

## Thornhill St Michael and All Angels Savile Chapel Glazing

*This summary report of our activities in Phase 1 of the glazing project has been produced at the request of Richard Jaques of English Heritage, at a meeting on 5th October to consider the future direction of research/conservation of this significant glass. It should be read in conjunction with our initial condition report of 2008 on the windows of the Savile Chapel, including the Appendix by David Martlew, his notes of the meeting on 5th October, his report on the environmental monitoring and chemical analysis of the glass of the east window, and David Gelder's summary report.*

*We are grateful to all those who have given so generously of their time and expertise in helping arrive at our present understanding of the problems of this glazing: David Gelder and Margaret West, Professor Parker and Dr Paul Bingham of Sheffield University's Department of Glass Science, Brian Pearson and all at Thornhill who have made us so welcome on our many visits, and to Richard Jaques for his helpful direction. Above all, we wish to acknowledge the unstinting and generous support given to us throughout by David Martlew, whose expertise and enthusiasm has guided us thus far. This is a layman's description of the science: any errors are entirely the authors'.*

In February 2010 Brian Pearson authorised us to proceed with investigations on the windows in the Savile Chapel which included "Installing environmental monitoring equipment, carrying out consultations, seeking recommendations and finding suitable persons/institutions to carry out a scientific analysis of the glass in the Doom window, and writing a brief for the scientific analysis and conservation of the glazing in the Savile Chapel."

In 2008 we had prepared a condition report on the Savile Chapel glazing, with scientific input from Dr David Martlew. David rose to the challenge presented by this glass, and took great interest from the outset. It is thanks entirely to him that we were able to invite the interest and assistance of the scientific glass community, through a presentation at the Society of Glass Technology's conference in Lancaster on 18th September 2009.

David also presented a paper on the significance of the east window and unusual nature of the deterioration of the white glasses it contains at the ICON conference on Protective Glazings in York on 10th March 2009.

In response to the formal commission by the client we convened a site meeting on 9th February with Professor John Parker and Dr Paul Bingham of Sheffield University, who assisted us in obtaining suitable monitoring equipment and offering advice as to its installation, to obtain the best possible information from the exercise.

In October 2009 the Church Buildings Stained Glass Committee had considered our report at their meeting. They had recommended that we explore the possibility of a full photographic record, to be carried out by English Heritage, because of the significance and condition of the glass. Initial indications were not hopeful but on 22nd December we were informed in a phone call from Steve Cole, Head of Imaging, Graphics and Survey that this would be done. We liaised as requested with Alun Bull, who attended site on 15th February with us in attendance at his request. The client and we have been provided with copies of his photographic record, which will prove an invaluable tool in monitoring any further changes in condition. The CVMA numbering system has been used throughout to catalogue the photographs. We are very grateful to Alun for finding a time to undertake this work before the sensors were installed.

Having obtained six sensors and leads, these were tested off site for consistency and reliability over various time periods from 1 hour to 1 day. Jonathan devised a support cradle for them to avoid any contact with the glass surface when in position.

After various consultations among the glass scientists and with Tobeit Curteis, the sensors were installed on 1st March, with David Martlew again in attendance. Readings have since been taken two monthly, and sent to David for interpretation.

On our first return visit in June, it was found that the glue attaching the repair glass to the hole in *b* light had failed completely and was hanging precariously and dangerously. Removal of this piece of white glass enabled us to obtain a small sample for chemical analysis. This was carried out by Margaret West of West X Ray Solutions.

We were originally planning for removal of a panel for chemical analysis in Phase 2 but the two analyses carried out by Margaret in the budget for the present phase provide sufficient information on the chemical composition of the vulnerable glass in her opinion, and that of David, to inform our understanding of the processes at work in the deterioration of this glass and contribute to proposals for its future.

The results of the chemical analysis and preliminary findings on the environmental monitoring were reported in a joint presentation to the SGT conference in Cambridge on 10th September and provided to the client in advance of 5th October meeting.

At the beginning of the current phase, we also considered the potential benefits of protecting the window from vibration by means of installing a polycarbonate shield. In the past, road traffic vibration and environmental pollution have at times been advanced as at least partial explanations of the condition of this glass. We now know beyond doubt that the process of deterioration has originated on the internal face, and it is the internal environment which will provide the explanation. Nonetheless, given its current state, vibration from any source is now a risk to the glass.

In the past fifty or so years, the stonework of the east window has been subjected to various interventions, which will have resulted in vibration to the glass: the initial installation of plate glass by the workshops of York Dean and Chapter in c.1956, its subsequent removal in favour of polycarbonate with drilled fixings, and the removal of polycarbonate in favour of guards with new drilled fixings. We explored the possibility of various weights of polycarbonate, and various means of attaching such sheets to the existing wire guards as a temporary measure. The result of our calculations and discussions with David Martlew was that there was a risk of any sheeting producing a percussive effect on the glass, transmitted through the wire guards into the surrounding stonework, and that the effect of suck/blow in the interspace due to air currents at the corner of the building could result in further ongoing mechanical shock to the glass. As we were unable to determine the balance of risk in favour of installation of polycarbonate, we decided not to proceed and reported informally to the client.

The processes of deterioration at work are primarily those of moisture on an inherently unstable glass at the extreme silica end of the range of glass composition. These are accelerated by the cyclical nature of wetting and drying, and the generous heating regime of the building over the last century is thought to be a significant factor. The recent arrival of a very efficient radiator directly under the east window, while clearly not the cause of the problem, has undoubtedly accelerated the deterioration in the last six years as it has produced a wider range of temperatures at the glass surface. As the first readings came in, we recommended that this radiator be closed off and this has been done.

The condition of the white glasses of north side windows is better. We know from the archives that deteriorated glasses in nIII and nIV crumbled on removal by York Glaziers' Trust in 1970s, and have been replaced. Although the windows are all thought to have been produced in York, the north wall glass is earlier, and the glass composition may be slightly different, rendering the majority of the glass less unstable than the east window. Despite the interest and kind assistance of Sarah Brown and her team at YGT we have been unable to locate any samples of the deteriorated glasses removed at time of restoration, and do not know if they survive. In their absence, David has suggested that portable XRF equipment might be used to carry out chemical analysis of the glasses currently in worst condition in these windows. At present, the intention is to isothermally glaze these windows to the interior of the building. Indications are that this will substantially reduce the range of temperatures to which the glass is subject, and the degree of cycling relative humidity which is regarded as so

detrimental to vulnerable glasses. David has further recommended that the sensors already purchased could be deployed at almost nil cost to monitor the condition at the glass surfaces of the temporary glazing of the north windows during 2011.

David Gelder's interest has focussed rather more than David Martlew's on the theoretical impact of heating levels of the building and specifically the drying part of the cycle as an explanation for the deterioration of this inherently unstable glass: if he is correct in this, and if it is found that the composition of white glasses of the north windows is similar to that of the east window, there may be an initial 'shock' to the north side windows as the internal surface layer dries: on balance, and in discussion with both Davids it is our understanding that the long term benefit of reduced range of temperatures and relative humidity is likely to more than outweigh any theoretical problem at the point of changing the environment for these windows. Our assessment of the current condition of the glass is that it can be removed with only the usual risk levels associated with removal of fragile glass of this date. On the basis of our understanding of what the scientists are telling us, we consider that the proposed isothermal treatment of the north side windows is the best means we have of providing a better environment *in situ* over time and retarding further deterioration.

This is not the case for the east window. Our conclusion, reached by close observations and informed by the views of David Martlew and others, is that the present condition of the east window does not permit intervention in the form of isothermal glazing.

At the meeting on 5th October, the possibility that it may well not be possible to conserve the east window by any known means that would enable it to remain *in situ* was formally and seriously discussed. Those present also accepted that conservation and display in very much more controlled conditions would be problematic. There is no risk free strategy for this glass. Moreover, the imminent work to the monuments in the Savile Chapel is likely to pose further risks to the glass.

In view of all the above, we now see Stage 2 as action in the form of removal of the glass from the east window, into storage conditions on site as stable and favourable to the glass as possible, as recommended by the glass scientists. Since the meeting we have discussed in detail with David Martlew what we would recommend in respect of storage for the glass in the event of its removal. We suggested that it should not leave the building: the shock of removal to another environment may be detrimental, the more so as we are not able at this stage to recommend what ideal conditions might be, there are insurance implications, and also practical considerations. In the absence of any evidence that we can improve the prognosis for this window whatever active measures we take, keeping it simple seems best. David accepted this pragmatic argument: he is, however, keen on air exchange at the glass surface, and so storage has to be a compromise, but would suggest archival quality packaging with as much ventilation to the interior of the boxing as is compatible with protection against vibration and dirt etc. This is a relatively low cost temporary short term measure, driven by the perceived risks to the window of the work to the monuments that is imminent. We would propose temporary clear glazing to the openings.

We are very aware of the sensitivity of our recommendations in respect of the east window, as we were when we first agreed to provide a condition report. It is the first time in nearly 30 years that we find ourselves recommending removal of any window, let alone such a significant one, without any prospect of returning it. This concern is compounded by our assessment that removal presents more than average risks and will almost certainly result in further irretrievable loss of original material, however carefully the work is undertaken. If this decision is taken to remove the window, we know that it will be the result of thoughtful and extensive informed discussions with all interested parties, and that we as conservators have a limited role here. The task of removal would be an invidious one, but we consider that the combined experience of Jonathan Cooke and Keith Barley would minimise all associated risks.

October 2010