the break edges and fixing sockets were cleaned.

6 Re-building

6.1 Once the concrete had reached compressive strength, re-building of the plinth commenced. This was in reverse sequence to dismantling with all elements built level and plumb. Once the plinth course was completed new stainless-steel fixings were secured into place (in the old sockets) in the top-bed, with epoxy-resin. All slots/channels and holes had been washed-out previously with water to ensure a solid bond between the resin to be employed eventually. The plinth was covered with protections for a weekend, and the resin employed allowed to cure fully before continuing building.

6.2 The bottom bed of the plinth blocks were roughly finished (not worked) flat which made for an uneven joint between the concrete and the bottom-bed.

6.3 The rear mitres and horizontal joins with the plinth were packed with the bedding mortar to provide additional support and filling (as were the tomb chest elements) and something against which to point against at a later date, with the gunnable pointing mortar.

6.4 Once the tomb chest was built, the resin employed in the restraint fixings was allowed to fully cure before reintroducing the massive lid. A uniform layer of coarse mortar was applied to the top-bed of the tomb chest within the slings – which had to be set-in a particular distance from the outer edges to ensure a strong lift. The lid was manoeuvred up and over and lowered onto a pair of scaffold-boards across the tomb chest. The slings were removed and stacks of lead shims the required bed-height as well as mortar at the opposing ends were applied and the lid lowered down into position using a pair of crow-bars, first to raise it to release the boards, before lowering down fully onto the mortar.

6.5 Once the lid had been allowed to settle over the course of a weekend, the whole memorial was pointed with a gunnable liquid mortar. This material is also based on NHL3.5, being initially much more fluid than conventional mortar before hardening and achieving the same relative strengths/qualities as a conventional mortar. Traditional mortar applied by even the smallest spatulas into thin joints cannot get back as far into the gap and therefore makes for a weaker surface or 'dummy' joint in the long-term.

6.6 After all components had settled into their new positions, the resulting joint lines were pointed. Demarcation lines (clean/dirty lines on the edges of stonework) indicated there had been relatively crude joint-lines between elements. A gunnable pointing mortar was applied into the joints, the horizontal bed joints which were kept consistent on the lead shims.

6.7 With this memorial as with all the others, it is important to minimise (not prevent) the ingress of excess moisture. The more fluid mortar ensures the bed joints in particular are filled from back to front, giving uniform support in the long-term.

7 Conservation Works

Cleaning

7.1 The only cleaning that took place on this memorial was removing biological growths from joint edges with high-pressure cold-water.

7.2 Pointing/Mortars

7.2.1 The material employed for pointing the joints was Masons Mortars - Fine Ashlar Pointing Mortar® and was built up in layers using a mortar-gun with different size needles, depending on the thickness of the degraded stone arrisses. The thixotropic mortar was inserted, excess material struck off level with the adjacent stonework and mortar pressed home, both processes with a spatula.

7.2.2 The more traditional, coarse mortar for bedding the plinth, tomb chest elements and lid was in the ratio of 3 : 1 (aggregate to binder) with local Bromsgrove Sharp and Bromsgrove Building sand (2 : 1) with an NHL3.5 binder.

8 Maintenance Considerations

8.1 Grass grows directly against the plinth as the level of the churchyard has risen over the decades and is a source of nutrients for the biological growths witnessed over the lower elements. Whilst such levels of colonisation may look visually appealing to most, the memorial having achieved a patina of age, the mortars employed will suffer at a faster rate, given the level of poly-saccharides within the algaes acting upon an alkali mortar surface, from rain-washing over the surfaces. For this reason the mortars should be monitored on a quinquennial basis at least, to ensure they are performing their architectural function of slowing-down, not preventing the ingress of moisture into the architectural elements.

8.2 The tarmac path will continue to direct rainwater toward the west elevation of the plinth. The aggregate spanning between the path and the plinth should be monitored to see if it gets silted-up in the medium-term. It is does it should be replaced with something similarly free-draining such that saturated soil does not sit against the stone of the plinth and cause damage from frost. That situation is likely to be a long way off.

8.3 Elliott Ryder Conservation will monitor the condition of the memorial (free of charge) and the appearance of any ivy near the plinth after twelve months, as part of our on-going maintenance commitment, and report back to the PCC with any findings.

The memorial prior to any treatments, note the proximity of the tarmac path in the foreground, which gives no sense of the camber of the path, directing water into the plinth block. Work was done by us to remove as much of the ivy growth as possible in the winter of 2019. New growth can be seen issuing from the joints of the memorial.

The compromised bed-joint between the tombchest and heavy lid, raised-up due to active, internal ivy growth. Note the poor architectural detailing of the lid with only a small bull-nose drip, effectively directing rainwater round onto underlying elements, instead of shedding water from the pitched lid, away from the memorial. Note also the tomb chest panel to the left is well out of alignment.

The extent of internal growth issuing from vertical and horizontal joints at the east elevation. Note the left-hand corner block has been forced-out beyond the plinth and the angle of the lid, raised at the left-hand (south) elevation, causing point-loading on the north 'long' panel and flanking corner blocks.

On the left, the north-west corner block being forced out, despite point-loading along the north elevation. On the right, the south-east corner block with its now very dove-tailed joint caused by ivy growth. The joint should be as it is at the top, instead of widening significantly towards the bottom-bed.

Detail of disruption over two courses, forcing significantly weighty blocks apart and breaking fixings (albeit corroded) apart. On the right, after removal of one of the corner blocks showing how the stems are compressed in the joint but still able to exert enormous, damaging forces over time.

Lifting the heavy lid away from the tomb chest. We were able to lift the lid as the stone was assessed visually and 'rung' (assessed audibly) to determine any fractures or geological faults. The stone of this memorial is different to the majority of the other memorials and is stronger for it. There was no delamination despite the extent of deformation witnessed, just some isolated 'scalloping' (scallop shaped areas of loss) due to point-loading.

The mass of ivy stems visible in the south-east corner. Note the internal mitres (indicated) are empty of mortar, which would have prevented ivy from penetrating the joints and moving outwards, seeking daylight.

The thick woody stems visible after removal of all tomb chest elements and which carried on down below ground-level. The scaffold was tight to the plinth due to the weight involved in lifting and lowering the lid which was calculated as weighing nearly ¾ ton, plus the requirement to keep both paths open, for movement around the churchyard by visitors.

On the left, the south-west corner block having been removed, showing the stems continuing down into the next course. Note how there is no bedding in the bottom-bed of the tomb chest panels. On the right, the south-east corner showing the substantial fixing has been pulled apart with the corroded turn-down, left in the left-hand socket. The joint should be 5mm wide not 30mm

Corroded iron fixings which have delaminated to now flaky metal, serving no useful purpose. Luckily there was no iron-staining to speak of, despite there being easy access for excess moisture, with which to initiate the process.
On the right, ivy stems grow easily beneath the fixing, ready to force this one apart.

After removal of all plinth elements. The loose slabs are what the sub-base was made from, loosely arranged on top of one another with very little mortar. Note the ivy stem protruding from the ground (indicated) that was pulled outwards beyond the footprint and cut off. Note the proximity of the headstone plinth in the foreground which hampered the width of the new concrete pad.

During removal of the stone sub-base to get sufficient level and depth for the new concrete pad.

The shuttering and re-enforcing mesh in place, prior to application of the concrete. Note the top-bed of the shuttering and ultimately the concrete pad is lower than the height of the tarmac (indicated). The gap between the two was packed with free-draining washed, clean aggregate. If the pad had been higher than the path, there would have been a huge expanse of concrete at the east (right) elevation, which would have looked unsightly.

The cured concrete within the shuttering and the four plinth blocks now in place. The rear of the joints was packed with coarse bedding mortar to provide additional support/rigidity. The bottom beds of the different blocks had been worked to varying degrees, with some relatively flat and others requiring more bedding mortar to make them level in both planes on the top-bed.

The west elevation 'short' panel being hoisted into position. The Lewis-pins enable blocks to be lowered into position precisely, without the need for removing straps. As none of the blocks were the same height or level on the top-beds, all eight had to be placed on the plinth dry, to see which was the highest and fix them around that block. This process was made much easier with Lewis-pins.

The last of the four main panels being lowered into position. The four corner blocks (which were just manageable by-hand) all fitted differently, with different masons interpretation of the 'bed-moulds' when carving the blocks obvious, during our fixing. Note the joints appear cleaner, having been jet-washed. No cleaning was carried-out on the outer faces.

The tomb chest panels were so wide and in sound condition, there was no need for an internal supporting core. Note the new stainless-steel dog-cramps before being secured into holes/slots originally cut by hand, which we deepened by us in the same manner, them being rectangular. Not one of the cramps was the same length.

The tomb chest constructed with all bespoke cramps secured into position with epoxy-resin. There was a good deal of compromise when fixing the corner blocks, to ensure there were consistent parallel joints from top to bottom. If using the original slots and dimensions there would have been numerous ugly, dovetailed joints.

The inside of the memorial showing the massive footprint of the plinth and the thick tomb chest panels. All internal mitres were packed with mortar and the gunnable mortar used initially where joints were tight at the rear. This adds extra rigidity and strength to the already sturdy new fixings as well as ensuring moisture cannot penetrate.

Detail of the gunnable pointing mortar injected into the rear of the fine-joint that coarse mortar would not fill. Coarse mortar was packed in on top of it. Both mortars are based on NHL3.5 and so are compatible. The greeny-grey epoxy-resin securing the underlying stainless-steel cramp into position. Note the channel appears misaligned. If both sides of the channel were parallel (as they were before dismantling) there would have been a dove-tailed joint on the front face and this detail, will never be seen. Compromises such as this have to be made to give a homogenous appearance to the whole memorial, when re-built. There didn't appear to be much care in its manufacture or construction.

Detail of the concrete pad after the shuttering is removed. A coffin-shaped grave-slab is pushed tight against the plinth on this elevation. Note the tight, uniform joint between the plinth and the overlying tomb chest blocks. The joint between the concrete pad and bottom bed of the plinth blocks undulates significantly to ensure the top-bed of the plinth is flat for the next course and ultimately the lid. Note the proximity of the two plinths to adjacent headstones (indicated) which hampered the size of the new concrete pad.

The west elevation of the memorial after all treatments. Note the uniformity of the joints and the small amount of overhang from the lid, which is rounded and therefore largely ineffective. The step down between the tarmac path in the foreground and the new cast slab is packed with free-draining aggregate. The biological growths on the upstand of the plinth should diminish in time, given it will no longer be saturated.

The memorial before dismantling showing an array of uneven, dovetailed joints caused by poor construction and the effects of ivy, forcing the memorial apart from the inside.

The east elevation after all treatments, note the dark-green biological growths on the plinth should also diminish in this location, however tall grasses were seen to grow against the memorial, before conservation. Note the concrete would have been even thicker at this elevation, had the pad been at the same height or above the tarmac at the opposite elevation.

The south elevation of the memorial before any treatments. Note the amount of deformation to the south-east corner in particular. Note the coffin-shaped grave-slab in the grass in the foreground.

The south elevation after completion of re-building, with soil due to be packed down into where the timber shuttering was for the concrete pad. The coffin-shaped slab will also cover the concrete on this elevation where the ground drops away to a far-greater extent. The downward sweep of the tarmac path can be seen to the left.

A three-quarter view of the completed tomb chest. Note the concrete pad could not be moved over any closer to the William Powell monument, which itself couldn't move any further to the north because of a granite kerb set to an adjacent family plot. The gap between the Griffithes and Powell memorials is a footpath, so it was important to maintain the existing dimension between both.

List of Materials and Suppliers

Material	Supplier	Address	Contact Number
Scaffold Lifting Rigs	Boyd Scaffolding Ltd	Craven Arms Business Park Craven Arms SHROPSHIRE SY7 8NU	01588 672688
Carved Tombchest Lid For Woolacott Memorial Woodkirk Stone – Building Grade	Mc Millan Masonry	Home Farm Leebotwood Church Stretton SHROPSHIRE SY6 6LX	01694 245060
Ammonium Sulphamate Crystals - Herbicide	Furore Products Ltd	118 Plumleys Pitsea Basildon ESSEX SS13 1NG	07905 879407
Hydraulic Lime NHL 3.5 Cement OPC Concreting Ballast Steel Re-enforcing Mesh Building Sand/Sharp Sand (both Bromsgrove Quarry) Roof Slates	Bishops Castle Building Supplies	Bishops Castle Business Park Bishops castle SHROPSHIRE SY9 5BX	01588 638666
Terram – Breathable Membrane Visqueen – Heavy-duty DPM	Travis Perkins - Lampeter	Business Park Unit 1 – 4 Lampeter CEREDIGION SA48 8LT	01570 422521
Celcon Thin-bed Blocks Celfix Mortar	Travis Perkins - Aberystwyth	Glan Yr Afon Industrial Estate Unit 1 Cae Gwyn Llanbadarn Fawr Aberystwyth CEREDIGION SY23 3HU	01970 625679
Lithomix Repair Mortars Fine Ashlar Pointing Mortar Free-flowing Grout	Masons Mortars Ltd	77 Salamander Street Leith Edinburgh MIDLOTHIAN EH6 7JZ	0131 555 0503
Synperonic A7 Surfactant Acetone	Conservation Resources	Units 1, 2 & 4 Pony Road Horspath Ind Estate Cowley OXFORDSHIRE OX4 2RD	01865 747755
De-ionised Water	Motorworld	Teify Garage Cwmann Lampeter CEREDIGION SA48 8JN	01570 423296
Cotton Wool	Claytons First Aid Ltd	Chiddingstone Causeway Tonbridge KENT TN11 8JP	01892 871111
Stainless-steel Dowelling, Flat-bar and Penny-Washers	Metals 4 U	Armitage Works Sandbeck Way Wetherby N YORKS LS22 7DN	01937 534318
Stainless-steel Mesh	Robinson Wire Cloth Ltd	1 Rebecca Street Stoke on Trent ST4 1AG	01782 412521

Epoxy Acrylate – Gunnable Resin	V J Technology	Brunswick Rd Ashford KENT TN23 1EN	01233 637695
Akepox 5010 - Knife-grade Epoxy Resin	C R Laurence	Kingsway Business Park Charles Babbage Avenue Rochdale LANCASHIRE OL16 4NW	01706 863600
RBS Anchor Grout	Resapol Bristol	Unit 2 City Business Park Easton Road St Judes BRISTOL BS5 0SP	0117 941 1525
Skip Hire	J Tranter Skip Hire	Brick Kiln Farm Five Turnings Knighton POWYS LD7 1NF	01547 528269