GEOLOGICAL CURATOR

GCG

Volume 9 Number 9

GEOLOGICAL CURATORS' GROUP

Registered Charity No. 296050

The Group is affiliated to the Geological Society of London. It was founded in 1974 to improve the status of geology in museums and similar institutions, and to improve the standard of geological curation in general by:

- holding meetings to promote the exchange of information
- providing information and advice on all matters relating to geology in museums
- the surveillance of collections of geological specimens and information with a view to ensuring their well being
- the maintenance of a code of practice for the curation and deployment of collections
- the advancement of the documentation and conservation of geological sites
- initiating and conducting surveys relating to the aims of the Group.

2013 COMMITTEE

The views expressed by authors in *The Geological Curator* are entirely their own and do not represent those of either the Geological Curators' Group or the Geological Society of London unless otherwise stated.

 ISSN 0144 - 5294

Cover: Europe's largest nest of dinosaur eggs. See paper by Val *et al*. inside.

THE GEOLOGICAL CURATOR

VOLUME 9, NO. 9

CONTENTS

GEOLOGICAL CURATORS’ GROUP - September 2013

THE STATE AND STATUS OF GEOLOGICAL COLLECTIONS IN THE WEST MIDLANDS AND RECENT WORK TO IMPROVE COLLECTIONS CARE

by Holly Sievwright

Sievwright,H. 2013. The state and status of geological collections in the West Midlands and recent work to improve collections care. *The Geological Curator* 9 (9): 459 - 475.

Past surveys of the 'State and Status' of geological collections in the UK in 1981 and 2001 revealed that significant collections across the country were at risk of decay, with a lack of staff time and expertise leading to their neglect. The West Midlands Regional Geology Stewardship project, funded by the Esmée Fairbairn Foundation from 2009-2012, aimed to gather up to date information on the distribution, condition and status of geological collections across the region's six counties and to provide advice and practical assistance with collections care, particularly to 'orphaned' collections that were deemed to be at risk. Contact was established with 48 museums, societies and universities that were reported to hold geological specimens in Staffordshire, Warwickshire, Worcestershire, Herefordshire, Shropshire and the West Midlands Metropolitan County to determine the current location and status of these collections. Benchmark assessments were carried out at 39 sites to document current standards of collections care and provide recommendations for improving the state of each collection and reducing risks of deterioration. This article summarises data on the distribution, ownership and content of collections in the region and identifies trends in collections management practices relating to agents of decay. Although more than half of the collections surveyed were in a good steady or improving condition, 16 collections or parts of collections were in a poor or declining state; at four of these sites management to improve the state of the collection may not be possible. At the end of 2012, only five museums in the region had a natural science curator on staff. Basic training for non-specialist staff and assistance in geological collections care provided through Regional Geology Stewardship and other similar projects is therefore essential in ensuring that these collections are conserved and made accessible in the future.

Holly Sievwright, The Potteries Museum & Art Gallery, Bethesda Street, Stoke-on-Trent ST1 3DW, UK. E-mail:hollysievw@gmail.com. *Received 1st May 2013.*

Introduction

The West Midlands region, which includes Staffordshire, Warwickshire, Worcestershire, Herefordshire, Shropshire and the West Midlands Metropolitan County (hereafter, MBC), is rich in geological resources and as consequence has been important in the history of geology and geological collecting. Roderick Murchison visited Shropshire in the 1830s and it is said that the systematically documented collections of amateur geologists helped enable him to deduce an order for his Silurian System (Shropshire Geology Society, online resource). Geology was also a key subject of discussion for the Lunar Society, a group of prominent industrialists, natural philosophers and intellectuals including Matthew Boulton and Erasmus Darwin, who met in and around Birmingham from 1765. Other notable collectors of fossils in the nineteenth century include James Bateman, who built a geological gallery at Biddulph Grange in north Staffordshire, Rev. Peter Brodie from Warwickshire and Dr. John Fraser of Wolverhampton. The businessman and industrialist George Maw (1832-1912) from Ironbridge in Shropshire amassed an interesting historically and scientifically valuable collection of UK sedimentology (Roden 1985). Charles Lapworth (1842-1920), remembered for his pioneering work on geological mapping techniques, his understanding of the Lower Palaeozoic and study of graptolites, was the first professor of geology at Mason College, which became the University of Birmingham, and spent much of his time studying the rocks of the Midlands and Welsh Borderland, leading field excursions for local societies, students and professional geologists (University of Birmingham, online resource).

Today around fifty museums in the West Midlands count geological specimens among their holdings. As well as objects associated with these key historical figures, many have specimens from numerous field clubs and societies that sprang up across the country in the late 19th and early 20th centuries. Over 95% of collections in local museums in the Midlands are postulated to have come from this source (Walley 1993). These collections form the foundations of area museums, including those in Stoke-on-Trent (from the North Staffordshire Field Club), Warwick (from the Warwickshire Natural History and Archaeology Society), and Worcester (from the Worcester Naturalist's Club).

The immeasurable historical and scientific value of these geological collections is not always appreciated. Disposal and custodial neglect leading to loss or decay of geological specimens has occurred at several sites over the years (not least when cabinets housing Matthew Boulton's collection of minerals were sold and the specimens tipped into bin bags before being rescued). In the early 1980s, a survey of geology collections across the UK (Doughty 1979; 1981) revealed that collections of historical and scientific significance were at risk of decay and neglect due to a lack of qualified staff, poor storage conditions and limited documentation or organisation. The West Midlands Area Museum Service, set up in 1984, also identified an urgent need for some form of pastoral scheme to provide care for geological collections. In response, the All Midlands Collections Research Unit (AMCRU) was set up to seek out, confirm the existence of, and record natural history collections in the Midlands area during the study period of 1980-1991. The data collected during this survey went towards producing a searchable national database, coordinated by Fenscore, the Federation for Natural Sciences Collections Research (Walley 1993). Peripatetic geology curators were recruited to undertake the curation and, in many cases, the rescue of geological collections that were noted to be at risk. In the West Midlands, this included the rescue curation of Dr. Fraser's collection at Wolverhampton Art Gallery and Worcester City Museum's mineral collection, and the acquisition and curation of George Maw's geological collection at Ironbridge Gorge Museum.

Despite this work, Museums, Libraries and Archives West Midlands (MLAWM), identified geology as a discipline where expertise and collections care across the region had not been renewed. In 2001 a second survey of geology collections in the UK showed that lack of staff time and resources to care for geological collections was still a major concern for many museum staff (Fothergill, 2001). To try to address this problem in the West Midlands, the Supporting Stewardship Traineeship project was set up in 2006, based at The Potteries Museum & Art Gallery (PMAG), Stoke-on-Trent and funded by Renaissance West Midlands, aiming to "Increase subject specialist knowledge in the region to improve stewardship and management of collections and to establish mechanisms to share this knowledge across the region". The Supporting Stewardship Traineeship project highlighted the fact that there had been a regional decline in expertise in the care of natural science collections, which resulted in under use of geological collections and limited time and attention being given to collections care. Many staff felt they were unable to make the collections accessible and relevant to communities, therefore the collections had become 'orphaned', leading to their neglect.

Funding for a new project to build on and extend the work carried out during the traineeship was obtained in 2009 from the Esmée Fairbairn Foundation. Regional Geology Stewardship (RGS), as a discrete project, was designed to utilise the contacts, experience and knowledge developed over the previous two years to raise the level of care for geology collections across the region. This work would consolidate our knowledge of the whereabouts and content of collections and ensure these collections were managed, preserved and used to their optimal extent for future years to come. To this end, the project aimed to offer stewardship for geological collections across the region, ensuring that lesser known collections at smaller institutions were given adequate care and attention, and best practice standards of care for geological collections were promoted at museums throughout the six counties. To aid this, a grant from the Curry Fund of the Geologists' Association was made available to provide conservation materials to smaller institutions with geology collections.

Five specific aims for the project were established:

- Visit each of the 40+ organisations listed in MLA's Fast Forward (2004) as having collections of geological material.
- Complete a Benchmark Assessment of the collections visited. This document provided an overview of material held, noting its condition and accessibility and current risks that might lead to its decay, and giving recommendations on how potential problems might be addressed.
- Offer assistance and advice to organisations who hold geology collections but who do not have staff with this subject specialist knowledge.
- Produce a comprehensive database of geology collections in the West Midlands region, to make

the collections more accessible and improve knowledge about the content and range of collections across the region.

· Build on the support and knowledge of subject specialist groups/networks, establishing partnership working among museums and heritage organisations and encouraging contacts with other organisations such as academic institutions and local geological societies from outside the museum sector.

Here we examine the data collected on geology collections in the region over the course of the RGS project. This data was sourced from benchmark assessments carried out at 39 sites, as well as information about the size, content and status of smaller collections at eleven other institutions gathered during site visits or through phone/email contact. This was done with the intention of building up as complete a picture as possible of the distribution, status, management and condition of geological collections in museums in the West Midlands, highlighting areas for improvement, assessing overall standards of curatorial care, and discussing what the future holds for collections in the region.

Methodology

At the start of the project, a list was drawn up of museums in the region that were likely to hold geological collections. The Renaissance regional document Fast Forward was used to produce a list of 44 museums in the West Midlands, who had declared holding geological material in their collections. New contacts at recently established or otherwise not previously recorded organisations were added to the list over the course of the project through contact with Museum Development Officers (MDOs) and staff at other organisations. The status of school and university collections, including those assessed by Rosemary Roden in 1999-2000, was also investigated.

Initial response to a letter inviting museums with geological collections to get in touch was slow, so a more direct approach was subsequently used to email or phone those responsible for known collections to establish their current status and arrange a visit if required. From 2009-2012 contact was established with staff, volunteers or advisers at 48 institutions, and the assistant collections officers were invited to visit 42 of these sites to assess and advise on geological collections care. Information on the content and status of collections at the other 6 sites was provided by phone or email. A full list of these sites is provided in Appendix 1.

A benchmark assessment was designed to assess standards of care for geology collections in museums in the West Midlands region. This assessment was based on the forms used for the RAW Collections Care Health Check Service, carried out by Jane Thompson Webb (JTW), Birmingham Museums Service, which focused on the ten agents of decay that pose risks to museum collections (Thompson-Webb, pers. comm.; Collections Link, 2011). Whilst these more general benchmark assessments provide valuable information relating to the general buildings, stores or displays, it was envisaged that this particular benchmark assessment would have a much tighter focus on risks to geology collections. The assessment was refined as the project progressed and ACOs identified which factors were most relevant to geology collections in the kind of museums that were being assessed. A template benchmark assessment can be found in Appendix 2.

Assessments were carried out by Stoke-on-Trent Museums Assistant Collections Officers Vicky Tunstall (from 2009-2011) and Holly Sievwright (in 2012) after visiting the site and usually after discussing the collection with those responsible for its care. The assessment recorded the size and general content of the collection, if necessary counting the number of specimens during the site visit. A questionnaire on storage and display conditions was then completed. Potential uses for the collection and areas for improvement were identified. The report, which was sent back to staff at the institution within two weeks of the site visit, included recommendations pertinent to that particular organisation on how to meet approved standards for Accreditation. The ultimate aim of the benchmark assessment form was to increase curatorial capacity and confidence amongst non-geological staff, by providing a standard across the West Midlands for orphaned or abandoned geology collections.

In total, benchmark assessment reports were compiled for 39 institutions. An additional 3 organisations were visited and a report on the condition of objects and priorities for their care was produced, although the size or current status of the collection meant that these collections were unsuitable for benchmarking at the time of visit.

Results

The current distribution of geological collections in the West Midlands region

The map in Figure 1 shows the distribution of geological collections in the West Midlands region. This

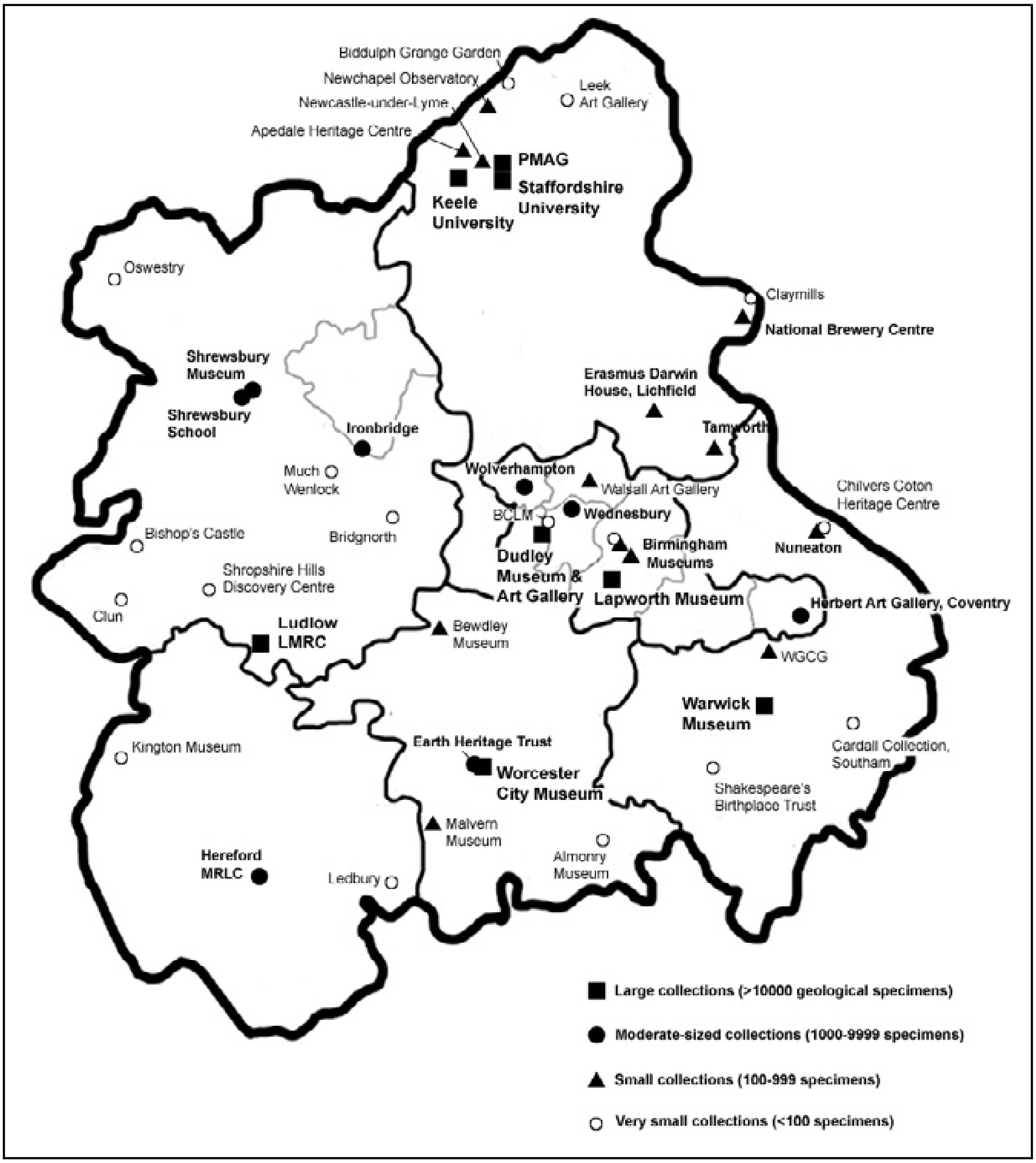

Figure 1. A map of museums in the West Midlands region that hold geology collections.

map can be accessed at http://goo.gl/maps/lRyPg. The interactive map gives the names and addresses of organisations, and the size and a brief description of their geological collections.

Types of museums

Figure 2 shows the types of ownership and management under which museums in the region with geology collections are currently run. Although most of the larger collections are under local authority control, around half of the museums that hold geological specimens in the West Midlands are run by charitable trusts. More than half of these trusts (14 organisations) are run entirely by volunteers. Two large organisations, The Herbert Art Gallery & Museum and Birmingham Museum & Art Gallery, have moved from local authority to trust status in the last five years. One museum, the National Brewery Centre, is run by an independent company and one is owned by the National Trust.

Of the 42 museums involved in the project, 35 are accredited and 2 - The Lapworth Museum at the

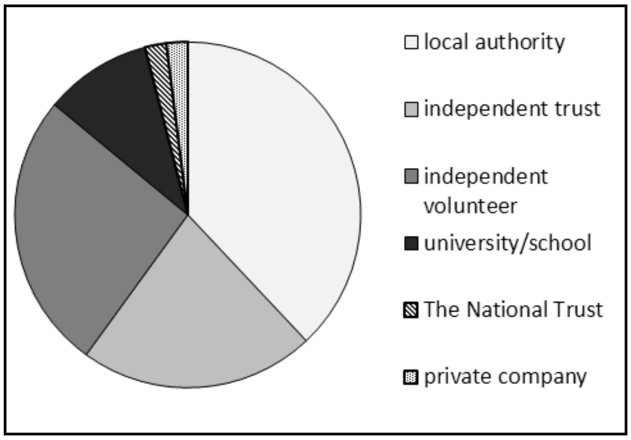

Figure 2. The proportion of museums with geology collections in the West Midlands under different types of ownership and management. Data was available for 42 museums: 19 museums were under local authority control; 11 were independent trusts; 13 were independent volunteer-run organisations; 5 were educational institutions; 1 was owned by the National Trust and 1 by a private company.

University of Birmingham and The Potteries Museum, Stoke-on-Trent - are registered as Designated Collections. Of the 8 not accredited, 3 are in the process of applying, 1 is not eligible for accreditation (being owned by a private company), 2 are university collections and the others are all independent volunteer organisations holding less than 500 geological specimens.

The Size and Content of Geological Collections

Size of collections:

The total number of specimens included in the survey was 446,512 (around half a million). It is thought that this includes the vast majority of all geological specimens in museums in the West Midlands. For the purposes of further analysis, these will be divided into:

- 8 large collections (>10,000 specimens), three of which are university collections,
- 8 moderately-sized collections (1001-10,000 specimens),
- 11 small collections (100-1000 specimens),
- 15 very small collections (<100 specimens).

Content of collections:

On average, the collections included in the survey comprised 53.9% fossils, 17.6% minerals and 20.9% rocks (data provided for 42 organisations).

- The 8 larger collections (>10,000 specimens) were 54.8% fossils, 16.0% minerals and 19.1% rocks. Other objects included archives, maps, thin sections, recent comparative material, plaster casts and geological records.
- The moderately sized collections (1001-10,000 specimens) were 68.2% fossils, 16.1% minerals and 18.9% rocks. Other objects included soil samples, plaster casts and literature.
- The 10 small collections (100-1000 specimens) were 49.6% fossils, 25.4% minerals and 16.2% rocks. Other objects included cut glass, plaster casts and recent shells.
- The 15 very small collections (<100 specimens) were 50.8% fossils, 13.8% minerals and 29.4% rocks. Other objects included in their 'geology' collections were plaster casts, recent corals, knapped flints, Blue John vases, calcified wood and teeth.

Seventeen of the museums surveyed hold nationally important specimens (all 8 large collections, 3 moderate sized, 3 small and 3 very small collections). Nine collections (1 small and 8 very small) only held material of local importance.

Specimens on display:

Dudley Museum had the largest number of geological specimens on display (approx. 2000 specimens, around 10% of its holdings). Other large display collections (200-500 specimens) could be found at universities and schools such as The Lapworth Museum, Staffordshire University, Keele University and Shrewsbury School. The Herbert Art Gallery and Museum (Coventry), Warwick Museum and The Potteries Museum and Art Gallery (Stoke-on-Trent) also had large displays of fossils, rocks and minerals (170-250 specimens).

Six museums had no geology on display (4 very small and 2 small collections); however, most of the other museums with very small collections (10 of the 15 surveyed) had more than 90% of their geology collections on display. Nine museums had 10-50% of their holdings of geology on display (2 moderate sized, 5 small, 1 very small collection). Seven had 1-10% of their holdings on display (3 large, 1 moderate sized, 2 small, 1 very small collection). Nine had 0.1-1% of their geological collection on display (4 large, 3 moderate sized and 1 small collection).

Changes to collections over the last 10 years:

Several of the organisations had recently or were in the process of relocating or redistributing their geological collections. These included: Birmingham Museum & Art Gallery, which transferred all its geology collection to the Lapworth Museum on long-term loan in the late 2000s; Shrewsbury Museum & Art Gallery, whose stored collections are in the process of being moved to Ludlow Museum

Resource Centre; Wolverhampton University, whose mineral collection is due to move to Wolverhampton Art Gallery in the near future; and Staffordshire University, which has had to dispose of around half of its collection during departmental restructure to organisations including Stoke-on-Trent Museums, Apedale Heritage Centre and Liverpool World Museum. Sadly, one collection of around 2000 specimens previously held by the Museum of Cannock Chase was transferred and has since been lost, after being listed in Fast Forward 2004 and included in the initial list of museums to target.

Just 4 museums have reported that their collections have decreased in size since the 2006 Fast Forward survey, while 3 have stayed the same size. The majority have reported an increase the number of geological specimens they hold in the last six years: 4 had a small increase (<10%); 10 significantly increased (10-100%); and 9 more than doubled their holdings (see Figure 3). Thirteen of those included in the project were not recorded in Fast Forward 2006. This shows that several large museums are still taking on new material, either through active collecting or the transfer of specimens from other institutions. Although some smaller museums are also acquiring specimens, in many cases the change in the size of the collection reflects the fact that museums are only now becoming aware of more extensive geology collections in their holdings (e.g. at Erasmus Darwin House, The National Brewery Centre, Tamworth Castle, Newcastle-under-Lyme Borough Museum and Malvern Museum). It should also be noted that previous reports of collection sizes may have been estimates and more recent counts of the number of specimens, particularly for larger collections such as those at Ludlow Museum Collections Centre and the Lapworth Museum, may be more or less than previously anticipated.

The distribution of specialist staff

At the end of the RGS project, in November 2012, just five museums (The Lapworth Museum, The Potteries Museum & Art Gallery, Dudley Museum & Art Gallery, Warwick Museum and Ludlow Museum Resource Centre) employed full-time staff with specialist knowledge of natural science curation. These were all museums with large geology collections run by local authority museum services. Of the university and school collections, the Lapworth Museum was the only institution to have curatorial staff and volunteers caring for the collection. Nationally, when the 1981 report was compiled, 15.7% of museums had a full time geological officer on staff. Excluding those museums with very small geological collections, in 2012 the proportion of institutions involved in the RGS project with specialist staff was 18.5%, indicating that overall levels of staffing may not have changed dramatically in 30 years.

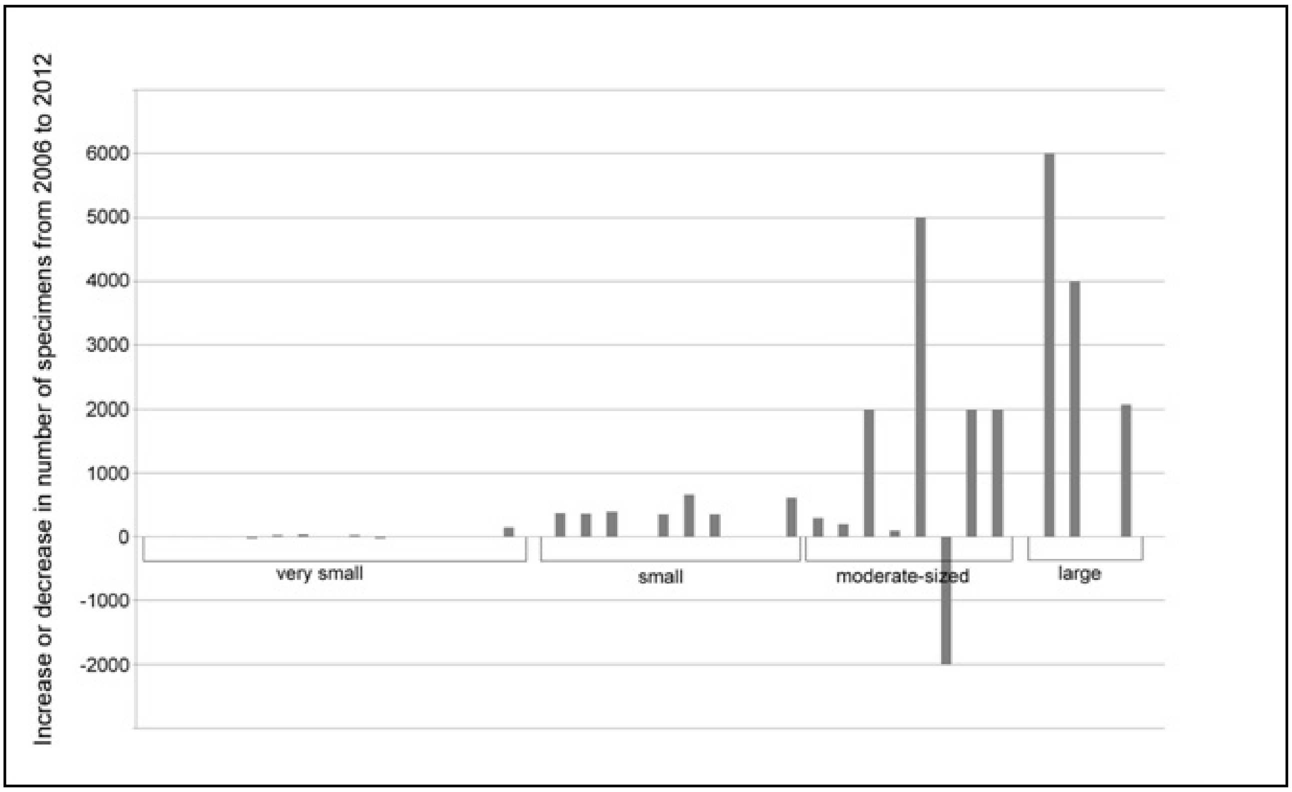

Figure 3. Chart showing the increase or decrease in the reported size of each of the collections surveyed between 2006 and 2012, ranked by the size of geological collection held by each institution in 2012.

Several smaller museums in the study, such as Clun and Bishops Castle, benefit from having curatorial advisors with natural science collections management expertise. Museums also benefit from the assistance of MDOs who can offer advice on storage and display conditions, documentation and other aspects associated with accreditation.

Collections management and the state of collections

Museum collections are said to be affected by a number of agents of decay or deterioration, including: direct physical forces, thieves, vandals, fire, water, pests, contaminants, ultra-violet light, incorrect temperature, incorrect relative humidity, and custodial neglect, which can lead to dissociation from documentation (Costain 1994; Waller 1995). The benchmark assessment examined how these agents might affect geological collections at each of the institutions assessed and provided advice on how to improve collections management and storage and display conditions to limit potential damage. Particular attention was paid to how risks from poor environmental conditions and contaminants can be limited by improvements in storage.

Storage location:

Most collections were stored on the same site as public displays. 21 institutions (65% of those that had at least part of their collection in storage) kept all material in the same building as display areas and offices. 11 of these institutions (35%) had some or all stores in a separate building to their museum display.

Storage furniture:

Most museums had storage furniture made out of inert materials (18 out of 22 for which data was available). Of these:

- 18 organisations had some kind of roller racking or suitable shelving made of wood (5) or metal (13) for storage furniture.
- 7 kept their collection in wooden cabinets (which in many cases was antique).
- 10 used archival card boxes for storing specimens. 5 used plastic boxes, crates or trays. 7 used wooden drawers and 2 used metal drawers.

Storage materials:

Ideally, geological specimens should be kept in acid-free card trays supported with acid-free tissue and/or Plastazote archival foam. Although only a handful of organisations had all their specimens stored in this way, most had at least some of their geological specimens stored in suitable packaging. Practical assistance provided through the RGS project was designed to improve storage to stabilise specimens and prevent decay, build-up of dust or breakage. To this end, boxes, bags, archival tissue and Plastazote were donated to more than 15 organisations and these were used to pack specimens most in need of preservation. By the end of the project, 11 museums were using archival card trays for at least some of their specimens, 8 used bags with acid-free tissue, and 8 used Plastazote to provide additional support either in trays or on surfaces to support large objects. There is still much work to do however, with 7 organisations using inappropriate materials for storage that does not provide adequate support.

Display conditions:

Most museums had adequate support for specimens on display, though some were poorly supported on flimsy shelves or vertically pinned to display backgrounds. Some were resting on hard surfaces and additional Plastazote was required to cushion the display objects. Use of sculpted Plastazote in Perspex-lidded drawers is quite a popular display technique, though specimens can become displaced due to drawer movement.

27 out of 32 museums with geology exhibits had uncased specimens on open display. These were usually larger specimens (e.g. large ammonites and building stones), casts and handling samples.

Indicators of decay:

The three main indicators of poor condition in geological specimens are pyrite disease, dust and breakage. These factors are associated with poor storage, environmental conditions and handling.

- Pyrite decay was identified in specimens at 22 museums, with active signs of deterioration evident at 6 sites (of 39 sites where specimens were assessed).
- 23 museums (out of 39 sites surveyed) had some specimens that were coated with dust and needed cleaning.
- 30 (out of 39) museums had specimens that showed some signs of breakage or bruising, though this may have been caused by poor handling or storage several years ago and not reflect current collections management standards.

Environmental conditions:

Variation in temperature can exacerbate pyrite disease and cause cracking and deterioration of certain fossils, rocks and minerals, as well as encouraging pests. Only 12 of the museums surveyed heated their public galleries and stores 24 hours a day. There was continuous environmental monitoring at 22 museums and 4 did regular spot checks of temperature and humidity; 10 museums had no environmental monitoring in galleries or stores (no data available for two organisations). Eight museums provided additional buffering for vulnerable objects (e.g. placing specimens in a sealed box with silica gel).

Security:
Intruder alarms were the most commonly used method of security and were installed at 27 of 31 sites for which data was available. 23 sites also had CCTV, usually in public galleries. Geological specimens on display were often not of high monetary value and only 6 organisations used case alarms for geological specimens (data available at 21 sites) and just 10 used display cases with secure locks for geological specimens (data available at 18 sites).

Fire risk:
30 museums had fire alarms on site, all of which were tested regularly. Most organisations had a generic emergency response plan but few had a specific salvage plan for collections. In some cases salvage of collections may not be possible.

Water risk:
Only 2 museums had buildings that were not weatherproof (out of 32 for which this data was available) and most were maintained regularly. 9 museums were liable to flooding, either due to the weather or internal leaks. 14 museums had pipes in object spaces, though at all but 2 museums, shelves were at least 2 inches off the floor. However, 14 museums had objects on the floor, either in storage or display areas. Evidence of water ingress was seen at 4 sites.

Pests:
19 museums used pest traps and 13 of these recorded any finds identified. 8 museums had no traps in place and did not monitor insect pests. None of the museums currently had rodent traps in place but birds and rats or mice were noted as a previous problem at 3 sites.

Light:
Light is not usually a problem for geological specimens as most fossils and rocks are not affected by strong light; however, some minerals such as fluorite are vulnerable and can fade if exposed to strong light. Ten museums had light sensitive material on display and half of these (5 museums) controlled the light conditions for these objects; 2 museums had display cases with UV lights to show the colour-changing effect on certain minerals. The majority (22 out of 27 museums) kept their stores dark and blackout conditions were maintained when the museum was not open to the public.

Documentation:
Poor documentation can lead to displacement of specimens and limit how accessible and useful the collection can be. Ideally, each specimen should be accessioned (or otherwise accounted for), with written records and/or a computer database, and each should have a written label and a specimen number, which is marked on the specimen. Movement control slips are important in limiting loss or displacement of specimens when they are moved for display or loan.

- At 21 of the organisations surveyed, collections were all accessioned, with written records available for all specimens. At 12 of the organisations, part of the collection was accessioned; and at 3 organisations, none of the geology collection was accessioned.
- 14 organisations had computer records for all or most of their collection; 9 had records for part of the collection; and 10 had no computer records. (No data available for 4 organisations.)
- At 24 museums, most of the specimens had labels; 6 museums had labels for some specimens (usually those on display); and 6 had no labels for any items. (No data available for 2 organisations.)
- 22 organisations had numbered specimens; 9 had some specimens numbered; and 5 had no numbered specimens (no data available for 2 organisations.) Numbers were marked on all specimens at 21 organisations, and on some of the specimens at 1 organisation.
- 11 museums used movement control slips or another form of documentation to keep track of the current location of specimens; at least 13 did not have any kind of system in place for tracking the current whereabouts of specimens.

Overall ratings

Figure 4 illustrates that geological collections at two-thirds of the sites assessed (26 of the 39 benchmarked museums) were found to be in a good condition overall, with seven collections in a steady condition, 15 improving (or steady-improving), and 4 in a declining state at the time of assessment. Nine collections were in poor condition: one was in danger of further decline in the coming years, but the others were improving with the help of the RGS assistant collections officers and curatorial staff or volunteers on site. At three museums, parts of the collection were in a good, steady condition, while other parts were poor and either improving (1 site) or in decline (2 sites).

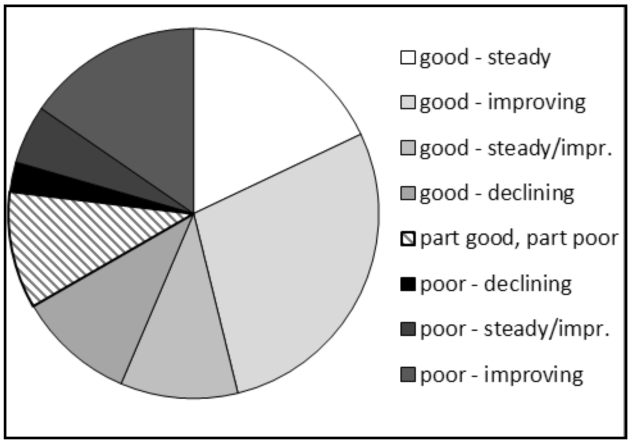

Figure 4. The overall ratings given to the 39 collections assessed on the basis of benchmark scores. Two-thirds of the collections were in good condition, 7.7% were partly in good and partly in poor condition and 23% were currently in a poor state overall.

At seven sites (all with collections in a good, steady condition), minimal management is currently being used and specimen condition is only monitored. At 26 sites, management is being undertaken or will be undertaken in the near future. At four sites, management is required but may not be possible. In one case this was because the collection was not easily accessible and was unlikely to be used, and in three cases this verdict was given in light of the relatively large size of the collections (3000 - 10,000 specimens) and a lack of qualified staff on hand to conserve those showing signs of decay.

Discussion

Assessments and investigations into the whereabouts, condition and status of geology collections in the West Midlands highlighted specific needs for collections care at each of the sites surveyed. Although some large collections such as those at Dudley, Warwick and Stoke-on-Trent are in the care of specialist natural science curators and used in large permanent displays, it quickly became clear that many collections had been neglected for years if not decades. Even at sites where significant historical collections had received curatorial attention in the 1980s and 90s, it was evident that it was not always possible to continue this legacy of good curatorial practice after the work was carried out, leaving significant parts of the collections untouched. Key concerns have been that collections have been stored in inappropriate materials, in inappropriate conditions such as damp basements, leading to problems with pyrite decay, accumulation of dust and loss of information about the provenance of specimens.

These are times of change for museums across the region. The Renaissance in the Region Fast Forward surveys, carried out every two years from 2000 to 2010, highlighted the changes that have been occurring in museums over this short period of time, many of which are quite extensive. Entire collections have been transferred and a number of institutions have seen a restructure of staffing and moves of collections to new stores. As noted in the 2001 UK wide geological collections survey (Fothergill 2005), many university collections, such as those as Staffordshire University and Wolverhampton University, are being transferred to museums as departments have closed or realigned their teaching interests. Unfortunately, it was not possible to track down the current whereabouts of collections previously held by Coventry University or Malvern College that were examined by Rosemary Roden in the 1990s.

Another real worry in most local authority museums has been recent budget cuts, leading to a loss of staff and depletion of specialist knowledge and expertise and the possible need to transfer or dispose of underused collections. At several organisations involved in the RGS project, there was concern that lack of staff time means that future work on geology collections may be limited, and due to high and variable humidity in storage areas, pyrite decay could occur in recently conserved fossils and minerals, which may not be noted until some damage has occurred. For many paid curators, particularly in local authority-run museums, time to work on collections is considered a luxury many cannot afford, as funding bids, events, exhibitions and management meetings to limit the impact of budget cuts often take precedence. Several of the larger local authority museum services are considering following the example set by Birmingham Museums Service and The Herbert Art Gallery to move to Trust status in the near future in the hope that this would improve financial sustainability and give greater freedom in terms of museum management. However, becoming a trust is not without its risks - an example painfully seen in Staffordshire in 2010 when the Wedgwood Museum Trust fell into administration, putting its internationally important collection of ceramics in jeopardy (Atkinson, 2010).

When the first survey of geological collections in the UK was published in 1981, it was hoped that scientifically and historically important collections could be preserved and the risk of further decay might be mitigated by raising awareness of the risks to geology collections, lobbying for legislative safeguarding of museum holdings, and establishing standards for basic levels of care (Doughty, 1981). By 2001 it was found that little had changed in the 20 years since the initial survey, with the focus in museums shifting towards 'learning and inclusion' outcomes, rather than maintaining and conserving the collections themselves (Fothergill, 2005). The RGS project therefore aimed not just to survey and assess collections, but to provide practical assistance and training to ensure that decaying collections were stored suitably and could be accessed and used in displays and educational activities. Over the course of the project, more than 1500 specimens benefitted directly from curatorial work carried out by the Assistant Collections Officers at 20 sites across the region, and informal training and advice was given to around 50 members of staff and volunteers across the 42 sites visited from 2009-2012. An advice pack, created with the aim of providing non-geologists with a comprehensive overview of what to do with geology collections, was also distributed to staff at each of these sites and made available online (at http://westmidlandsmdo.files.wordpress.com/2012/05/advice-pack-for-geological-collections.pdf). Overall, there are obvious benefits to museums with smaller or neglected geological collections having access to help with specialist care. It is recommended that regional assistance with natural science curation should continue to be provided in the future.

The RGS Assistant Collections Officers also worked with the West Midlands Natural Sciences Curators Group to establish a network of support for those responsible for caring for geology and natural history collections. A new website (http://naturalsciencewm.wordpress.com) was set up to promote and gather together information about the natural science collections held at institutions across the region. This can now be developed further with the aim of providing an overview of the content and status of all natural science collections in the West Midlands. To ensure that knowledge about previous curatorial projects is preserved and can be accessed by new curators, an Archive for Geological Collections Care at the Lapworth Museum was set up as part of the RGS project. The archive holds details about the work of geological curators and conservators such as Rosemary Roden and Kate Andrew, as well as copies of the RGS Benchmark Assessments and curation project reports. This should make it easier for future projects to build on the work done by specialist curators in the past. It is recommended that museums involved in the project review their benchmark assessments within the next five years to establish whether recommendations have been acted upon to improve standards of collections care.

Despite the many challenges faced by museums in the West Midlands and across the UK over the coming years, it is hoped that the risks of neglect, loss and mismanagement will be lessened by having this store of information about natural science collections large and small across the West Midlands region. As more people are reminded of the importance of natural science collections in terms of their scientific, historical and educational value and taught about the impact that lack of proper care and poor storage can have, it is hoped that these collections will benefit from being better used, conserved and cared for. Moreover, by sustaining regional subject specialist networks such as the West Midlands Natural Sciences Curators Group, promoting partnership working and exploiting new digital tools for sharing and publicising collections information, museums can reach out to a wider audience, producing larger-scale projects in a more cost-effective way. Ultimately, our rich scientific and geological history can benefit from the lasting impact of curatorial projects - including Regional Geology Stewardship - in preserving this heritage through caring for collections.

Acknowledgements

The Regional Geology Stewardship project was funded by the Esmée Fairbairn Foundation (grant number: 08-4782), with an additional grant for materials from the Curry Fund of the Geologists' Association.

The author would like to thank Vicky Tunstall, the previous Assistant Collections Officer (Regional Geology) at the Potteries Museum & Art Gallery, Stoke-on-Trent, who set up the RGS project, established valuable contacts and carried out many of the benchmark assessments, and Don Steward, Collections Officer (Natural Sciences) at the Potteries Museum & Art Gallery for indispensable advice and help throughout the project.

Assistance and advice from Daniel Lockett (Shropshire Museums Service), Jon Radley (Warwickshire Museums Service), Kate Andrew (previously Herefordshire Heritage Services), Graham Worton (Dudley Museum & Art Gallery), Jon Clatworthy (University of Birmingham) and Rosemary Roden (previously peripatetic geology curator and now volunteer at Worcester City Museum) was also much appreciated.

Assistance from MDOs, especially Helen Johnson, Sue Knox and Emma Buckler, was particularly helpful in establishing contact with sites and distributing advice packs.

Finally, we would like to thank staff and volunteers at all sites involved with the project for kindly inviting the ACOs to visit and view their natural science collections and providing information about collections management and the background to their collections.

References

Atkinson, R. 2010. Wedgwood Museum Trust in administration. *Museums Journal news* [online] Available at: http://www.museumsassociation.org/museums-journal/news/26042010-wedgwood-museum-trust-in-administration.

Collections Link. 2011. Benchmarks for Collections Care. http://www.collectionslink.org.uk/programmes/benchmarks-for-collections-care [last accessed 27 Nov 2012].

Costain, C. 1994. Framework for preservation of museum collections. *Canadian Conservation Institute Newsletter* **14**, 1-4.

Doughty, P.S. 1979. The state and status of geology in the United Kingdom Museums. In Bassett, M.G. (ed.) Curation of Palaeontological Collections. *Special Papers in Palaeontology* **22**, 17-26.

Doughty, P.S. 1981. The state and status of geology in United Kingdom Museums. *Geological Society Miscellaneous Paper* **13**, 1-118.

Fothergill, H. 2005. The state and status of geological collections in United Kingdom Museums: 2001. *The Geological Curator* **8**(3), 53-114.

Roden, R. 1985. Collections Information Network, Geology 1: The George Maw Collection, Ironbridge Gorge Museum. *The Geological Curator* **4**(6), 349.

Shropshire Geology Society. 2012. *Why is Shropshire Important for Geology*? http://www.shropshiregeology.org.uk/sgspublications/Why%20Shropshire%20is%20important.htm [online]. Accessed 27 Nov 2012.

Thompson-Webb, J. *Renaissance At Work Collection Care Health Check*. [documentation provided by the author].

Waller, R.R. 1995. Risk management applied to preventive conservation. Pp. 21-27 in C.L. Rose, C.A. Hawks, and H.H. Genoways (eds.) *Storage of Natural History Collections: A Preventive Conservation Approach*. Society for the Preservation of Natural History Collections: Iowa City.

Walley, G.P. 1993. *Register of Natural Science Collections in the Midlands of England*. All Midlands Collections Research Unit. Nottingham City Museums: Nottingham.

University of Birmingham. 2012. *Professor Charles Lapworth LL D FRS.* http://www.birmingham.ac.uk/facilities/lapworth-museum/about/lapworth.aspx [online]. Accessed 27 Nov 2012.

Appendix 1. List of institutions with geological collections in the West Midlands

County and Museum	**number of specimens**
Herefordshire	
Hereford Museum Resource & Learning Centre*	c.4500
*Butcher Row House (The Ledbury & District Society Trust)**	*39*
*Kington Museum**	*21*
Worcestershire	
Worcester City Museum & Art Gallery (Worcester City Council) *	c.12,000
Herefordshire and Worcestershire Earth Heritage Trust	800-1000
Bewdley Museum (Wyre Forest District Council) *	752
Malvern Museum	729
*Almonry Museum (Wychavon District Council) **	*<1000*
Shropshire	
Ludlow Museum Resource Centre (Shropshire Council) *	c.36,000
Shrewsbury Museum (Shropshire Council) *	c.4000
Ironbridge Gorge Museum Trust *†	c.5000
Shrewsbury School	c.1300
Clun Local History Museum *	96
Much Wenlock Museum (Shropshire Council) *	29
Bishop's Castle Town Council (House on Crutches Museum Collection Trust)*	50
Oswestry Museum	40
*Northgate Museum (Bridgnorth and District Historical Society)**	*13*
Shropshire Hills Discovery Centre (Shropshire Council)	*6*
Warwickshire	
Warwick Museum (Warwickshire County Council) *	c.17,000
Nuneaton Art Gallery & Museum (Nuneaton and Bedworth Borough Council) *	c.400
Warwickshire Geology Conservation Group	c.400
Chilvers Coton Heritage Centre, Nuneaton	29
*Shakespeare's Birthplace Trust *†*	*<20*
The Cardall Collection (Southam)	*12*
Staffordshire	
Keele University	40,000
Staffordshire University	18,000
The Potteries Museum & Art Gallery (Stoke-on-Trent City Council) *†	c.12,000
Newcastle Borough Museum & Art Gallery (Newcastle-under-Lyme Borough Council)*	399
Tamworth Castle (Tamworth Borough Council) *	395
Apedale Heritage Centre	c.400
The National Brewery Centre	c.400
Erasmus Darwin House	126
Newchapel Observatory	111
Claymills Victorian Pumping Station	80
Biddulph Grange Garden (The National Trust)	45
The Nicholson Museum & Art Gallery (Staffordshire Moorlands District Council)	*1*
Museum of Cannock Chase (collection transferred and now lost)	*0*
West Midlands Metropolitan County (MBC)	
The Lapworth Museum, University of Birmingham*†	250,000
Birmingham Museum and Art Gallery (moved to The Lapworth Museum) *	0
Dudley Museum & Art Gallery (Dudley Metropolitan Borough Council) *	20,000
The Herbert Art Gallery & Museum (Coventry Heritage and Arts Trust) *	5300
Wolverhampton Art Gallery (Wolverhampton City Council) *	5000
University of Wolverhampton (moving to Wolverhampton Art Gallery)	500-1000
Wednesbury Museum & Art Gallery (Sandwell Council) *	3622
Thinktank (Birmingham Museums Trust) *	300
Museum of the Jewellery Quarter (Birmingham Museums Trust) *	100
Soho House (Birmingham Museums Trust) *	28
Black Country Living Museum *	23-30
*Walsall Museum (Walsall Council) **	*<20*

Museums listed in bold have a specialist natural science curator on staff.
Benchmark assessments were not carried out at museums listed in italics.
**** accredited museum***
† designated collection

Appendix 2. A template benchmark assessment designed and completed at 39 sites as part of the Regional Geology Stewardship project.

Regional Geology Stewardship

Benchmark Assessment

for Collection held by

INSERT MUSEUM

Esmée Fairbairn FOUNDATION

GEOLOGISTS' ASSOCIATION 1858 THE CURRY FUND

This assessment is based on the forms used for the RAW Collections Care Health Check Service, carried out by Jane Thompson Webb (JTW), Birmingham Museums Service. The RAW forms are themselves based on the Nine Agents of Decay. Many of the sections would form part of the service JTW offers and it is intended that, with prior agreement by organisations visited, recommendations and information may also be passed to Jane Thompson Webb to inform her work of collections within the West Midlands Region.

Whilst these are often more broad questions relating to the general building, exhibitions or displays, it is envisage that in this particular benchmark assessment there is much tighter focused on the geology collection. The information gained, particularly regarding figures and importance of collections, will then be used to update forthcoming Fast Forward editions. Additionally, some of the points raised in the general overview could impact on the collection, and it is useful to have both for reference.

The aim of the benchmark assessment form is to increase curatorial capacity and confidence amongst non-geological staff, by providing a standard across the West Midlands for orphaned or abandoned geology collections.

! symbol will indicate a potential problem. (e = environment, d = document, s = storage etc.)
1-9 numbering will highlight a priority rating for the collection, where **1** is **most urgent**.

Museum Details

Museum	Contact at Museum
Address	Type of Museum & Accreditation details
Benchmark Assessor	Date

Assessment of Collection

Composition of Geology Collection	Yes	No	Narrative
Number of specimens?			
Fossil material?			
Minerals?			
Rocks?			
Other			
Collection relevant to Museum?			*to Museum collecting policy / local regional nationally etc.*
Strengths in collection?			
Additional comments to note			

Access to collection (geology specific)	Yes	No	Potential Problem	Priority Rating	Narrative
Specimens on display?					*inc. number of specimens, then refer to Direct Physical Forces table*
Specimens in storage?					*inc. number of specimens, then follow questions below*
Where are specimens stored?	Offsite Onsite *Additional, including ease of accessing collection*				
Security of stores?	*Include access to stores & refer to Thieves, Vandals & Displacers section too*				
Method of storage?					
Is the collection physically accessible?					
Movement control slips in use within stores?					
Control of visitors / volunteers to stores					
Suitable storage materials used?					

Condition Checking	Yes	No	Potential Problem	Priority Rating	Narrative
Evidence of pyrite decay?					*Past, present? Plus refer to rh & temp tables*
Specimens free of dust and/or other contaminates?					
Evidence of breakage?					
Received previous attention?					*i.e. from Kate Andrew, Rosemary Roden, Jane Thompson Webb, Vicky Tunstall, etc.* *in what form?*

Documentation	Yes	No	Potential Problem	Priority Rating	Narrative
Collection documented / accessioned?					
Register / written records?					
Computerised records?					
Specimens have labels?					
Specimens numbered?					
Numbers marked on the specimens?					
Number refers to records?					
Staff understand and use acquisitions/loans/conservation records procedures?					

Direct Physical Forces	Yes	No	Potential Problem	Priority Rating	Narrative
Display specimens cased?					
Display specimen support adequate?					
Open display behind barriers?					
Gloves used for handling?					
Boxes/trays used for object movement?					
Specimen support adequate in stores					

Thieves, Vandals and Displacers	Yes	No	Potential Problem	Priority Rating	Narrative
CCTV in use?					*Internal External Both*
Intruder alarm present?					
Case alarms present?					
Display cases have good locks?					
Display cases have good seals?					
Glass is laminated / safebreak film?					

Fire	Yes	No	Potential Problem	Priority Rating	Narrative
Fire alarm present?					
Fire alarm tested?					
ERP in existence?					

Water	Yes	No	Potential Problem	Priority Rating	Narrative
Building is weatherproof?									
Gutters checked regularly?					
Regular maintenance of building?					
Building on flood plain?					
Water pipes present in object spaces?					
Shelves in stores at least 2" above floor?					
Objects on floor raised on blocks?					
Evidence of water ingress?					

Pests	Yes	No	Potential Problem	Priority Rating	Narrative
Pest traps placed in museum?					
Traps checked at least 4 times a year?					
Finds recorded?					
Staff confident at identifying pests?					
Rodent traps in place?					
Evidence of birds in building?					
Evidence of bats in building?					
Evidence of other animals in building?					

Contaminants	Yes	No	Potential Problem	Priority Rating	Narrative
Cases have good seals?									
Vulnerable objects cased / boxed?					
Cases made from inert materials?					
Non-inert materials sealed?					
Store furniture made from inert materials?					
Housekeeping carried out regularly?					
Annual deep/winter clean carried out?					
Vacuums with variable suction?					
Paper/textiles stuck up with cellotape?					

Incorrect Temperature and RH	Yes	No	Potential Problem	Priority Rating	Narrative
Museum is heated?					
Stores are heated?					
24 hour heating?					
RH & temperature monitored by spot reading?					
RH & temperature continually monitored?					
Vulnerable objects buffered?					
Silica gel used with specimens affected by pyrite decay?					

Light	Yes	No	Potential Problem	Priority Rating	Narrative
Windows have UV film fitted?					
Windows have blinds fitted?					
Blinds can reduce daylight?					
Fluorescent tubes have UV film?					
Spotlights have filters?					
Lamps are individually dimmable?					
UV levels monitored					*Cont./Spot*
Lux levels monitored					*Cont./Spot*
Meters calibrated?					
Light sensitive material on display					
Light levels controlled for sensitive objects					
Light sensitive objects rotated?					
Stores kept dark?					
Blackout achieved in museum outside opening hours?					
Objects laid on top of each other on display?					

Overall Working Assessment	Yes	No	Potential Problem	Priority Rating	Narrative
Is the geology collection in a desirable condition?	Good Good Improving Good Steady Good Declining	Poor Improving Poor Steady Poor Declining Poor Declining or Lost			Minimal management (monitoring only) Management required and is being undertaken Management required and is going to be undertaken Management required and is not going to be undertaken Management required but is not possible Management being undertaken Management going to be undertaken Management not going to be undertaken Management not possible

PREPARATION OF EUROPE'S LARGEST NEST OF DINOSAUR EGGS

by S. Val, N. Guerrero, C. Cancelo, M. Valls, D. López, R. García and R. Sadurní

Val, S., Guerrero, N., Cancelo, C., Valls, M., López, D., García, R. and Sadurní, R. 2013. Preparation of Europe's largest nest of dinosaur eggs. *The Geological Curator* 9 (9): 477 - 486.

In the present work we describe the whole process of extraction and preparation of a large nest of dinosaur eggs. The dinosaur nest found in the locality of Pinyes is the largest one discovered in Europe and the excavation and preparation processes used were very long and complex.

The discovery of this nest took place in the year 2005. A new campaign of excavations, in 2007, placed particular emphasis on the importance of this nest and it was not until the year 2009 that it could be extracted without damaging the integrity of the fossil.

Its preparation, during 2009-2010, has allowed the researchers of the Mesozoic Group (of the ICP) to study it in depth. The investigation has emphasized the relevancy of the finding worldwide, since it reveals new information on the reproductive behavior of sauropods. The use of excavation techniques based on the acquisition of three-dimensional data helped during the preparation process, and it has allowed very precise results to be obtained regarding the interpretation of their nests and the way these dinosaurs laid theireggs. These results indicate that the nest contained 28 eggs, many more than other nests found in Europe and India. The eggs are positioned in three superimposed levels, and the nest shows an asymmetric, concave and elongated morphology when it is observed in lateral view.

The nest is currently exhibited in the Dinosfera Museum, Coll de Nargó, Alt Urgell (Spain).

S. Val, Head of Department of Conservation-Preparation. Institut Català de Paleontologia Miquel Crusafont. Universitat Autònoma de Barcelona 08193 - Cerdanyola del Vallès, Barcelona, Spain; e-mail valsandra@hotmail.com
N. Guerrero,C. Cancelo, M. Valls, and D. López, Technician, Department of Conservation-Preparation. Institut Català de Paleontologia Miquel Crusafont. Universitat Autònoma de Barcelona 08193 - Cerdanyola del Vallès, Barcelona, Spain.
R. Garcia, Technician Department of Paleobiology. Institut Català de Paleontologia Miquel Crusafont. Universitat Autònoma de Barcelona 08193 - Cerdanyola del Vallès, Barcelona, Spain.
R. Sadurní, Technician in Conservation-Restoration and Chemistry, Freelance of Barcelona, Spain. *Received 1st May 2013.*

Introduction

Researchers of the Mesozoic Group of the Institut Català de Paleontologia Miquel Crusafont (ICP), with Dr Àngel Galobart as head of the Group, have been conducting palaeontological fieldwork in the area of Coll de Nargó (Alt Urgell), where Europe's largest nest of dinosaur eggs was found (Figure 1). The importance of the discovery has been of international significance, given that it provides new information on the reproductive behaviour of sauropods.

This dinosaur nest, found in the locality of Pinyes (Figure 2), is the largest one recovered in Europe, and its process of excavation and restoration has been long and complex. The discovery of this nest took place during the first campaign of excavation at the site of Pinyes in 2005. A new campaign of excavations at the same site in 2007 allowed evaluation of the importance of the discovery and preparation for the work that needed to be done during the years 2008 and 2009, when the whole clutch was extracted from the site without being damaged.

Figure 1. Europe's largest nest of dinosaur eggs.

The palaeontological richness of Pinyes (one of the most important sites worldwide, due to the abundance of dinosaur eggs) has allowed very accurate interpretations to be made about the dinosaur clutches and nests. This clutch had from 28 eggs, many more than the ones found in other fossil sites of Europe and India. The eggs of this nest are arranged in three overlapping levels in an elongated, asymmetric and bowl-shaped morphology that can be observed in lateral view.

The staff of the Preparation-Conservation Team have performed long and costly work in order to recover and preserve this dinosaur nest. Their work began in the fossil site when helping the palaeontologists during the extraction of the whole nest, which turned out to be very complex.

The preparation of the nest lasted more than nine months. The work began in September 2009 and fin-

Figure 2. Site location map (Albert García).

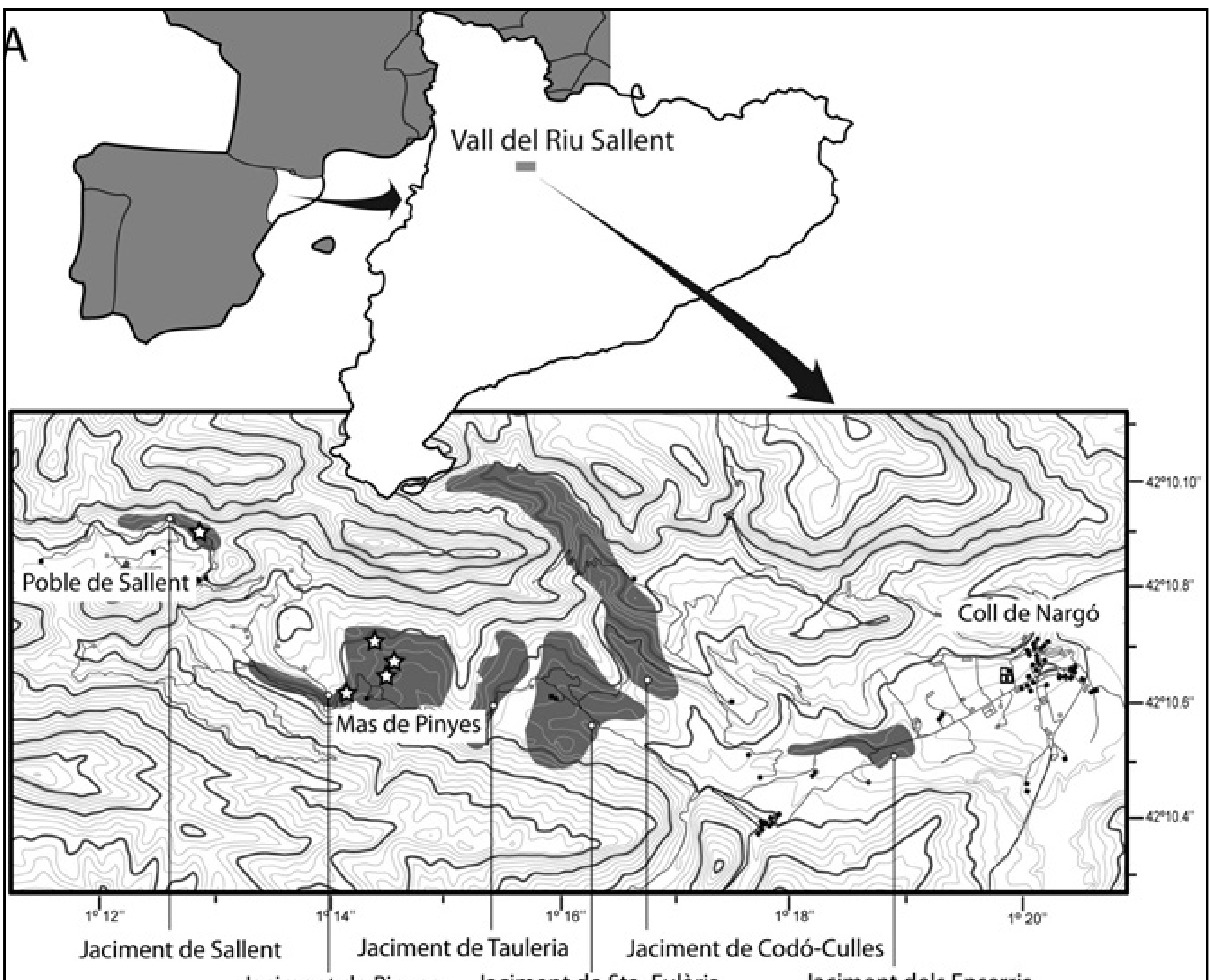

Figure 3. Making the resin and fibreglass binding.

ished in May 2010. The work was done in the Conservation-Preparation laboratory of the Institut Català de Paleontologia Miquel Crusafont (ICP), in the campus of the Universitat Autònoma de Barcelona (UAB). When the nest was ready, a display system that could hold its great weight and that facilitated its transport and manipulation was designed. The movement of the whole nest to the museum was undertaken by a company specialized in moving fine arts, and the complete process was overseen by our team to ensure that the transportation was expedited with care and precision. This nest is currently exhibited in the Dinosfera Museum, Coll de Nargó, Alt Urgell (Spain).

Methodology

This dinosaur nest presented several challenges. The first one was to find a suitable extraction system that would not jeopardise its preservation yet would allow its complete extraction. This was not easy since there was a fault in the central part of the nest, which made it difficult to lift as a whole. The second issue was that the fossil site where the nest was found was difficult to access. We needed to use machinery to extract the nest intact, and make sure that the transport and the manipulation of the fossil was done with care. Finally, we also needed to be able to perform good conservation and preparation techniques on the specimen in the lab, which due to its large dimensions, the hardness of the matrix and the fragility of the eggs, was a difficult task to achieve.

During all these processes it was very important not to lose sight of what was the ultimate objective: the good preservation of the nest in order to ensure that a proper subsequent study by the researchers of the Mesozoic Group of the ICP was possible. It is always extremely important to follow a rigorous working methodology which is respectful for the fossil as well as having a multidisciplinary team of well-coordinated professional preparators.

Figure 4. A metallic structure was build over this binding in order to give it more strength.

The extraction in the field

To ensure the extraction of the nest as a whole we needed to strengthen the fossil by building a special wrapping system that held the fossil together and prevented it from cracking into two parts during its extraction and transport. This binding was mainly achieved through the use of a two-component resin and a powder of mineral crystals, which were applied on a special glass fibre mat especially knitted with a combination of glass fibres of different thickness. This combination of different fibres gives much more elasticity and higher strength to the binding than other glass fibre tissues. The acrylic resin used has a short curing time, low toxicity and high resistance, which makes it very useful for this type of fieldwork. (Figure 3)

Later, a metallic structure was built on top of this binding in order to give it more strength (Figure 4). In addition, a foamwork made with polyurethane foam was added to complete the preparation process for the extraction of the fossil. The polyurethane foam is very resistant and avoids adding weight to the fossil, whilst absorbing shock energy and vibrations that may occur during transport.

Preparation-Conservation in the lab

The methodology followed during the preparation process had several phases. First, we started with the removal of the matrix in order to expose the eggs and

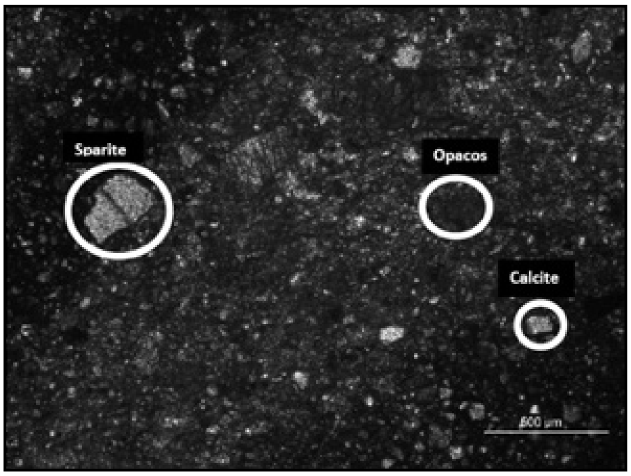

Figure 5. The matrix is mainly composed of small recrystallized crystals of calcium carbonate (sparite + micrite = small yellow crystals), which dominate over the content of opaques (black in colour). The latter have a composition of iron oxides and are combined with a micritic matrix made of calcium carbonate (see fig1). In smaller proportions, we can also see in this picture larger crystals that are also part of the matrix, which have a carbonatic composition and bright colours such as red and blue (due to the polarized light with the gamma filter).

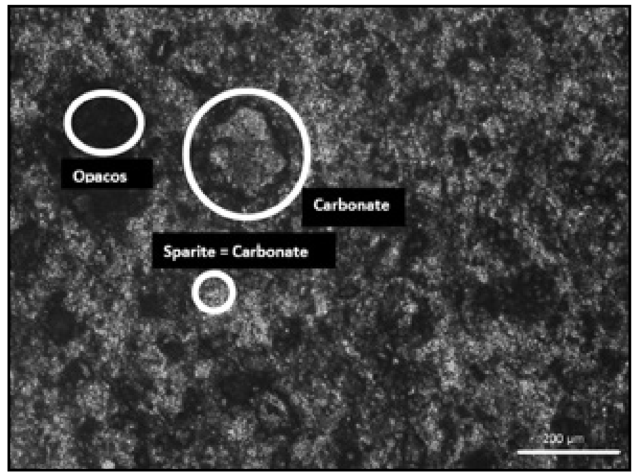

Figure 6. There is quite a large proportion of opaques (iron oxides). Although black color dominates this part of the section, there is also some part of the matrix made of micrite, of calcium carbonate. We can also observe individually developed crystals, with a similar composition to that seen in thin section in fig.4, although their development is not exactly the same, and they are smaller.

study their number and distribution in the nest. No eggs were extracted from the nest; they were all left in the original position in which they were found, since this can give much more information to researchers. The process of removing the matrix was very expensive due to its extreme hardness. First, it was considered interesting to make a petrographic study of the matrix in order to know its composition and decide which preparation techniques would be better to use. A thin section of the matrix was made and observed under a petrographic microscope LEICA DM 2500P. These sections, when observed under polarized light (Figure 5), showed that the matrix was dominated by yellow recrystallized calcium carbonate crystals (sparite and micrite), which are predominant over the opaque red ones, rich in iron oxide, and combined with a micrite calcium carbonate matrix. Other larger and less abundant crystals that constitute the matrix can also be observed. Because of the colours they show (due to the polarized light and the gamma filter), bright blue and red, they are also made of calcium carbonate. In the image of the same section observed under transmitted light (Figure 6) it can be seen that there is also quite a huge amount of opaque iron oxide. Although black colour dominates this part of the section, there is also some part of the matrix made of micrite calcium carbonate.

Once we knew that the matrix had a highly carbonatic composition, we could determine the preparation techniques to be used, which would be mechanical during the first phase of the preparation process and chemical thereafter.

During the first phase, the mechanical preparation techniques were performed using heavy tools in the early stages and other more delicate tools once we got closer to the eggs. The tools with which we started were chisels and hammers, although they were quickly abandoned because they produced dangerous vibrations that could damage the fossil. For this reason, it was decided that the matrix would be removed using cutting equipment that could be more easily controlled, such as small radial stone-cutting machines. The aim was to produce cut marks on the matrix like small grids (Figure 7), which would later be removed using smaller chisels and hammers (Figure 8). This working method could be more easily controlled and prevented the eggshells from suffering fractures due to excessive vibrations.

This first phase was very long and hard. After a few months, the first eggs began to be visible. At this point we decided to change the type of instruments to be used as well as the working methodology. We began to use micro chisels and micro vibration hammers (Figure 9). This type of equipment allowed us to perform much more controlled and delicate work, preserving the integrity of the eggshells.

Figure 7. Cutting the matrix with a small radial saw.

Figure 8. Using chisels to remove the matrix.

Figure 9. Using micro incision tools to remove the matrix when getting close to the fossil eggs.

During the process of removing a large amount of the matrix from the fossil nest, we had to cut the binding of resin and fibreglass made in the field, as well as the metallic structure around it. In order to do this, the use of a radial saw was necessary (Figure 10 and Figure 11).

While getting close to the eggs when removing the matrix, all exposed fossil parts were consolidated with an acrylic resin, Paraloid B-72, dissolved in 15% alcohol and acetone in equal parts. We chose to work at this highly diluted level in order to create a more adhesive binding agent inside the micro cracks of the shells, to prevent their detachment (Figure 12). Acrylic resins such as Paraloid B-72 in matrices as hard as this one and with such low porosity are not the most appropriate, although they can be used as adhesives thanks to their bonding strength (Shelton 1994). For this type of matrix silicoorganic products such as ethyl silicate are much more suitable. These products are made of silicon, which binds strongly to itself, and thus allows the formation of inorganic compounds that are analogous to organic ones and that can hydrolyse and produce silica in aqueous solutions. This silica can join the polar lattice sites of minerals or their hydroxyl groups by electrostatic bonds. In this fashion, its protective and consolidating effect is achieved (Esbert 1997). This type of consolidant can be used in combination with epoxy and acrylic resins, which increase the mechanical strength of their simpler compounds named silanes (Calvo 1997). For this reason we consolidated the part of the matrix that we wanted to preserve as well as the fossil eggs with these silicoorganic products. Paraloid B-72 was also applied to the parts that were more exposed.

After the removal of the matrix that covered the eggs, it was observed that the nest had a total of 27 eggs. We performed a bonding process on the large fractures of the matrix in order to prevent the nest from breaking apart. For this process we injected a high strength epoxy resin under high pressure into the cracks. In order to make this process reversible, we applied a layer of acrylic consolidant at a very high percentage (20%) to all contact areas. The reversibility of the union is an important factor to consider in any preparation or restoration intervention. The effects of epoxy resin are difficult to reverse, although we could eliminate it easily using a dissolution of the acrylic resin in the contact areas.

The rough surface of the eggshells had a significant layer of matrix attached to it, which did not allow a clear observation of its surface structure. We wanted

Figure 10. Cutting the resin and fibreglass binding.

Figure 11. Cutting the metallic reinforcement.

Figure 12. Consolidating eggs with Paraloid B-72.

to thoroughly clean the surface to facilitate its better study and observation. For this delicate surface cleaning process it was important to test the products to be used on different fossil eggshells with different types of matrices. These tests have been done by our team over several years of work (Val 2007; Val *et al.* 2010, 2011). Thus, we could use the results obtained before in fossil eggshells with matrices similar to this one. Traditionally, cleaning fossil eggshells especially for studies for electron microscopy is done with the help of organic acids such as acetic acid (Fredholm and Mattiasson 1985; Ivy *et al.* 1994; Shelton 1994). This type of acid cleaning treatment had a significant risk involved in the preservation of the shell, since the eggshells are made of calcium carbonate and therefore the acid also attacks them (Figure 13a).

Our team began to develop another working methodology based on attacking other elements of the matrix other than carbonate. Other more alkaline chemical agents were tested to try to attack the silicates instead of the carbonates of the matrix (Figure 13b) (San Andres Moya and de la Viña Ferrer 2004), as well as other agents that transform calcium carbonate into another more soluble type of carbonate, which could therefore be removed easily without using acid (Figure 13c). As can be seen in the electron micrographs (Figure 13b), the most effective treatments seem to be those using potassium hydroxide (KOH). However, this product has a complicated application and a difficult neutralization, which must be done with the aid of ultrasonic bath machines in order to avoid the presence of traces that can recrystallise afterwards. These factors made us choose the treatment that used sodium hexametaphosphate $(NaPO_3)_6$, which is also very effective and less aggressive (Figure 13c). Moreover, it is much easier to apply and neutralize with the help of simple dressings (Val 2007; Val *et al.* 2010, 2011).

Sodium hexametaphosphate $(NaPO_3)_6$ is a polyphosphate that acts as a sequestering agent. It exchanges its sodium ions (Na+) with the calcium ions (Ca_{2+}) of the calcium carbonate ($CaCO_3$). Calcium carbonate is poorly soluble in pure water (H_2O). However, once it gets these calcium ions (Ca_{2+}), it transforms into sodium carbonate ($NaCO_3$), which is highly soluble in water. This way we can attack the carbonated matrix without using acid, which is much more aggressive, and we prevent any damage to the eggshells, since the calcium carbonate of the eggshells is much stronger. The chemical reaction that occurs is as follows:

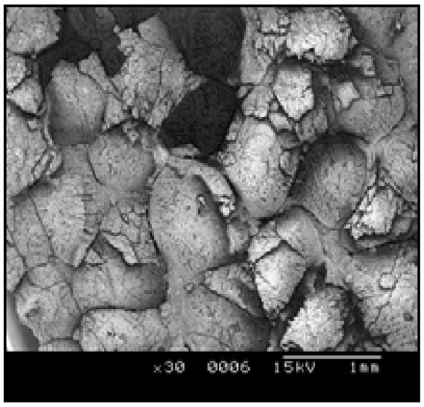

Figure 13a Acetic acid

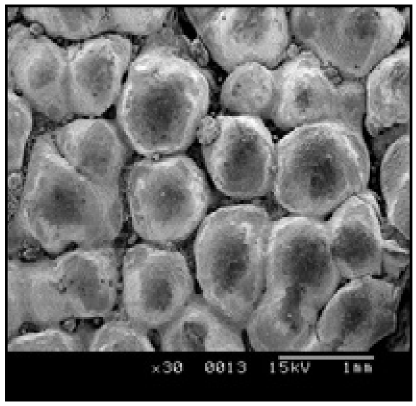

Figure 13b - KOH.

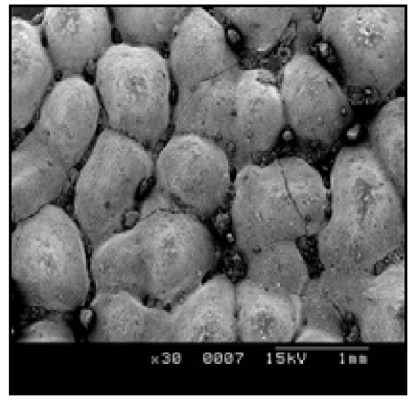

Figure 13c - $(NaPO_3)_6$.

$$\underset{(s)}{2CaCO_3} + \underset{(aq)}{(NaPO_3)_6} \rightleftarrows \underset{(aq)}{Na_2Ca_2(PO_3)_6} + \underset{(aq)}{2Na_2CO_3}$$

The cleaning methodology began with the removal of the acrylic resin present on the surface, since it could prevent the good performance of the cleaning chemical. Next, Japanese paper sheets were applied on the surface of the eggs, and were stuck to them with the application of a water nebula (Figure 14). After that, paper pulp soaked in a 10% solution of sodium hexametaphosphate $(NaPO_3)_6$ in distilled water was applied on top (Figure 15). This pulp, once applied, was covered with plastic to prevent the evaporation of the solution, and left to react for 24 hours. After that, the pulp was removed and some more was reapplied. This process was repeated twice. Once the pulp was removed, the surface of the eggshells was cleaned with the help of brushes, resulting in an optimum level of cleanliness (Figure 16 a-b).

After the chemical cleaning was over, we proceeded to neutralize the action of the cleaning chemical, which has a slightly acidic pH (pH=6), with the application of paper pulp soaked in distilled water. During this process, the pulp must not be covered with plastic because we are depending on the evaporation through capillary rise of the product that still remains on the surface of the eggshells and inside the fossil eggs. The idea is to transfer to the pulp the remains of the chemical product that may still be attached on the surface of the eggshells by a simple absorption process. Subsequently, pH measures of the pulp must be made, repeating the process until a neutral pH of 7 is achieved. The neutralization

Figure 14. Applying Japanese paper over the eggs.

Figure 15. Applying paper pulp soaked in $(NaPO_3)_6$.

process is essential after any chemical treatment in order to avoid greater damage in the future, resulting from the action of chemical residues that may be deposited on the fossil.

Once the preparation of the nest of dinosaur eggs was completed, we decided to strengthen the whole fossil nest by building another metal structure adapted to the new shape of the nest (Figure 17). After that, we applied another binding over this metallic structure, made with the same resin and fibreglass as the one made in the field. The aim was to continue to maintain the integrity of the entire nest.

Before the preparation process was over, we wanted to give a finishing touch to the fossil nest, to make it tougher and more attractive for display purposes. For this reason, a custom-made wooden box with support pieces on its base, useful for handling and transportation was designed. After that, the whole nest was lifted with a boom truck and placed in the wooden box (Figure 18).

The remaining space in the wooden box was filled with polyurethane foam in order to support the fossil. To prevent the contamination of the fossil nest with the gases given off by polyurethane, it was covered with a resin layer that isolated it. Later, desalinated sand was applied and adhered over this resin layer with nebula acrylic resin. This way a great exhibition effect was achieved, since the fossil nest got the look it had when discovered at the fossil site (Figure 19). Finally, the box was painted with ecological varnish to beautify and better protect it (Figure 20).

In order to transport the nest to the museum for exhibition, a company specializing in the transportation and handling of fine art was hired. A custom box for transporting the fossil with a special structure on its base that made it very strong and distributed the weight of the fossil was made. At the same time, this base was also used as an exhibition stand (Figure 21).

Conclusions

The extraction and preparation works performed on the largest nest of dinosaur eggs found in Europe required the use of new systems and working methods, both in the field as well as in the lab. These new

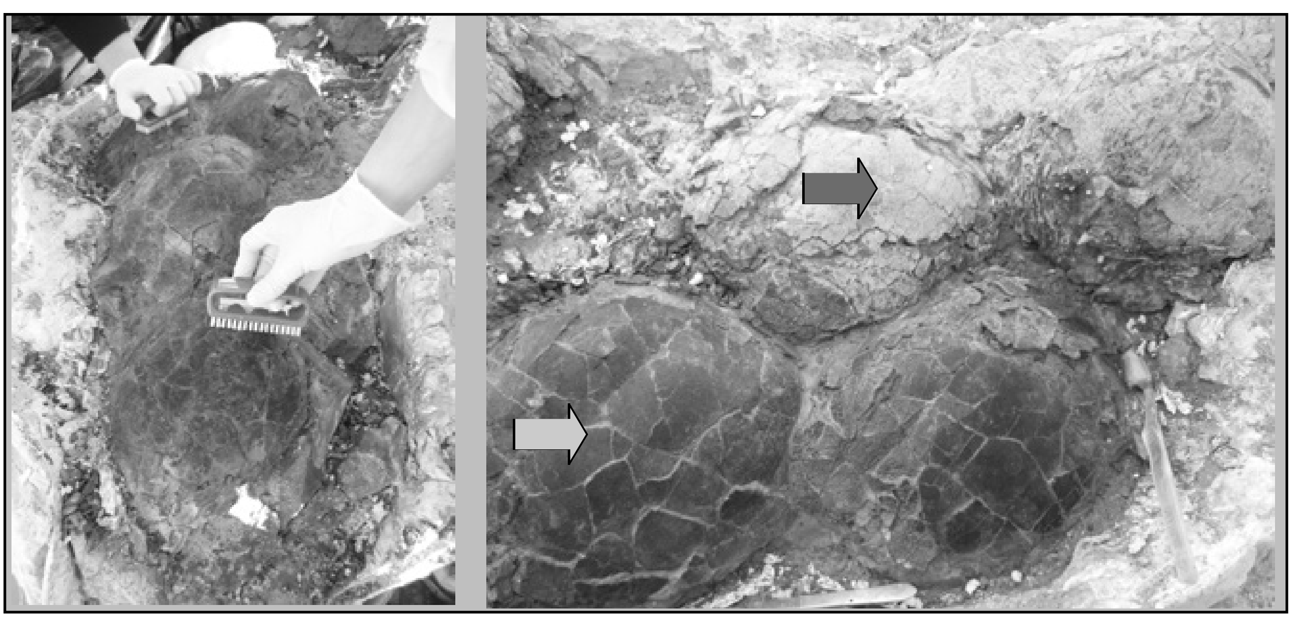

Figure 16a Cleaning up after treatment. *Figure 16b Clean and still dirty eggs.*

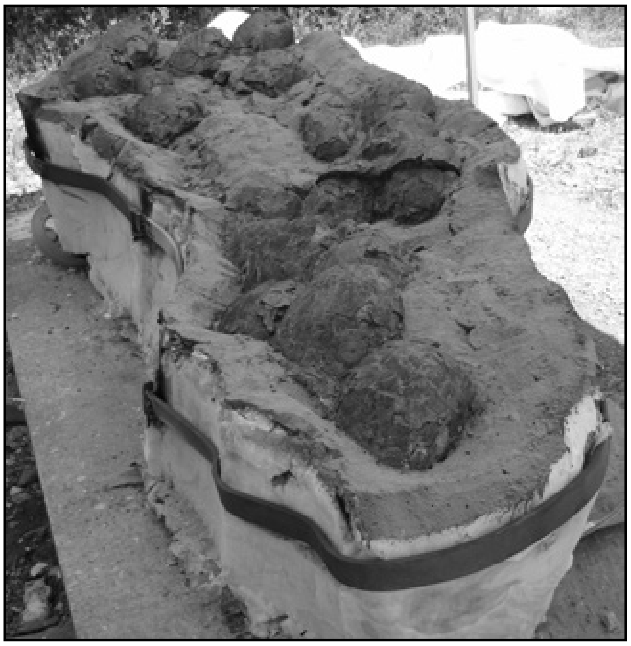

Figure 17. Metallic structure adapted to the new fossil outline.

Figure 18. Placing the fossil nest into the custom-made wooden box.

working systems have given very positive results and represent a very useful and interesting source of information for future works in the field of palaeontological conservation-preparation.

It is important to note that a preliminary analysis of the composition of the materials to be prepared is strictly necessary, as well as performing various tests to study the possible effects preparation techniques may have on fossil remains. This is the key to good preparation work when wanting to find new ways of working not tried or tested before. Never make assumptions without a prior test, since that could lead to the future destruction of already-prepared fossils.

It is always interesting to test new working methodologies which are respectful of the materials under study. To respect the original fossil remains, as well as ensure their good future preservation, is the key to enable a good study of these fossil remains and allow future generations to enjoy our palaeontological heritage. For this reason, sharing our own experiences with other professionals in this field is very rewarding and helps us grow together.

Figure 19. Application of desalinated sand with Paraloid B-72.

Figure 20. The finishing touch for display.

Figure 21. Transport to museum for exhibition.

Acknowledgements

We appreciate the work of the entire research team of the Mesozoic Group of the Institut Català de Paleontologia Miquel Crusafont (ICP) for giving us the opportunity to prepare this nest, especially to Dr Bernat Vila and Albert Garcia, for the good times during the extraction process and the preparation of the fossil. We would also like to thank Dr Xavier Jordana and Jose Maria Robles for the realization of the petrographic study of the matrix, and the professionalism of Emilio Palazón for his participation in the removal and transport of the nest.

References

CALVO, A. *Conservación y restauración. Materiales técnicas y procedimientos. De la A a la Z.* Ediciones del Serbal, 1997

ESBERT, R.M, ORDAZ, J.,ALONSO, F.J., MONTOTO, M., *Manual de diagnosis y tratamiento de materiales pétreos y cerámicos*. Ed. Col.egi d'aparelladors i Arquitectes Técnics de Barcelona, 1997

FREDHOLM, D. and MATTIASSON, B., 1985. Acetic Acid and phosphatic fossils. *Journal of Paleontology* **59**, 952-956.

RUTZKY, I.S., ELVERS, W.B., MAISEY, J.G. and KELLNER, A.W.A. 1994. Chemical preparation Techniques, pp.155-186 *In* Leiggi, P., May, P. *Vertebrate Paleontological Techniques*. Cambridge University Press vol.1.

SHELTON, S.Y. 1994. Conservation of vertebrate paleontology collections, pp. 3-33. *In* Leiggi, P. May, P. *Vertebrate Paleontological Techniques*. Cambridge University Press. Vol. 1.

SHELTON, S.Y. and CHANEY, D. 1994. An evaluation of adhesives and consolidants recommended for fossils vertebrates, pp. 35-47. *In* Leiggi P, May P. *Vertebrate Paleontological Techniques*. Cambridge University Press vol.1.

SAN ANDRES MOYA, M., DE LA VIÑA FERRER, S. 2004. Ácidos y bases, pp.121-147. *In* Fundamentos de química y física para la conservación y restauración. Ed. Síntesis. Patrimonio Cultural.

VAL, S. 2007. Ensayos de limpieza sobre huevos de dinosaurio, pp.115-117. Fundamental-Laboratorios de paleontología.

VAL, S., CANCELO, C., VILA, B., SALLÉS, A. 2010. Preparation of dinosaurs eggshells: New insights to traditional techniques. Pòster- 3rd annual Fossil Preparation & Collections Symposium- The Field Museum Chicago-April 29-May 1, 2010

VAL, S., LÓPEZ, D., GARCÍA, R., 2013. Chemical Preparation of dinosaurs eggshells. Rev. Curatorial, Centre de Restauració i Interpretació Paleontològica, Els Hostalets de Pierola, Barcelona.

GALLERY REVIEW

THE CHURCHILL AND SARSDEN HERITAGE CENTRE, CHURCHILL, OXFORDSHIRE

by Owen R. Green

It is not often that the geological community and specifically a museum curator, is compelled to offer thanks to a politician or Member of Parliament. James Haughton Langston (1796 - 1863) may prove a rare exception, although a touch of vanity in his actions (not unknown amongst politicians) cannot be ruled out. Langston lived in west Oxfordshire on the Sarsden Estate, in a 17th century house of the same name that he had inherited in 1812. He was the Member of Parliament for the City of Oxford for two terms, 1826-1835 and 1841-1863. During 1826, he was instrumental in funding the construction of a new church in the Oxfordshire village of Churchill. Architecturally the church consists of a mixture of imitations. The tower is a scaled down (approximately two-thirds) version of the Magdalen College tower in Oxford, whilst the hammer-beam roof of the nave is modelled on Christ Church Hall, Oxford. The buttresses are versions of those of the chapel of New College, Oxford. One noticeable feature, again derived from Magdalen Tower, is the external staircase leading to the ringers' chamber, while the windows are modelled on those of various Oxford colleges. The Church, known as All Saints, was completed and consecrated in 1827. The church suffered extensive damage in 2007 following a fire, and it took two years to complete the restoration.

The geological community has to thank the local Squire of Sarsden and Churchill, James Langston MP, for not building the new church on the site of old church (in the Lias Clay based vale), but at the top of a scarp on the Inferior Oolite Clypeus Grit limestone, ensuring the tower could be seen from miles around. However, the old church occupied a site at the centre of the village on which a church had stood since the 14th century. Twenty houses of the original village were destroyed by a disastrous fire in 1684 started by a baker who, to avoid a chimney tax, knocked through an adjoining wall into a neighbour's chimney. The wooden framed, thatched roof buildings of the old village were abandoned, and new stone buildings were rebuilt higher up the hill. The site of the old village is still evident as grassy mounds in the pastures to the south of the old church and graveyard. As the village 'migrated' up the hill, the old church was partially demolished, until only the old chancel was retained, and despite partial restoration in 1869 and use as a mortuary chapel and to house memorials, its condition deteriorated and demolition was threatened in the 1980s.

Figure 1. The Old Church chancel, now restored and housing the Churchill and Sarsden Heritage Centre.

The Churchill and Sarsden Preservation Society was formed in 1988 to fight for its survival as the last mediaeval building in Churchill. It is thanks to a dedicated and energetic group of fund-raisers and grants that over £30,000 could be spent in restoring the roof and building. Over ten years after initiating the project the Heritage Centre was finally opened in 2001 in the restored chancel (Figure 1). The museum at Churchill is possibly the smallest museum in Oxfordshire, with the building measuring approximately 4.6m (15') by 9.1m (30'). In 2010, the Centre's management committee was awarded a Heritage Lottery Fund grant to enable work on the maintenance of the building, enhancing the displays and extending the outreach projects undertaken by the Centre. The Heritage Centre is also supported by grants from West Oxfordshire District Council and Friends of the Cotswolds. The Centre re-opened in April 2011 with the addition of touch screen displays, new exhibits and exciting plans for wider public engagement (Figure 2).

Figure 2. Inside the Heritage Centre touch screens to the left and right provide information on the lives of Warren Hastings, William Smith and James Langston.

But why would the community of a small Oxfordshire village undertake such an ambitious project? The village of Churchill is the birthplace of two significant figures in British history: Warren Hastings (1732 - 1818) was born in Hastings House on Church Hill, subsequently renamed Hastings Hill, and as a young man joined the East India Company, and eventually went on to become the first Governor-General of India. On his retirement from office and return to England, and surviving impeachment and a seven-year trial before the House of Lords (a plaque in Westminster Hall indicates the place where Hastings attended for the 142 days the court was in session), he returned to the Cotswolds to repurchase his ancestral home estate of Daylesford situated 8km to the southwest of Churchill in Gloucestershire (and then situated within a detached part of the county of Worcestershire).

However, perhaps the most famous son of the village is William Smith (1769 - 1839), 'the Father of English geology', and the main reason why the geological community has to be thankful to a Victorian politician in funding the building of a new church within the village. Smith's humble beginnings were not that of the typical noble or clerical gentleman scientists of the late eighteenth and early nineteenth century; indeed he had been excluded from the institutional development of the science of geology. However, unlike the Dorset fossil collector Mary Anning, Smith did gain some recognition during his later life, but as the state-of-the-art touch screens (Figure 3) installed in the Heritage Centre illustrate, brief fame and little fortune were achieved through considerable hard work, undertaking diverse geological related projects and obtaining commissions in many parts of the country. Smith's remarkable story did, however, begin in Churchill.

Smith was born on 23rd March 1769 in Churchill, where his father was the village blacksmith. Sadly, the house has been demolished, but the site is one of several around the village that are connected with his life. His father died when he was eight, and in 1779 his mother was remarried to Robert Gardner, the landlord of the Chequers Inn. Fortunately, the Chequers Inn remains a thriving hostelry, and members of the geological community can, with a clear conscience, raise a glass to the memory and geological legacy of William Smith.

As a young boy Smith spent some time on his uncle's farm in the village of Over Norton, 5km to the north-east near Chipping Norton, and at the age of eighteen he became an assistant to the land surveyor Edward Webb (1751-1828) and moved to Stow-on-the-Wold, 8½km to the west. Four years later in 1791 Smith was sent by Webb to survey and value an estate at Stowey in Somerset. The rest, as is frequently said, is history. Smith's examination of fossils found at outcrop and along newly dug canal cuttings enabled him to formulate a theory that established the chronological order of strata in England and Wales, and he eventually prepared a geological map published in 1815 and depicting 23 different strata in 21 colours. His life's work has been popularised by the biographical publications of Simon Winchester (2001) and John Morton (2004), now supplemented by a pamphlet produced by the Heritage Centre. New for 2013 is the 'Secrets of the Landscape' trails guide produced by the Oxfordshire Geology Trust and the Heritage Centre. Four walks will guide the

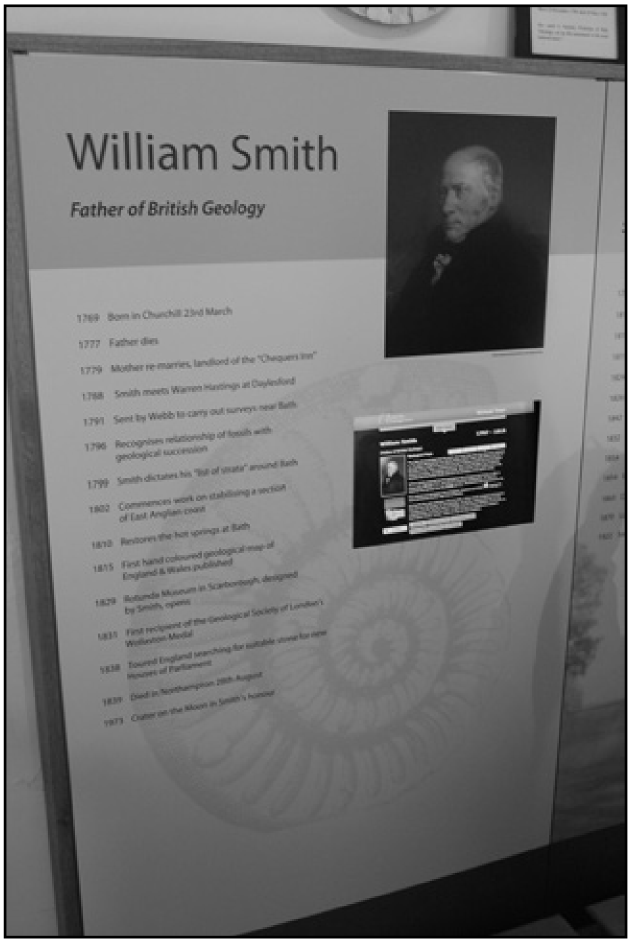

Figure 3. The interactive screen and display relating to William Smith.

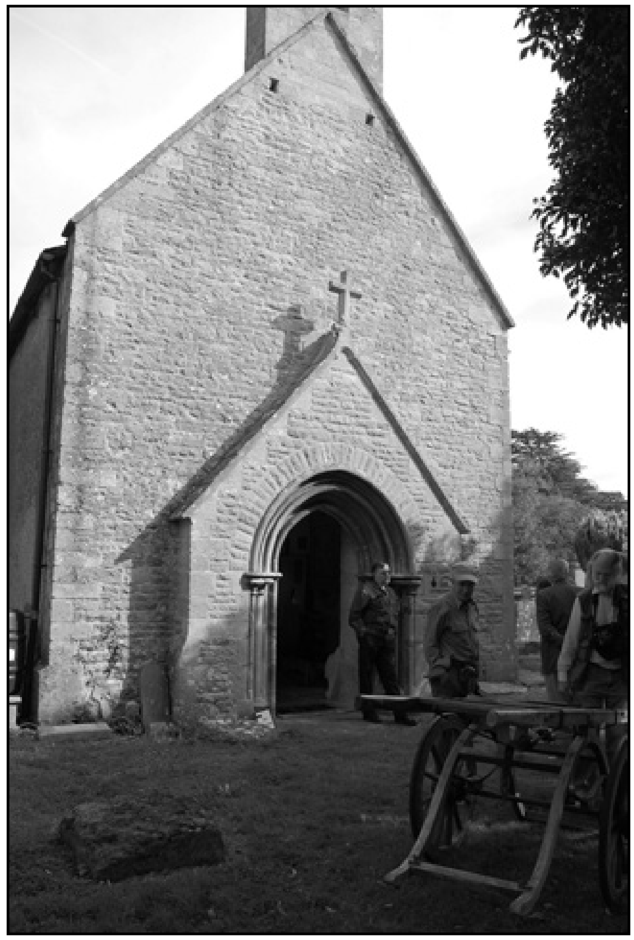

Figure 4. The west door entrance to the old chancel.

visitor around the village and along the bridleways and footpaths indicating local geological features and building stones.

There is little evidence of Smith returning to his childhood village (although he returned to Oxford in 1832 to receive the Wollaston Medal from the Geological Society of London in a ceremony at the Sheldonian Theatre), but his achievement is commemorated by the 4.5 metre monument constructed from Middle Jurassic 'Rugg stones' - large silicified blocks of Chipping Norton Limestone, purported to be from nearby Sarsgrove Wood, and situated on a small green in the middle of the village. It is also commemorated in detail by the touch screen exhibition in the Heritage Centre where his extraordinary story can be traced, together with examples of his revolutionary geological maps.

The part played in the community by the village squire, James Langston (1796-1863), is also displayed on a third touch screen unit, while the Heritage Centre also has all census returns for Churchill and Sarsden for the years 1841, 1851, 1861, 1871, 1881, 1891 and 1901, plus many other local records, maps, building records, photographs and local family trees. Staffed by volunteers, the Centre (Figure 4) is usually open from April to September on Saturdays and Sundays from 2-4pm, and at other times by appointment. Further information can be found on the website at: http://www.churchillheritage.org.uk/index.html.

Acknowledgements

I would like to thank Alan Watkins and David Chambers of the Churchill and Sarsden Preservation Society for inspirational discussions on the history of the village and the biographies of Smith and Hastings in the Chequers Inn. Special thanks to John Nudds and Cindy Howells for comments on the manuscript and suggesting a 'gallery review' during the field trip for the 60th Annual Symposium of Vertebrate Palaeontology and Comparative Anatomy held at Oxford in September 2012.

References

MORTON, J.L. 2004. S*trata: the remarkable life story of William Smith, 'the father of English Geology*, 2nd edition. Tempus Publishing, Horsham. 170p.

WINCHESTER, S. 2001. *The Map that changed the World: the tale of William Smith and the birth of a science*. Viking (Penguin Group), London. xiv + 338p.

Owen R. Green, Department of Earth Sciences, University of Oxford, South Parks Road, Oxford, OX1 3AN. E-mail: oweng@earth.ox.ac.uk

EDITORIAL NOTE:
2015 will be the bicentenary of the publication of Smith's map and the geological community (particularly the Geologists' Association) will be markiing this in various ways. Oxford University Museum will be co-ordinating some events with the Heritage Centre and the Oxfordshire Geology Trust.

PHILIP SIMON DOUGHTY (1937 - 2013)

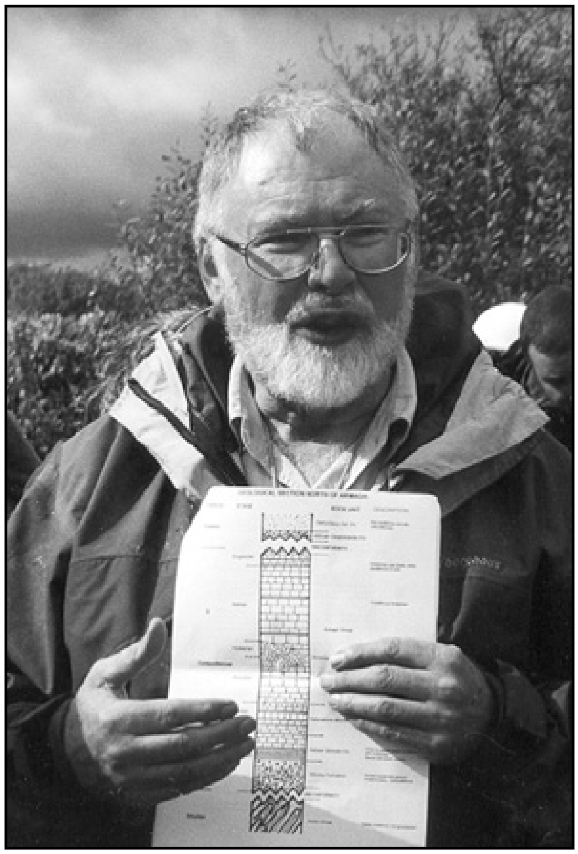

Photo: Tony Bazley

Philip Doughty came from the small mining town of Wombwell in the West Riding of Yorkshire. He went to nearby Barnsley Grammar School, overlapping with Michael Parkinson, then on to Nottingham University where he graduated in Geology, completed a Master's degree, and helped to run the Swinnerton Geological Society. While writing his Master’s thesis he married Janet and taught at a school in Keighley, West Yorkshire. His thesis *Joint densities in the Great Scar Limestone* was eventually published in the *Proceedings of the Yorkshire Geological Society*.

His first museum job was as a general natural history curator at Scunthorpe Museum. Then in 1965 he became an Assistant Keeper in the Natural History department of the Ulster Museum. Phil always stressed that he was appointed as a geologist to care for and develop the *geology* collections - a specialist geologist on the staff for the first time in the Museum's long and complicated history, dating right back to the opening of the Belfast Natural History & Philosophical Society's Museum in 1831. This was an exciting time to join the fledgling Ulster Museum - with its recent elevation from local authority to national status, its growing staff numbers and a large new extension to the existing building being planned.

In 1970 he became Keeper of his own new Department of Geology. Against a generally favourable background of Museum expansion, over the next few years he built up a team of geologists: Terry Bruton, John Wilson, Rab Nawaz and Ken James. His top priority was rescuing the stored geology collections from where they had languished since World War Two - at the bottom of a lift shaft in the Museum and in rat-infested lock-ups beneath the railway bridge on Tate's Avenue, Belfast.

Phil and his team were responsible for creating a series of innovative and award-winning geology galleries which opened sequentially through the 1970s - *Variety of Life, Geology of Ireland, Landscape* and *Earth's Treasures* - the success of these galleries followed from the detailed briefs Phil had prepared. It is a testament to their effectiveness that, with only relatively minor changes, they remained popular with visitors for some three decades.

The geology collections were built up by astute purchases of display material and by systematic field collecting. Phil also knew that good research projects helped to boost the Museum's credibility - projects such as the Bovedy meteorite in 1969, the 1972 Pollnagollum cave excavations in Fermanagh, and the 1986 Aghnadarragh mammoth discoveries near the Antrim shore of Lough Neagh. It is telling that both the Polnagollum and Aghnadarragh projects arose from chance discoveries made by members of the public who knew that the place to find out more would be Phil's Geology Department at the Ulster Museum.

His personal mission, to raise the profile of geology, geology collections and museums generally, took him beyond Northern Ireland. He was a prominent member of the Museum Assistants Group, editing their newsletter, and he helped to found the Geological Curators' Group (GCG) in 1974 - the first of the subject specialist groups that have done so much to raise curatorial standards generally. He organised a ground-breaking survey of museums for GCG, published in 1981 as *The State and Status of Geology in UK Museums*. This helped to change attitudes towards long-neglected geology collections across the country. He chaired GCG in the mid-1980s and was quite recently awarded the group's prestigious Brighton Medal for outstanding services to museum geology.

While a Council member of the UK Museums Association, he became involved with their Information Retrieval Group and helped to pioneer new methods of managing information about museum objects. This put the Ulster Museum at the forefront of the digital revolution in museum data handling, during the late 1970s and 80s.

But Phil knew better than many that there's no point in having well-organised and well-documented museums if you don't get out there and communicate the excitement and relevance of collections to the public. He was a great communicator, with an ability to inspire his audiences. From answering enquiries one-to-one, to the many extra-mural classes he taught for Queen's University Belfast in the 1970s and 80s, and establishing the *Geology Tamed*! lecture series at the Ulster Museum in 2002, his ability to grab and hold people's attention was clear. That same talent was just as evident in the field, when leading trips for the Belfast Geologists' Society, or the Belfast Naturalists' Field Club, or the annual *Rocks Around the North* week. This ability to get the message across extended to his many radio and TV broadcasts, and to the written word - from articles in the popular press to the formality of site conservation reports - most famously perhaps, his words to UNESCO which helped bring World Heritage Site status to the Giant's Causeway in 1986.

Phil also knew that to effectively engage with an audience, you needed to put on a good show! The locally legendary *Moon Rock* display in 1970 attracted 27,000 people to the Museum in a single day - which has never been beaten. The *Dinosaurs Alive!* exhibition in 1992 brought giant, robotic dinosaurs to Ireland for the first time, attracting 200,000 paying visitors to the Ulster Museum in three months - another record.

His love of fieldwork, and its centrality to both the current practice and historical development of geology, meant that site conservation and interpretation were constant threads running through his career. At the site level he helped with the development of Marble Arch Caves by Fermanagh District Council and he was writing text for the National Trust about the Giant's Causeway as long ago as 1969. At a national level, he was a founder and chairman of the Geological Society's GeoConservation Committee. And in his retirement, he wrote hundreds of 'plain-language' site summaries for NIEA's Earth Science Conservation Review - all of which are available on the web (www.habitas.org.uk/escr).

Phil was a fine all-round scientist, with a holistic understanding of the natural world. From the early 1990s, by then Head of the Museum's re-organised Sciences Division, he worked with colleagues in the Museum and at the Department of the Environment to nurture an infant environmental records centre that eventually became today's Centre for Environmental Data and Recording. In the late 90s he was a key member of the Northern Ireland Biodiversity Group, which in 2002 produced the national *Biodiversity Strategy* that informs the country's wildlife policy to this day.

So, his professional legacy is clear - he worked and lobbied hard and successfully to improve standards of collections care and interpretation, information management, public engagement, site conservation and recording, and the development of public policy in all these areas.

He also consistently supported the work of local and regional voluntary groups, such as the Belfast Geologists' Society, the Belfast Naturalists' Field Club and Earth Science 2000 (ES2k, now Earth Science Ireland) - all three of which he led as president or chairman at different times, and served on their general committees for long periods. In his retirement and until his final illness last year he organised the Belfast Geologists' Society's annual Summer Programme of field trips, and was himself a regular leader. His Christmas review of popular geology books became a regular feature of the Society's December meeting each year.

But I suspect that Phil would have judged his most important legacy to be all those countless individual sparks of interest which his infectious enthusiasm fanned into flame. For the youngster with a puzzling fossil to be identified, he could vividly bring to life a long-extinct creature from a strange and ancient world - for many, such an experience would open the door to a life-long interest in geology. What better epitaph could there be than that?

Peter Crowther

LOST & FOUND

Enquiries and information, please to Matthew Parkes, (National Museum of Ireland - Natural History, Merrion Street, Dublin 2, Ireland; e-mail: mparkes@museum.ie). Include full personal and institutional names and addressess, full biographical details of publications mentioned, and credits for any illustrations submitted.

The index to 'Lost & Found' Volumes 1-4 was published in *The Geological Curator* 5(2), 79-85. The index for Volume 5 was published in *The Geological Curator* 6(4), 175-177.

Abbreviations:

CLEEVELY - Cleevely, R.J. 1983. *World Palaeontological Collections*. British Museum (Natural History() and Mansell Publishing Company, London.
GCG - *Newsletter of the Geological Curators' Group*, continued as *The Geological Curator*.
LF - 'Lost & Found' reference number in GCG.

269. Stolen at the Lyme Regis Fossil Festival on 5th May: Cretaceous shark vertebra from Seymour Island, Antarctica

Hilary Blagborough
Science Facilities (Geoscience Lab Suite Manager)
British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, UK.
Tel: +44 (0)1223 221378
Email: hibl@bas.ac.uk

The fossil is approximately 7cm diameter and has the number DJ.952.38 written on one face in permanent marker pen. If anyone has any information or is offered the item, please contact me.

The police have been informed.