

Stripping the Land Bare – Conservation and Restoration of William Smith's 1815 Geological Map of England and Wales

By: Nicholas Burnett, Director, Museum Conservation Services Ltd, | Email: mcs@paperconservation.co.uk; Ken McNamara, Director, Sedgwick Museum, University of Cambridge | Email: kjm47@cam.ac.uk; Sarah Finney, Conservator, Sedgwick Museum, University of Cambridge | Email: smf22@cam.ac.uk

On August 1st, 1815 arguably the most important map ever produced in the United Kingdom was published. It proudly announced itself to the world as "A *DELINEATION of the STRATA of ENGLAND and WALES with part of SCOTLAND; exhibiting the COLLIERIES and MINES; the MARSHES and FEN LANDS ORIGINALLY OVERFLOWED BY THE SEA; and the VARIETIES of Soil according to the Variations in the Sub Strata; ILLUSTRATED by the MOST DESCRIPTIVE NAMES*". But the most important name comes next - "By W. SMITH". This gigantic colourful map, measuring 8 ½ feet by 6 feet, documenting in detail for the first time the geology of England and Wales, was the culmination of years of work by one man, civil engineer, canal surveyor and self-made geologist, William Smith (1769–1839).

It is thought that about 70 or so copies of Smith's great map still exist. Some institutions, like the Geological Society of London and the National Museum of Wales, have more than one copy. So does the Sedgwick Museum of Earth Sciences, in the University of Cambridge. This museum, embedded within the Department of Earth Sciences, is the oldest geological museum in the world, having been established following the death of its patron, Dr John Woodward, in 1728.

For many years the museum has been proud in the knowledge that it possessed two of Smith's great maps: one a set of 15 sheets, bound together like a huge book; the other, beautifully preserved, nestles in its leather travelling case. Every couple of years these are displayed for a day in the department to excite another generation of geology students. Two years ago a third, forgotten, copy was "rediscovered" in the collection. Folded in a box with some other early geological maps, it was easy to miss. Unfolding it had to be done with care as it gave the appearance of not having seen the light of day since Queen Victoria sat on the throne. This was clearly in contrast to what it had endured during her reign, as it looked as though it had been exposed to the light for many decades. It was faded, the paper discoloured and it carried the stains of frass from long dead spiders and flies that had used it for their regular battles.

What to do with such a map? The reaction of the librarian of the Department of Earth Sciences, Sarah Humbert, who had relocated the map, was clear - it needed to be hung in the museum for all to see. Who could disagree with that? Given that, to the best of our knowledge, despite the map's great importance, no other museum, library or art gallery has a William Smith map on permanent display, this seemed a wonderful idea. Then reality set in. The map would need conserving, restoring and somehow framing in such a way that it would see off, hopefully, many more reigning

monarchs. With the realisation that the 200th anniversary of the first publication of Smith's map was fast approaching, what better time to display it than on August 1st, 2015.



The map partway through surface cleaning with some of the bags holding loose fragments still in position.

First the map had to be conserved and restored. When the map arrived at Museum Conservation Services it was gently unfolded, photographed, and loose small fragments were collected and placed in polyethylene grip-lock bags labelled according to location. Examination showed a very dirty map printed on 15 sheets of paper which had been hand-coloured using watercolour and lined with linen fabric. The watercolour was badly faded in places. The paper was stained and showed its age, though, somewhat surprisingly, the different sheets of paper had discoloured to different extents. This must have been due to differences in manufacture, use or storage before the map was assembled.

Old linings are sometimes removed during conservation work if they no longer function or are a cause of decay. In this case the fabric lining was left in place. The main reason for this was that the lining was almost certainly original, having most likely been sold "Mounted on Canvass and Rollers" (the rollers no longer being present). Additionally, there were a number of historic inscriptions on the lining which were of significant interest, and the fabric had suffered only minor damage so it could continue to fulfil its original function.

After examination and documentation, the next step was to remove the best part of two centuries of dirt by cleaning the front and back using a variety of soft brushes, specialist cleaning materials and a museum vacuum cleaner. This resulted in a dramatic improvement in appearance, but could we go further? Washing by immersion in water would

remove soluble discolouration and acidity. Small areas were tested, which revealed that large areas of the hand-colouring were very sensitive to moisture. This meant that it was only possible to use very limited amounts of water, so, washing the map was not going to be a practical option.

Individual fly spots were painstakingly removed by hand either dry or with a tiny spot of moisture (or lessened where they could not be removed entirely). Once cleaning was completed, the original fabric lining, where it was torn or damaged at the folds (particularly where they cross), was repaired and strengthened using wheat starch paste and Japanese paper.



Part of the map with an un-faded section from a second copy overlaid in its correct position.

On the front, areas of lifting paper were laid down and re-adhered, minor edge tears repaired and the small fragments were repositioned in their original location where possible. The map was uneven, so to allow the map to lay flat the folds were dampened on the underside with deionised water applied with a Japanese wetting brush. The paper was then dried under light pressure, sandwiched between silk tissue and blotting paper.

Once flat, the edges of the map were reinforced on the back so that it could be attached to an aluminium stretcher. The reinforcement was carried out using a carefully prepared, 100% linen fabric and a Lascaux acrylic emulsion adhesive. The aluminium stretcher was assembled with one cross piece in the short side and two in the long side. The map was attached via the linen strips and progressively stretched over the course of several days until it reached a natural flatness.

The long exposure of the map in the 19th century to light, UV and pollutant gasses had caused some of the colours to fade entirely. This absence of colour meant that the geological information on large areas of the map was missing.

Fortunately the two other copies of the Smith map held by the museum are in superb condition, having been hidden from the light for 200 years. These have allowed us to get a good indication of what the map would have looked like in its heyday. It was therefore possible to add this missing information back in. However, a significant problem to tackle before this could be undertaken was to ensure reversibility, so that the new colour could be safely removed if desirable at a later date. This was achieved by protecting the original surface with a coating to act as a release layer. One of the conservators, Maria Martinez Viciano, selected a number of materials used in paper conservation for testing. Six different solutions were tested on their own and in combination for their suitability. These were applied to a sheet of very discoloured, blank 19th century paper that was found in the conservation studio's old papers stock. A solution of photographic grade gelatine gave the best result, with minimal darkening of the paper substrate, greatest reversibility and the best working surface.



The map partway through retouching. The sections immediately to the right have had only part of the first wash applied. The difference in the black area between the two sections in South Wales is the result of the original hand colouring. No pigment has been added to this area.

After sealing the surface, Maria used Winsor and Newton Artist's Quality watercolours, applying the colour to the faded areas and building it up by a series of washes. Lightfast pigments were chosen where possible, with potentially less stable organic pigments only used where absolutely necessary. The final shades achieved are deliberately paler than when the map was originally published, so that they match the general fading of this particular example and can be visually differentiated from the original colours alongside. The Museum's unbound map was used as a model both for the colours and as to where exactly to apply them. The sheets from this other map were of course protected in polyester pockets while being used. Interestingly, the retouching took about six and a half days to complete: Smith's nephew, the geologist John Phillips, had recorded that in 1815 it took seven or eight days for each map to be coloured.

The application of a large area of colour is very unusual in a paper conservation treatment. This however was an exceptional occasion when it was ethical to replace faded pigment. For a watercolour or other unique artwork it would be unthinkable. In this case, the map was originally coloured by a colourist (probably one Mr Morse) following a master map produced by Smith, and the conservator was performing a similar job.

Some of the damage to the paper, particularly where it caused pigment loss, was also partly retouched so that it visually blended with adjacent areas.

A further challenge was that Smith didn't just produce 350 or so identical copies of the same map. All of the maps are thought to have been produced over at least a four-year period. During that time Smith continued his geological research and was forever making new discoveries and needing to adapt and amend the map, no doubt much to the frustration of the map maker, John Cary. Fortunately the technique of hand-colouring of the maps at least made this possible.

Happily, apart from the first few maps that were produced, Cary and Smith introduced a numbering system for them. Smith signed each one individually and gave it a number, sometimes with a letter prefix. Research carried out in the 1930s established that the maps fell into five series. The restored map has the number a91, making it the last known of Series III, and was (literally) signed off by Smith on January 23rd, 1816. Each series has some changes to the colouring of the geology which, in some parts of the map, are quite significant. Thus establishing where our map falls in the production sequence was crucial for ensuring that any colour restoration was faithful to the original colour scheme.



Nicholas Burnett gained his conservation qualification at Camberwell School of Art and Crafts. He was subsequently one of the first conservators to be Accredited by the Institute of Paper Conservation. His professional career of 32 years started at the British Museum. This was followed by a spell running a conservation studio in the Fitzwilliam Museum. He is currently the director of Museum Conservation Services Ltd where he works for clients both in the UK and abroad. He specialises in works of art on paper and historic photographs. Website: www.paperconservation.co.uk



Sarah Finney is the Conservator at the Sedgwick Museum. She is involved in researching the origin & evolution of the earliest land vertebrates from the Devonian/Carboniferous period. This involves fieldwork to collect fossils in The Arctic & Scottish Borders and working collaboratively with other museums in the UK and abroad. As Conservator at the Sedgwick Museum she cares for the Museum's vast collection of fossils, minerals, rocks and an extensive archive. The Museum has a dedicated conservation laboratory based in West Cambridge.



Ken McNamara is a Senior Lecturer in the Department of Earth Sciences and Director of the Sedgwick Museum in the University of Cambridge. He has written over 20 books and 150 scientific articles on a range of geological and palaeontological topics, with a special focus on evolution and the fossil record. He is currently researching Dr John Woodward whose collection, given to the university in 1728, forms the basis for the Sedgwick Museum.