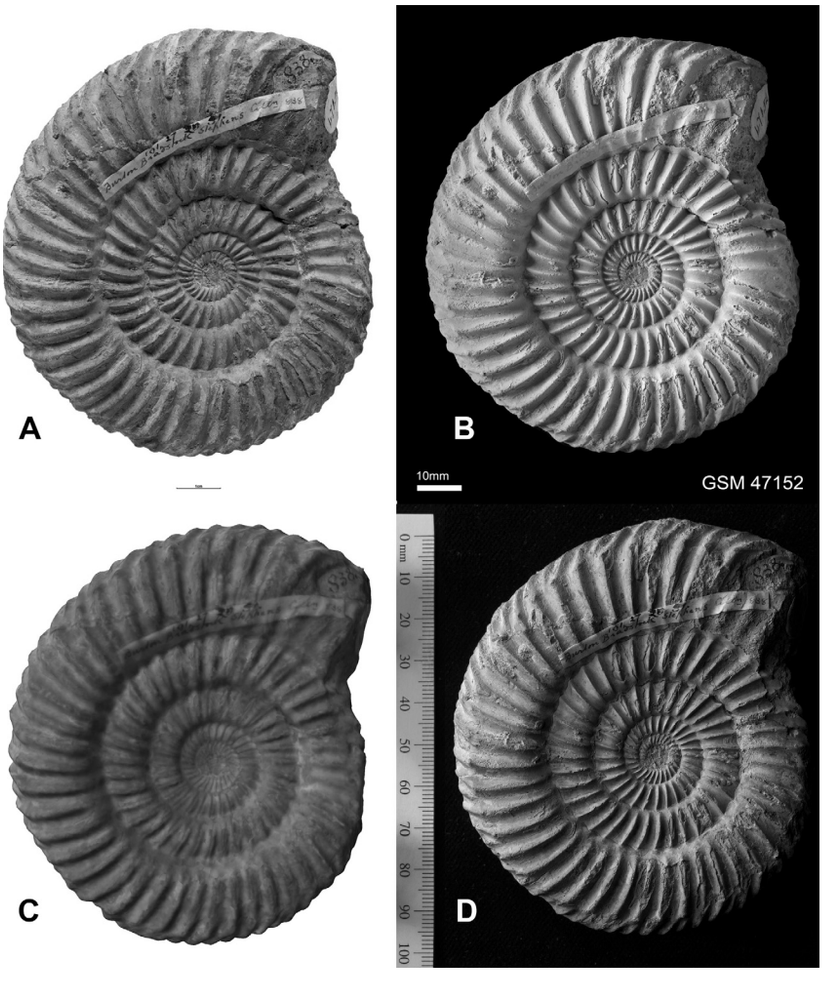
GEOLOGICAL CURATOR

Volume 10 Number 8



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 wellbeing
- 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.

2017 COMMITTEE

ISSN 0144 - 5294

Cover: GSM 47152 in different lighting techniques, see Figure 3 in Pickup and Harris inside.

THE GEOLOGICAL CURATOR

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CONTENTS

EDITORIAL

Normal service is resumed! After the extraordinary feast of a 'Hugh Miller Special' in Volume 10, Number 7, this part is back to a more normal mix of papers, book reviews, AGM minutes and an obituary for a colleague. Preparing this issue, and addressing other submissions, which I expect to appear in the future, has reinforced for me how diverse our individual members and supporters are, even if we choose to label ourselves under one common banner of being 'geological curators'. In fact there is probably no one amongst us who could be selected as lectotype for our 'species'. In parallel to the creation of the Hugh Miller 'special' and then this issue, I have been invited onto the editorial board for the NatSCA Journal, and seen the mirrored struggles of their editor to get the job done against deadlines, personal workloads and quite variable submissions.

We seek to maintain a standard, to keep the quality of papers up to a notional benchmark. Yet very few submissions ever come in above the bar at first go. The referees play an absolutely essential role in picking up on inadequacies or oversights in a manuscript. They check and cross-check scientific, historical, technical or other content, the references, the figures and the grammar. They make a recommendation as to whether the paper is fit for publication, or whether it needs further work to reach that standard. Peer review is a delicate process, but one where I can only pay tribute to all those who have reviewed submissions for me, and often gone to great lengths to do a thorough job, giving the author every assistance or guidance.

For some academics the number of papers rejected from a journal is as important a metric of the status of the journal, as are the number actually published. I hope that The Geological Curator never strays into that territory. For me as editor, helping people bring their work to the highest standard achievable for them and getting it published in the journal is a key objective. Many of the papers you actually see in the journal have gone through a protracted process of encouragement of the author to actually write up a talk or a project, along with sometimes extensive work to revise it, and generally improve it with the help of the referee(s) and sometimes the editor. Sometimes, looking back over past issues, aside from my own errors, it is easy to see things where the text could have been tightened up, where images could have been greatly improved or where unnecessary excess was not excised. As editor I take full responsibility for these, but it is my aspiration to let contributors have their own voice. If consistency to a notional 'standard' sometimes suffers as a result, it is because I believe in inclusivity. I do not want to discourage or reject engagement with the journal in order to have a ‘Stepford Wives’ style uniformity and blandness.

Of course many submissions arrive in my inbox unheralded and unexpected. It is a pleasure to get them. Between the various routes we are fortunate to maintain a fairly steady output. I sometimes regret the decline in variety of content, compared to many of the early volumes of the journal. One contribution on Henry Riley, which would perhaps have been better treated as a long missed 'Collectors and Collections of note' appears as a Lost and Found item from Mike Taylor, but time deadlines for this issue meant it stayed that way.

To conclude, my sincere thanks go to contributors, referees and to Mark Rogers at Naas Printing Ltd for enabling me to get this issue out in time for the AGM, and not right at the end of the year as normally happens. If you have an interest in taking on the journal, please get in touch with me or any member of the committee - I will actually miss it, but it is probably time for someone with fresh ideas and a modern approach to take over.

Matthew Parkes

THE PALAEONTOLOGIST WILLIAM HELLIER BAILY (1819-1888): NEW BIOGRAPHICAL INFORMATION

by R. B. Williams

R. B. Williams. 2017. The palaeontologist William Hellier Baily (1819-1888): new biographical information. *The Geological Curator* 10 (8): 465-467.

A biographical account, previously published in *The Geological Curator* in 2009, of the palaeontologist William Hellier Baily (1819-1888) has already addressed his struggle for advancement in the Geological Survey of Ireland, and various aspects of his publication of *Figures of Characteristic British Fossils* ([1867]-1875). Further light, revealed by documents recently discovered in the Geological Society of London archives and the Linnean Society of London library, is now cast on those matters.

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Introduction

During research for my recent bibliographical study (Williams in press) of *Figures of characteristic British fossils* ([1867]-1875) (hereinafter referred to as *Characteristic fossils*) by William Hellier Baily (1819-1888), new information emerged, which supplements a previous account of his life by Wyse Jackson and Parkes (2009). Their Appendix 4 comprises sources for "archive holdings of Baily material or correspondence", which is now added to.

The Geological Society of London archive

The Geological Society of London (GSL) may now be added to Wyse Jackson and Parkes's (2009). Appendix 4. The GSL archives include a previously unrecorded letter from Baily to Sir Roderick Impey Murchison (1792-1871), who was then Director General of the Geological Survey of Ireland (GSI); and two letters from Baily to the London publisher John Van Voorst (1804-1898).

The letter to Murchison (GSL archive ref. LDGSL/838/B/4), pleading for promotion, is an important addition to Wyse Jackson and Parkes's (2009) documentation of Baily's protracted but futile struggle to enhance his status and salary in the GSI. Having been appointed in 1857, initially as Senior Geologist (Acting Palaeontologist) in Dublin, he began to press for promotion in 1859, but was consistently blocked, although automatic annual increments raised his salary to the maximum of £350 per annum by 1865. Although his serious falling-out in 1861 with his immediate superior and Local Director, Joseph Beete Jukes (1811-1869), could have had an adverse effect on his potential promotion in the GSI, Murchison, the Director General, apparently successfully "quenched the flames of argument" (Wyse Jackson and Parkes 2009: 67).

Nevertheless, it seems that this disagreement did not irreparably damage Baily's reputation. In 1867, he was awarded the Wollaston Fund by the GSL to aid in the publication of his *Characteristic fossils*; and in 1868 he was appointed Demonstrator in Palaeontology in the Royal College of Science for Ireland, a position outside his GSI employment, which ensured him an additional income of £100 per annum. As recorded by Wyse Jackson and Parkes (2009), Baily was generously backed by Murchison in all these matters. It is difficult to understand, therefore, why, with his outstanding professional skills and the support of the Director General himself, Baily was consistently thwarted in his career aspirations. To his enduring chagrin, he never progressed beyond Acting Palaeontologist. The aforementioned letter to Murchison, held by the GSL, conveys the impression of a potentially successful outcome for Baily's hopes of promotion, yet his plea still came to naught. The letter makes this situation all the more perplexing, particularly since even Jukes seems to have been willing at least to forgive, if not to forget, Baily's perceived transgressions:

> July 29th 1867
>
> My dear Sir Roderick,
>
> I mentioned to Mr Jukes your kind promise to endeavour to get me acknowledged Palæontologist in Ireland, to which he assured me he has no objection.

> I hope therefore you will be enabled to obtain this improved position for me from the commencement of the year, corresponding with the other gentlemen who have benefited by the recent changes on the Survey and that the pay of Palæontologist will be made to assimilate with that of the District Surveyors viz. a maximum of £500 per annum.
>
> With grateful feelings for the kindness I have already experienced at your hands

It can only be concluded that, despite his influential position in the GSI, Murchison did not have the last word on Baily's career progress.

Passing on to the letters from Baily to Van Voorst (GSL archive ref. LDGSL/1044), one of them includes an intriguing reference to the involvement of Baily's immediate family in his artistic work. In the letter of 25 April 1867 about the proposed publishing of *Characteristic fossils*, Baily wrote,

> The price to the public need only be placed on the cover I thought 5/- for plain copies and 6/- colored altho' that does not pay for coloring, however as it is done at home by one of my daughters it would perhaps bring in a little pocket money for her.

His comment is of particular interest because, concerning other naturalists, it is well known that the wives and children of various ornithologists used to co-operate in print-colouring as a family enterprise (see Jackson 2011). Prominent examples are John Gould (1804-1881) and his wife Elizabeth (Jackson 1975: 39-58); Henry Leonard Meyer (1797-1865), his wife Mary Anne and their children (Jackson 1986); and Richard Bowdler Sharpe (1847-1909) and his daughters (Jackson 1994).

Hence the Bailys may now be numbered among these families of colourists. Perhaps Baily was referring to his eldest daughter (whose name we do not know), who was about 18 years old at the time when part I of *Characteristic fossils* was being prepared for publication in 1867 (Wyse Jackson and Parkes 2009: 75). She may have been the first colourist in the family, unless her mother had preceded her in such work. Two younger sisters, Charlotte and Amy, would perhaps also have been able to contribute to colouring lithographs by the time parts II and III came out in 1869 and 1871, respectively. However, Charlotte unfortunately died, aged 21, in 1872, but, when part IV was issued in 1875, Amy was still alive (Wyse Jackson and Parkes 2009: 75).

The Linnean Society of London library

As well as the GSL, the Linnean Society of London (LSL) may also now be added to the archival sources in Wyse Jackson and Parkes's (2009) Appendix 4. Baily was elected a Fellow on 19 March 1863. Although Wyse Jackson and Parkes (2009) suggested that he made few contributions to the life of the society, in all fairness to Baily, he would have had little opportunity to do so, living as he did in Dublin.[1] However, the LSL library holds a coloured copy (914.1/2:56 BAI) of *Characteristic fossils* apparently bound from the four parts.[2] It contains a short letter to Richard Kippist (1812-1882), the LSL librarian: "I have sent by this post a colored and plain copy of the 1st part of my work Figures of Characteristic Fossils for the Society's acceptance".[3]

The Baily family homes

Finally, concerning the various residences around Dublin of the Baily family, an advertising leaflet issued in November 1871 by Van Voorst for *Characteristic fossils* evidences that they were then already living at Apsley Lodge, 92 Rathgar Road, Rathgar, although Wyse Jackson and Parkes (2009: 76) stated that they did not arrive there until 1872.

Notes

[1] It was for that reason that he was prevented from receiving in person his Wollaston Fund award from the GSL; Murchison accepted it on his behalf (Wyse Jackson and Parkes 2009: 66).

[2] Since this copy includes the temporary title-pages of parts I-III, and a presentation letter from Baily, the parts were apparently donated to the LSL by him. Perhaps, as for the first part, Baily sent both plain and coloured copies of all four parts, but if so the fate of the plain set cannot now be established (Lynda Brooks, pers. comm., 14 June 2017).

[3] Remarkably, according to Kippist's initialled note of acknowledgement, this letter from Dublin, dated 28 October 1867, was received in London the following day.

Acknowledgements

I thank Caroline Lam (Archivist, Geological Society of London) and Lynda Brooks (Librarian, Linnean Society of London) for providing access to documents in their care, and for permission to quote from them.

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WYSE JACKSON, P.N. and PARKES, M.A. 2009. William Hellier Baily (1819-1888): forever an Acting Palaeontologist with the Geological Survey of Ireland. *The Geological Curator* **9** (2), 57-84.

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NOTE

BURIAL PLACE AND HEADSTONE OF WILLIAM HELLIER BAILY (1819-1888)

by Patrick N. Wyse Jackson and Matthew Parkes

In our biographical account of William Hellier Baily, the Acting Palaeontologist with the Geological Survey of Ireland we stated that the headstone over his grave was missing (Wyse Jackson and Parkes 2009, p. 76). Baily was buried in Mount Jerome Cemetery then just south of Dublin city, and despite knowing the grant/plot number (2654 in Sector 187/B1) and PNWJ walking the cemetery and searching extensively, the headstone was not located. Recently a comprehensive photographic study was carried out of the headstones of the cemetery and the images and transcriptions are available online (http://www.igpweb.com/IGPArchives/ire/dublin/photos/tombstones/markers.htm). This shows that Baily's headstone is in fact *in situ*. PNWJ revisited the cemetery and located the grave and headstone (Figure 1). The inscription reads:

SACRED
TO THE MEMORY OF
AMY REBECCA
AGED 8 YEARS DIED JANY. 4TH
AND
ALFRED EDWARD
AGED 16 MONTHS DIED JANY. 20TH 1866
THE BELOVED CHILDREN OF
W.H. AND A.E. BAILY
"OF SUCH IS THE KINGDOM OF HEAVEN"
MATT. XIX. 14.
ALSO THEIR DEARLY BELOVED DAUGHTED
CHARLOTTE
WHO DIED FEBRUARY 20TH 1872 AGED 21 YEARS
ALSO
ANN ELIZABETH BAILY
MOTHER OF THE ABOVE AGED 64
WHO FELL ASLEEP IN JESUS
FEBRUARY 17TH 1887
ALSO
WILLIAM HELLIER BAILY
F.G.S., F.L.S., M.R.I.A.
OF THE GEOLOGICAL SURVEY
HUSBAND OF THE ABOVE AGED 69
AUGUST 6TH 1888

Figure 1. Headstone of W.H. Baily and family at Mount Jerome Cemetery , Dublin (image Patrick Wyse Jackson).

Reference

WYSE JACKSON, P.N. and PARKES, M. 2009. William Hellier Baily (1819-1888: forever an Acting Palaeontologist with the Geological Survey of Ireland. *The Geological Curator* **9** (2), 57-84.

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The Geological Curator 10 (8): 468 [2017]

NEXT GENERATION MINERAL PHOTOGRAPHY - THE CASE AND GUIDE FOR TAKING 360-DEGREE SPIN PHOTOGRAPHS

by Barry Flannery

Flannery, B. 2017. Next generation mineral photography - the case and guide for taking 360-degree spin photographs. *The Geological Curator* 10 (8): 469-472.

This article presents a workflow and guide on how to take "360 degree" photographs of mineral specimens whereby the specimen is rotated on a turntable and numerous still photographs of are taken of the specimen. Digital post-processing facilitates the creation of interactive photographs that can be viewed online in a web browser whereby the mineral specimen can be manipulated and rotated at will. Whilst the focus of this article is mineralogical specimens, it is equally applicable to petrological and fossil specimens. A brief discussion on the merits and need for such photographs is also given including benefits that are specifically relevant to the curatorial community.

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Introduction

Advances in computing and information technology coupled with the wide availability of high resolution, low cost, digital cameras has enabled both the museum curator and mineral enthusiast alike to record their collections in unprecedented detail at negligible cost. In the context of mineral specimens, www.Mindat.org (Mindat), is the world's premier web repository for mineralogical knowledge. It is an outreach project of the Hudson Institute of Mineralogy, a 501(c)(3) not-for-profit organization. Mindat allows users to upload and catalogue their collections on the website for free whilst still retaining copyright ownership. Recording mineral specimens on Mindat is particularly advantageous as the specimen's locality is cross-referenced against the website's vast database which is continually updated and maintained by an army of volunteer experts.

A novel feature was recently implemented on Mindat whereby tens or hundreds of sequential photographs of an individual specimen can be uploaded to the site in a .zip archive and the website will automatically process these into a single interactive photograph of the specimen that can be rotated and zoomed at will. An example of such a photograph can be seen here: http://www.mindat.org/photo-787460.html .

Spin photographs are not a new idea; they have become increasingly common in general product photography. Even in the mineralogical community, a number of commercially available automated "spinning" systems such as the OrbitVu 360 have been trialled in museums with great success. However, such systems may be too expensive for smaller or poorly-resourced museums or institutions. More sophisticated techniques such as 3D scanning have also been used very successfully (e.g.the GB3D Type Fossils project led by the British Geological Survey). With a programme such as Agisoft (www.agisoft.com) and photogrammetry, stunning 3D images can be obtained. Reflectance Transformation Imaging (RTI) is another method, involving moving the light rather than the specimen that offers scope for 3D photos. However, this paper does not attempt to review the history of the technique, nor review the scope of freeware or commercial software that may be available. Here, an alternative method that is marginally more labour intensive is described that can be achieved for less than $100 (excluding DLSR camera).

The benefits of spin photos

In a world of ever dwindling museum resources and budgets, the long-term survival of hugely important collections is an ever present challenge. Digitally recording significant specimens in as much detail as possible is another way to preserve collections for future generations. It has the significant additional benefit of making the information widely available to

the public whilst simultaneously reducing pressure on curatorial staff to facilitate physical visits to view collections or loans of specimens.

With the right workflow, spin photographs in fact can be quicker to perform than traditional photographs. First, it is important to define what is meant in this context by the term "photograph". A photograph of a mineral specimen should be well-lit, feature a contrasting background and show the specimen's most significant features. Ideally, the photograph should be suitable for publication as is. Figure 1 shown below is an example of how a mineral should ideally be photographed. It is a single frame of a spin sequence.

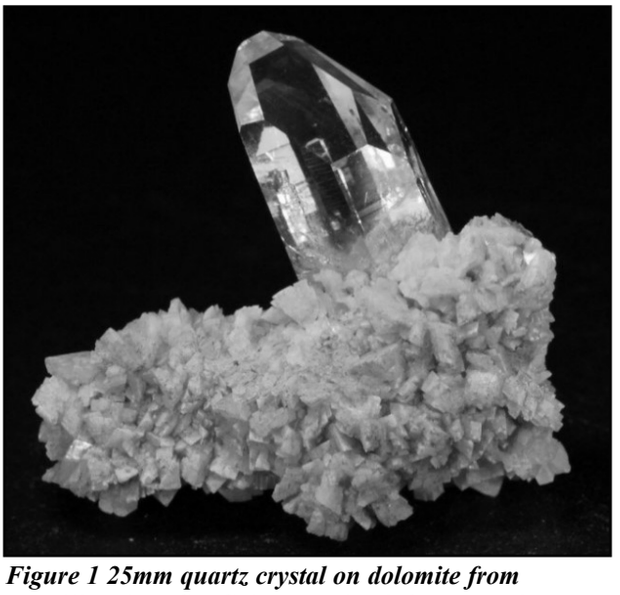

Figure 1 25mm quartz crystal on dolomite from Renville Mine, Co. Galway, Ireland. © Barry Flannery

Taking good photographs of mineral specimens is non-trivial and requires experience. Careful adjustment is often necessary to ensure that the specimen is appropriately lit and optimally positioned to highlight crystal faces. These prerequisites mean that good photographs typically must be performed by an experienced photographer, will be time intensive and are likely only worthwhile for the most important specimens. Experience is a particular challenge in the context of museums where much of the work is likely to be done by volunteers and non-experts. Spin photography eliminates the majority of this complexity because with just a basic placement of the specimen and lighting it will rotate through the lighting field and crystal faces will naturally become visible in subsequent photographs. Therefore, spin photographs will significantly enhance the work quality from non-expert volunteers and also greatly increases the time efficiency of experienced curators too. For example, the time taken to produce the spin photograph of figure 1 was about 2 minutes. This consisted of about 45 seconds of setup and presentation and 1 min 15 seconds of spinning automatic photographing.

Lastly, the benefits of full 360-degree views of mineralogical, petrological and fossil samples extend beyond the purely aesthetic. The aesthetic "display face" of mineral specimens, though pretty, lack the context and information which is usually evident in the matrix of the specimen. Traditionally, if one were trying to thoroughly record a specimen, this would mean multiple repositioning and seating of the specimen which is a time consuming endeavour. It is difficult to overstate the importance of seeing all of a mineral specimen particularly for field mineral collectors. The matrix of a specimen provides valuable clues and insights when attempting to relocate long forgotten mineral localities that may no longer exist. Again, spin photography solves this challenge naturally by giving a detailed overview of the specimen.

Setup

The full setup necessary for taking mineralogical photographs is shown below in Figure 2.

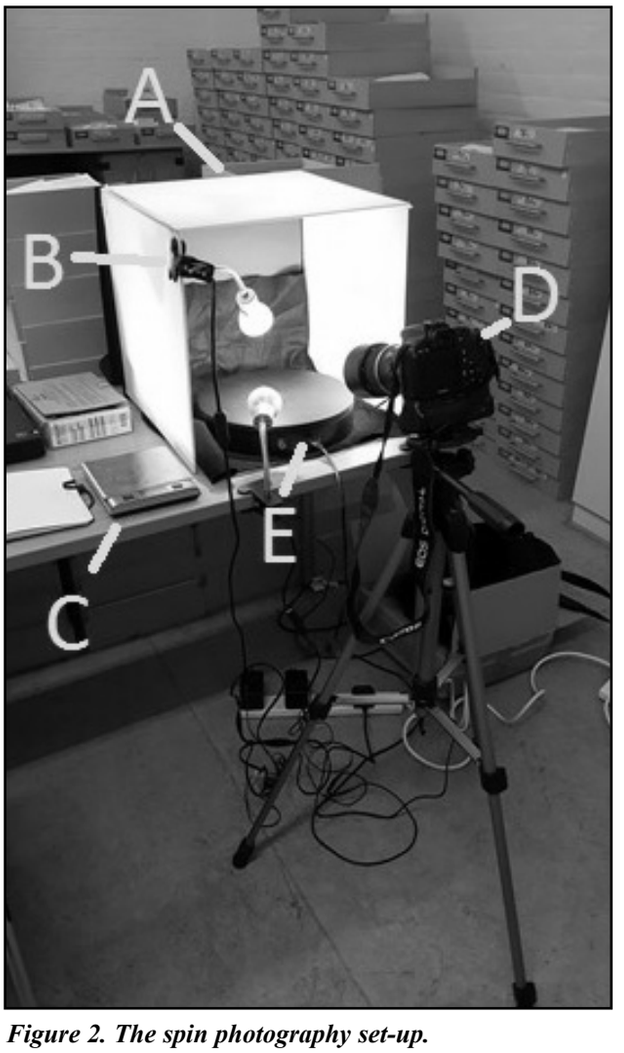

Figure 2. The spin photography set-up.

In Figure 2 the labels refer to the items below.
A. Folding light room photo studio. A folding studio is valuable as it facilitates mounting of the lighting and also tends to block out spurious external light sources which will interfere with the white balance in the photographs.

B. Flexible "goose neck" lighting. The lighting used in this setup are clampable Gu5.3 bulbs on flexible stalks. The halogen bulbs have been replaced with LED bulbs to reduce the heating effect. Halogen bulbs are a hazard for the photographer as the outer glass is sufficiently hot to burn on contact. Excessive heating can also damage mineral specimens. Not shown in the photograph is a third light obscured by the camera. Additional lights can be used but three independent sources tends to be sufficient for illuminating the specimen and highlighting crystal faces. It is vitally important to have very powerful lighting when performing spin photography. Powerful lighting enables the photographer to significantly reduce shutter speed. This will increase the effective depth of field of photos (and darken them). A short shutter speed will also eliminate any potential motion blur whilst the specimen is rotating.

C. Weighing scales. Digital weighing scales are cheap and can provide a quick additional quantitative measurement of a specimen in addition to its physical dimensions.

D. Canon EOS 550D DSLR camera and tripod. The method presented here is independent of camera provided that a number of key features are available. The DSLR must be capable of taking "time-lapse" photographs or interval shooting. This feature is not natively available in mid-range Canon DSLR's so an open-source firmware modification called Magic Lantern must be installed. This update is trivial to implement and provides many additional features to the camera. A full guide on how to perform this update to enable the camera intervalometer can be found here: *http://www.magiclantern.fm/* .

A rigid tripod is critically important for successful spin photographs as even minor vibration and shaking will ruin the photograph.

E. Motorized turn table. This motorized turn table was readily and cheaply available on eBay. They are typically intended for mannequin displays but a number of savvy sellers have recognized this alternative application and are directly marketing them as "product photography" turntables. The key criteria for a turntable are a distinctive matte background and slow rotation speed on the order of 1 rpm.

Physical workflow

1. Place the specimen on the centre of the turntable. A degree of care is necessary when deciding what the natural axis of rotation of the specimen is. Furthermore, it is important that the specimen is on the centre of the table. Otherwise, the specimen will appear to move towards and away from the viewer as it rotates.

2. Perform a basic adjustment of the lighting so that the specimen is well lit.

3. Start the turntable rotation. Ensure that the specimen is within the camera frame throughout its rotation and make sure that as much of the frame is used so as to not waste resolution needlessly. Manually focus the camera onto the most important part of the specimen. Note that the image presented on the preview screen will likely not represent the true image taken at a short shutter speed. It may be worthwhile taking a preview shot to see if the specimen has sufficient depth of field.

4. Once the specimen is focused and in frame, set the camera intervalometer to 1 second and begin shooting. The camera will continually take photographs every second until stopped. Allow the specimen to perform at least 1.1 - 1.5 full rotations while the camera is shooting. Is it crucial that the tripod is not bumped or the adjacent ground disturbed or shaken during the photography process. Any hint of vibration will ruin the photograph.

5. Once the specimen has completed its rotations stop the camera from shooting. The physical part of the spin process is now completed.

Digital workflow

1. Copy and save all of the photographs from the camera onto your hard drive. Isolate individual sequences of specimen into separate folders. Assuming a 1 rpm turntable; if there are 80 shots of a specimen taken discard the first 10 and last 10 images of the sequence as they might be spoiled by vibration or shaken from camera operation.

2. The remaining 60 images of the specimen should now be compiled into a .zip archive ready for upload. IMPORTANT: do not rename the photographs as it may confuse the Mindat server when performing compilation.

3. Upload the .zip archive to Mindat using the photo upload form. This assumes that the user is already registered (free) with the site. Note that the .zip

archive is likely to be very large as it could have up to 60 photographs each several megabytes in size.

4. Once the photographs have successfully uploaded Mindat will present the user with a form to be filled out where the locality, species and dimensions must be inputted. Additional features, unique to spin photographs, must also be set. The starting frame of the specimen rotation must be chosen. This is important as the first photograph in the archive may not be the display face. You must change the "starting frame" to whichever photograph in the sequence is the display face. This photograph will also serve as the thumbnail photograph for the specimen. Note that the server takes time to update the thumbnail photograph after the starting frame has been changed. Furthermore, the end user may need to clear their browser cache to see the change.

5. Once all of the information has been uploaded then the specimen photograph should now be visible and able to be manipulated in a web browser.

Common pitfalls and solutions

1. Specimen out of frame
Perhaps the most common challenge with spin photographs of is the specimen running out of the camera field of view. When taking photographs of mineral specimens it is important to utilize as much of the camera's depth of field as possible or resolution will be wasted. Having many megapixels on a camera is wasting much of this capability if the subject only captures a fraction of the frame..
For large or oddly shaped specimens the only solution here is to do a trial rotation of the specimen and observe on the camera display whether or not it is all within frame throughout its revolution. If time is important, this can be done in conjunction with lighting setup.

2. Specimen out of focus
It should be uncommon for all but the largest and most irregularly shaped specimens to run out of focus. Unless the camera has extremely fast autofocus lens, it is best to simply manually set the focus to a single setting throughout the full revolution. Reducing shutter speed as low as possible within the confines of lighting will increase depth of field. Additional digital sharpening can also marginally reduce blurring.

3. Specimen rotating off centre
This issue can only be solved with experience. It is important that the specimen rotates about a natural axis of rotation. Failure to do so will result in the specimen moving away from the viewer or coming towards them as it rotates. This is generally not grounds to retake the photograph but it is distracting and avoidable.

4. Movement of the camera or specimen
Any movement, shaking or vibration of either the camera or specimen will ruin the photograph and cause a discontinuity in the rotation when viewing it digitally. This must be avoided at all costs as it means the photograph must be retaken. It is very important to take more than 1 full revolution of photographs. For example, if the turntable rotates at 1 rpm and the camera intervalometer is set to 1 Hz then 60 still images will capture all 360 degrees of the specimen. If one were only to capture 60 photographs then the starting and finishing shots are likely to be spoiled by vibration and shaking from the user pressing the start button on the camera. A solution to this is to use a remote shutter controller or simply take 70 or 80 photographs and discard the first and last images from the sequence.

5. Images out of sequence on Mindat
The most common fault here is due to renaming the photos. It is best to leave the photographs with the camera naming scheme. Mindat is poor at recognising sequential photos and so it may not distinguish properly between "Quartz 1", "Quartz 10" and "Quartz 11". The best solution is to leave it in a natural long sequence like "IMG_9426", "IMG_9459" …etc.

Conclusions

A practical technique for performing 360 degree spin photographs was described in this article. Spin photographs represent an important advancement in the digitizing of mineralogical collections and doing so could in fact be less time and cost intensive than traditional photography.

Acknowledgements

The method described in this article is inspired by previous work by Mindat founder Jolyon Ralph. Furthermore it would not be possible without behind the scenes technology implemented by him and the Mindat team to whom I am extremely grateful.

CLEANING MINERALS: PRACTICAL AND ETHICAL CONSIDERATIONS

by Lu Allington-Jones

Allington-Jones, L. 2017. Cleaning Minerals: practical and ethical considerations. *The Geological Curator* 10 (8): 473-479.

Mineral specimens have a dual nature, both as a scientific resource and an aesthetic pleasure. Combine this with a long history of sampling for study, and the developed nature of most specimens on the commercial market, and it is difficult to relate to the ethical principles of conservation when cleaning minerals.

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Introduction

There is a vast amount of information available in published journals and online regarding mineral "cleaning" but little regarding the ethical considerations necessary for undertaking this work. Both supergene and associated minerals are considered sacrificial by many collectors and dealers, as they develop their specimens to enhance aesthetic value at the expense of scientific truth. Within the museum environment the term "cleaning" is used for a completely different concept: removing particulate contaminants and other alien matter accumulated during periods of storage or display. This article explores the ethics and practical aspects that must be considered when cleaning minerals within a museum collection.

Ethical Considerations

The conservator must strive for a balance between protection and access, between preservation for future use and use now, between the needs of science and the other interests of people (Pye 2009, 136). Conservators use ethics to aid these decisions. The guiding principles include reversibility, minimal intervention, discernible alteration, stakeholder consultation, scientific approach and authenticity. When these are applied within the context of cleaning, problems immediately become apparent: cleaning is not reversible, even if the soiling is retained separately; minimal intervention is inherently obscure and, when undefined, unhelpful: minimal intervention to achieve different goals requires different levels of intervention. There is a difference between the minimum amount of intervention required to stabilise a mineral and to make it pristine, and the latter is a matter of individual taste and expectations. Discernible alteration is also problematic when applied to cleaning, should a small area be left dirty so there is a contrast for the observer? Documentation of chemicals and techniques, and digital images of the object before and after treatment, can largely solve the ethical questions of cleaning.

Stakeholder consultation poses less of a problem for minerals than for ethnographic artefacts, as long as curators, conservators and exhibition designers are in agreement. A scientific approach is easy to comprehend: understanding the chemistry of the specimen, and the cleaning products, and testing all treatments before proceeding. The most confusing ethical principle, when considering cleaning, is that of authenticity.

Authenticity incorporates physical, conceptual, aesthetic and historical aspects of an object. Physical authenticity demands that the original state of the object should be preserved, which is impossible if any deterioration has occurred, and also leads to complex arguments about true authentic states differing at different points in time: Muñoz Viñas (2009a, 35) proposes that earlier conditions are memories or hypothetical states, which no longer exist. The only authentic state of an object is its current condition. All attempts to recover an "authentic" state are therefore preferences, not reality. Muñoz Viñas (2009a, 36) maintains that conservation cannot make an object more, or even less authentic. This would mean that any action would result in the object's new true state, nullifying the concept of authenticity.

Since minerals are not man-made, conceptual

authenticity (religious and cultural meanings, or artist's intent) does not usually require consideration, but the remaining two forms of authenticity are both relevant and often in conflict with each other: aesthetic authenticity requires that the object be returned to it's original appearance, whilst historical authenticity demands preservation of all stages of an object's history, including dirt and damage. To repair an object returns it to its original aesthetic state but destroys its history and physical truth (with the addition of new chemicals). If the repair is not obvious then it restores aesthetic authenticity but does not fulfil the principle of discernible alteration; if a repair is readily discernible then it has not restored aesthetic authenticity. Cleaning destroys, at least part of, the historical authenticity of an object, but restores aesthetic authenticity and can also improve other values: a clean object is easier to interpret, easier to study, less likely to contaminate other objects and has higher aesthetic value. The attitude to secondary minerals here is unclear, should they be considered part of the specimen and its history or is it ethical to remove them because they are not strictly part of the original assemblage? Moreover, species resulting from supergene influences are often altered forms of the original minerals. Can there be a concept of aesthetic integrity, and does this refer to the authentic appearance of the mineral before or after secondary minerals are formed?

> "Every conceivable conservation treatment has negative effects…whenever an object is treated, some of its original features are altered, some portions of the object's history are obliterated, and some information conveyed by the object is hidden or lost." (Muñoz Viñas 2009b, 52)

When deciding to clean a mineral, the history of the soiling should be considered, and the gain in aesthetic or scientific value achieved by cleaning, must be weighed against the loss of other attributes. The specimen must then be recorded through a condition report and digital images. Once these have been completed the nature of the object and the nature of the soiling should be established, both chemically and physically. For example, self-limiting tarnishes such as those sometimes observed on stibnite (Howie 1992a, 63) form a protective layer that should not be removed, whilst dull or brown tarnish on pyrite can be considered a passivating film (Howie 1992b, 76).

A cleaning treatment must be able to remove the unwanted material without causing short or long-term damage to the primary mineral or any accessory minerals that are present. A conservator must first check that the mineral is not soluble in, or sensitive to, the chemicals in question. The method posing least risk to the assemblage should always be tried first and, when a treatment has been decided upon, a small, unobtrusive area of low scientific value should be test-cleaned first. The potential removal of lacquers and old repairs should also be considered. Common associations must also be noted, such as stilbite and pyrite, in case this has any bearing on potential risk from the treatment. Damage to any labels attached to the specimen must also be considered. Once the treatment has been completed, a record must be created of the technique, date and chemicals used. This will allow the long-term stability of the specimen to be monitored, will aid future conservators when deciding which treatments can be repeated (and which should be avoided) and will enable future researchers to understand why certain chemicals are present on, or absent from, the specimen.

Preparation

There are many internet forums for mineral collectors that consider the removal of unattractive mineral species from an assemblage to be "cleaning". Online recommendations include oxalic acid, hydrochloric acid, household vinegar, household ammonia, ultrasonic baths, sandblasting, Rust-Out, water gun, brine, air scribe, brass brush, and dental picks. This "development" of assemblages equates to a loss in scientific value, and is a contentious subject (Davidson 1942), it can also cause instability in the remaining assemblage (King 1982, 42). Brunton *et al.* (1985, C3) view the removal of secondary weathering products as unethical, but do not feel the same about cutting rock specimens to create slides or removing the matrix from fossils. It is difficult to judge minerals in the same way as other types of museum objects when there is a long tradition of destructive processing of specimens for scientific research. Price (1992, 7) believes that, as long as it is done carefully, and fully documented, mineral development may be allowable if at least some of the associated mineral remains. This would require some type of resin or wax barrier if the preparation technique includes immersion. Kile and Wilson (1997) believe that minerals have a dual nature: scientific and aesthetic, but are disposed against both enhancing a specimen to a state better than it has ever been and also treatments that may make future scientific analysis unreliable. An understanding of the chemistry and relative solubility of each mineral species is essential, and conservators must beware of intermediates between end members of a mineral series.

Strictly following conservation principles, only han-

dling greases, particulate contaminants and deteriorated resins should be removed, but the true value of a specimen may sometimes only be revealed through more extreme measures. This should always be considered carefully and on an individual basis.

Dry Cleaning

The potential damage caused by particulate contaminants should not be underestimated. Aesthetic considerations are not the only motive for dry cleaning: dust can be surprisingly damaging. Particulate pollution can contain abrasive grit, carbon particles, oil droplets, skin, vegetable matter, textile fragments, bacteria, mould spores and myriad chemical compounds. These can cause abrasion, changes in colour and lustre, can retain moisture on the object's surface and accelerate the spread of fire, attract insect pests, be acidic or contain salts and metallic catalysts (Hatchfield 2005, 34). Dust can also obscure early signs of deterioration, such as cracks, colour changes and efflorescence.

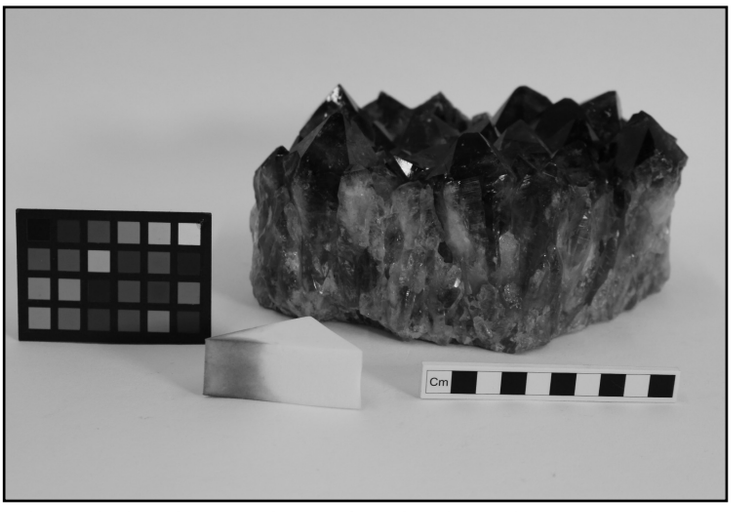

Figure 1. Amethyst specimen after cleaning using a cosmetic sponge (in the foreground). Natural History Museum specimen; Lu Allington-Jones photo.

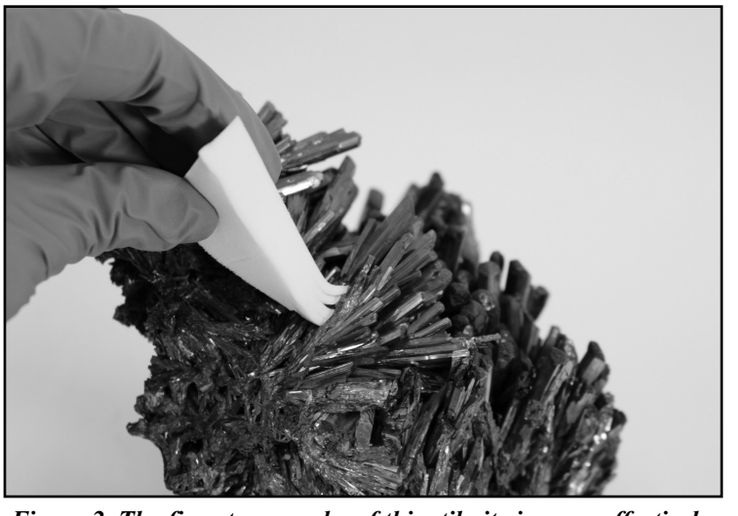

Figure 2. The finer topography of this stibnite is more effectively cleaned using a small scarified piece of cosmetic sponge. Natural History Museum specimen; Lu Allington-Jones photo.

There are many options for dry cleaning and the physical properties of a mineral should be considered when making a choice. Very delicate, acicular and villiform crystals should only be cleaned using an air puffer. Compressed air should only be used on more robust specimens with extreme caution, especially when the mineral is highly cleaved. Larger particles may be carefully fished out using vacuum tweezers or a small piece of Groomstick on the end of a cocktail stick. For more physically robust crystals a soft mop style brush may be used, with a museum vacuum cleaner on a low setting to suck up particles. A piece of muslin can be fixed over the nozzle of the vacuum cleaner to catch any mineral particles that may be dislodged.

Excellent results have recently been achieved at the Natural History Museum (London, UK) using latex-free cosmetic sponge (Figure 1). For complex specimens, slits can be incised into the sponge to allow it to follow the topography more closely (Figure 2). Cosmetic sponge is very soft and will not abrade the mineral surface or leave behind chemical residues. It will not drag on the surface like Groomstick or crumble like Smoke Sponge. It will pick up more particulate contaminants than a brush would dislodge, and it also has the advantage of not generating dust.

An absence of chemicals means no risk of contamination, no potentially damaging residues, no chemical alteration of the specimen or accessory minerals, and no risk of removing old repairs or coatings. Dry cleaning should always be attempted before any chemicals are introduced.

Laser Cleaning

Lasers have become extremely popular in building and sculpture conservation (Alves and Sanjurjo-Sánchez 2015), and excellent results have been achieved at the NHM on soot-blackened specimens (Personal Communication, L.Cornish, NHM, 2016). They are highly directional and monochromatic so, once a suitable wavelength and fluence (energy density) has been chosen, they can be easily controlled. Another advantage of laser cleaning is that it can remove materials of different chemical composition simultaneously (Samolik *et al.* 2015). The selection

of the correct wavelength, pulse length and fluence, however, is a matter of trial and error, and the investigation of chemical and microscopic physical change is essential (Grammatikakis *et al.* 2015).

Laser ablation exploits the fact that dark-coloured material absorbs light energy preferentially whilst pale-coloured material is more likely to reflect light energy. The dark-coloured matter is heated and expands, detaching from the pale substrate (Cooper and Larson 1996, 29). Infrared (1064 nm) is less likely to be absorbed by pale coloured material than green (532 nm) and ultra-violet (355 nm) light so the former is generally considered less likely to cause unwanted damage. For example 355 nm and 532 nm wavelengths can cause colour changes and pitting on gypsum, whereas 1064 nm does not (Grammatikakis *et al.* 2015; Samolik *et al.* 2015). At low fluence, the predominant mechanism is rapid thermal expansion of dirt layers, causing them to be ejected from the surface of the substrate. At higher fluence, plasma formation occurs and a shock wave causes the dirt to detach from the specimen (Cooper and Larson 1996, 32). The latter is far less selective and more likely to cause damage to the substrate. Laser ablation should only be attempted when the fluence removal threshold of the unwanted material is far below the damage threshold of the substrate (Grammatikakis *et al.* 2015) and is only successful if there is minimal penetration of dark material to be removed (Samolik *et al.* 2015).

Baude (2014) found infrared laser to be effective in removing black weathering crusts from marble and gypsum, and that no damage was caused to the substrate, concluding that, in this case, laser cleaning is self-limiting. The theory that dark material can be removed from pale-coloured material in a self-limiting reaction becomes problematic when the inhomogeneity of minerals is considered: Grossi *et al.* (2007) discovered that laser cleaning caused colour loss in pink potassium feldspars due to the alteration of iron minerals that were present in very fine cracks. Iron compounds are very sensitive to infrared radiation, which causes a reduction in red hue. Lasers can also create micro-fractures in quartz and cause biotite to melt (Grossi *et al.* 2007). Samolik *et al.* (2015) discovered an adverse reaction and colour change in TiO_2 when cleaning paint. This has implications for minerals such as brookite and rutile, and also illustrates the necessity of testing the effects of the laser thoroughly before using it to clean minerals.

The presence of moisture can improve the performance of laser ablation due to the explosion of the water vapour (Grammatikakis *et al.* 2015), but this presents similar risks to cracked, porous or strongly cleaved minerals as immersion in an ultrasonic bath, and in any case should not be attempted with water-sensitive specimens. In addition, laser cleaning should never be attempted on light or temperature-sensitive minerals.

Laser ablation can be an excellent method for cleaning, but it is an extremely complex treatment with many variables. If attempted on an unsuitable mineral, it can cause melting, surface microcracks (leading to a change in lustre and opacity), light and temperature damage. Laser cleaning should not be attempted without careful planning, testing and a consideration of both the mineral and the nature of the soiling.

Water

Inappropriate relative humidity is the largest cause of deterioration within mineral collections. High humidity can cause deliquescence, phase transitions, deformation, hygrostatic stress and mechanical failure (Waller 1992). In addition, many corrosion and oxidation reactions require the presence of water (Howie 1992a, 57). Waller (1992, 36-39) lists mineral species known to undergo humidity-related phase transitions, but estimates that the stability range of hundreds of minerals is unknown. Brunton *et al.* (1985) list groups that are vulnerable to damage when washed in water. Specimens may also be structurally unsuitable for cleaning with liquid: minerals with a strong cleavage may allow permeation, causing weakness and changes in opacity or colour (King 1992). With so much risk of damage from high humidity, the use of water as a cleaning agent should not be taken lightly. Moisture-sensitive specimens cannot be wet cleaned and then quickly dried in an oven because the warm minerals may absorb atmospheric moisture as they cool (Howie 1992b, 82). Elevated temperatures can also cause expansion damage, melting and colour changes, whilst rapid changes in temperature can be catastrophic for sensitive minerals (Pearl 1973, 68-69). Although not water soluble (Hamilton *et al.* 1974, 18), sulphur is so sensitive to temperature changes, that immersion in water, or indeed any liquid, that could have a different temperature to ambient room temperature, poses too high a risk (Wilson and Currier 2001, 337). Cleaning in an ultrasonic bath should never be attempted on well-cleaved, cracked or porous minerals (King 1982, 44), regardless of their chemical attributes, due to the damage caused by the generation and rapid expansion of bubbles. The nature and pH of water should also be considered before use: very weak acids affect carbonates but deionised water, purified of the ions that could adversely react with a specimen, can sometimes be acidic, and must be tested before use.

Chemical Cleaning

Online recommendations, sometimes bizarre and hazardous, include soap and water, milk, alcohol, ether, dry-cleaning compounds, nitric acid, hydrochloric acid, a mixture of vinegar and cigar ashes made into a paste, bleach, oxalic acid and cyanide. The health risks associated with these chemicals must always be considered (Brannock 1970). Recommended commercial cleaners should be approached with caution, even chemicals used within other conservation disciplines should be tested before use: products used to clean corrosion from metalwork, for example, are likely to contain phosphoric or citric acid and, whereas these might be safe to use on quartz, for example, they would cause severe damage to minerals such as aragonite or calcite. Some of these products are available in gel form, which allows a localised and more controlled application as opposed to complete immersion. Care should be taken however when rinsing away the gels, since the water could push chemicals further inside the specimen. King (1992, 131) and Hansen (1984) recommend that a sodium salts solution developed by Waller (1980) should be used instead of acids to remove iron oxide films on silicates, but not on calcium or magnesium minerals. King (1982) warns of some of the side effects of accepted development treatments, for example a sodium citrate/glycerine/chalk poultice (commonly used to remove iron oxides) will etch calcite, whilst oxalic acid can produce a calcium oxalate residue and hydrochloric acid may cause ferric chloride to precipitate. The potential hazard posed by a mineral must also be considered before handling, cleaning and development (Freedman 2012), for example acid should never be used on arsenic minerals due to the risk of arsine liberation (Museum's North Natural History Panel 1996).

At the NHM objects on open display and in handling collections usually develop a thick layer of "visitor grease". This is first removed using wooden picks (as long as they are softer than the minerals themselves) and then a mixture of equal proportions of Stoddard solvent and de-ionised water (with up to 2% non-ionic detergent e.g. Synperonic A7) is applied locally before rinsing with water, a treatment also recommended by the Victoria and Albert Museum (V&A 2016). If solvents are applied locally, and removed immediately using swabs, the risk of long-term damage is significantly reduced compared with immersion techniques.

Pearl (1973) provides an extensive amount of anecdotal but nevertheless extremely useful information and, even though written over fifty years ago, the recommendations are invaluable. The work is organised by cleaning technique, rather than by mineral, so careful study of the text is required. Some practices are outdated, such as rubbing pyrite oxidation with a bactericide and using proprietary radiator cleaner to remove oxides, but it is the warnings that can help curators and conservators the most. For example brown calcite geodes with a thin film of stilpnosiderite cannot be cleaned with liquids because their iridescence will be destroyed, whilst mica will delaminate in a liquid (Pearl 1973, 25; 28). Although this work should be considered in the light of modern principles of conservation, this sort of information is essential to reduce the potential for future damage, and it at least tells us what not to do. Wilson and Currier (2001, 338) detail an example where a black oxide was removed from prehnite with acidified hydrogen peroxide, but the minerals that had been removed turned out to be an extremely pure todorokite and far more important than the prehnite itself. Prior to chemical cleaning, a thorough investigation into the mineral assemblage is essential. King (1983) outlines the most common development techniques for different types of minerals, and this forms a useful reference for divining what may have already occurred to a specimen or assemblage. This is useful not only for academic analysis, but also when determining the cause of deterioration and assessing what techniques or chemicals should be used now without triggering an unexpected adverse reaction.

Conclusion

There is a great deal of advice to be found online and in published journals (although there is a paucity of recent published material) regarding the cleaning of minerals. Much of it is excellent, because it is based on many years of trial and error, but conservators should be extremely cautious. What is sometimes termed cleaning is in fact destruction of associated minerals, and therefore leads to a loss of scientific data. Many specimens will have already been prepared in this way before they enter a museum, and there is nothing that we can do to reverse these treatments. Our job is to ensure the long-term preservation of collections whilst also allowing access to researchers and the public. If cleaning a mineral is desirable for study or display then the ethics must be taken into account, the physical and chemical properties of the specimen, including all associated minerals must be investigated and the method that poses the least risk should be selected. The condition of the specimen prior to treatment must be recorded in detail (including colour digital images) and a treatment proposal agreed upon, before any work is undertaken. A record of all techniques and chemicals used must also be maintained.

Objects chosen for display must almost be viewed as sacrificial and anticipate suffering loss, since inappropriate humidity, inappropriate temperature, light and gaseous pollution will cause many minerals to deteriorate (Brill 1980, 223; King 1985; Saunders and Kirby 2004, 63). Modern conservation theory stresses balance and common sense - whereas the risk of a treatment must be considered and each mineral specimen evaluated on an individual basis, their aesthetic value as objects for exhibition cannot be ignored.

Acknowledgments

The author would like to thank Claire Kelly (Natural History Museum, London UK) for advice on cleaning specimens on open display, Efstratia Verveniotou (Natural History Museum, London UK) as the inspiration for cutting slits in cosmetic sponge, after developing the technique for smoke sponge, and also Lorraine Cornish (Natural History Museum, London UK) for advice on editing. The author would also like to thank Allyson Rae (freelance conservator) for introducing us to the use of cosmetic sponge as a method for cleaning feathers, and the reviewers and editors of this journal for their valuable contributions.

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BOOK REVIEW

***GeoBritannica. Geological landscapes and the British peoples.* Mike Leeder and Joy Lawlor. Published Dunedin Academic Press Ltd, 2017. £24.99, hardback, xiv + 281pp. ISBN 9781780460604.**

When this book arrived unexpectedly I was delighted and annoyed at the same time. I was delighted that someone had written it, but annoyed that they had written it before the vague idea in my mind had crystallised into a tangible book. In the event the actual book was quite different from what I had conceived in my mind, but no less enjoyable and delightful for it. This is a rich, heady distillation of how Britain's geodiversity, the landscape and the raw materials it provides, all influence the way the British people have developed. It was an ambitious target, but the authors have succeeded on many levels.

The book is in 7 parts totalling 34 chapters. More than a third of the book is part 7, comprising short cameos of Britain's (not including Northern Ireland) georegions. Some 17 regions united by their geological character are defined. The cameos comprise a mix of historical and cultural analysis of how the geology influenced the development of society in those regions. For each region there are superb examples carefully selected and beautifully illustrated. What sets this book apart from some superficially similar books (Trueman's *Geology and Scenery in England and Wales*, and Whittow's *Geology and Scenery in Scotland*) is the shift of emphasis to human society influenced by geology, rather than simply the (admittedly) fascinating story of the landscape itself. The icing on the rich fruit cake here is the way that artistic interpretation and recording of the landscape has been woven into the cameos, and indeed throughout the book. Every georegion has at least one painting, sculpture or artwork featured. As shown in the South Pennines chapter, the artist John Atkinson Grimshaw captured the wet urban flagstones by moonlight of Park Row in Leeds beautifully. I now want to visit Leeds City Art Gallery just to see the real thing.

Returning to the first parts of the book, it is quite difficult to explain them in a meaningful way without describing them at length. The delight I found in this book is the way in which it steps outside the conventional frames with which we view things. It cuts across and links up disparate ideas in surprising ways throughout. Chapter 4 - Works of the Imagination focuses on artistic responses to the landscape and particularly exemplifies this. Painting, sculpture, poetry, literature and all artistic forms get a look in. Even a modern site specific audio-walk at Portland is featured. Part 6 explores these themes in more depth, with different chapters on different artforms.

Chapter 6 is a short look at how geological science was developed and some key players, but highly readable and not dry at all. Attention catching titles are used on sectional headings - 'Cool Pacemaker' for example, on Milankovitch and his cycles. The subsequent chapter is a brief geological history of Britain, using familiar palaeoreconstructions yet made accessible and readable.

Without a blow by blow listing of chapters, it simply suffices to note that other chapters cover themes like settlement and communication, natural resources, building stone and aggregates, metals and mineral salts, and coal, peat and oil. The story in each ranges widely in time and geography, covering the essential geological background but establishing how the geology has helped create the people and the communities that make up society in England, Wales and Scotland. The book is beautifully illustrated throughout with high quality and well-chosen pictures. The book is a good read, and highly recommended. How can you go wrong with a chapter title like 'Affection for Things Geological'?

REFLECTANCE TRANSFORMATION IMAGING - A POSSIBLE ALTERNATIVE TO AMMONIUM CHLORIDE COATING FOR SPECIMEN PHOTOGRAPHY

by Chris Pickup and Simon Harris

Pickup, C. and Harris, S. 2017. Reflectance Transformation Imaging - a possible alternative to ammonium chloride coating for specimen photography. *The Geological Curator* 10 (8): 481-486.

Coating specimens with ammonium chloride for photography has become the de facto standard for publication in palaeontological journals. However, it has several drawbacks such as the risk of damage to the specimen, and it requires access to a laboratory and a certain level of skill to carry out proficiently. This paper presents Reflectance Transformation Imaging (RTI) as a technique that can be carried out using digital photography equipment available to most researchers, museums or labs. The results of the process are compared with conventional photography, ammonium chloride coated photographs and 3D laser scans.

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Introduction

By using a coating process, the distractions of colour variations in fossils can be eliminated, allowing the researcher to concentrate on the morphology of the specimen. Ammonium chloride is often chosen for this process as instead of melting it sublimes from a solid to a gas when heated, and can thus be "puffed" onto the surface of a specimen from a glass bulb heated over a Bunsen burner (Feldmann 1989). A typical process might be as follows:

1. The specimen should be clean and dry before coating commences. It is often a good idea to set up the camera equipment before commencing with the coating operation.
2. To improve contrast, the specimen can be coloured with black ink which should be allowed to dry in a thin uniform film on the specimen.
3. The coating equipment is loaded with ammonium chloride powder. In a fume cupboard, the glass bulb is gently heated until the chamber fills with white vapour. When sufficient vapour has built up, it is expelled from the nozzle on the end by squeezing a rubber bulb attached to the glassware, or via some other very low-pressure air-line.
4. The white vapour is allowed to settle onto the surface of the specimen until the desired result is achieved. It may be necessary to switch off the fume extraction at this point as this will tend to suck the powder away rather than allowing it to settle.
5. Photography should now be undertaken immediately - the powder is deliquescent (tends to absorb water) and can damage the specimen if not removed as soon as possible.
6. Removal can usually be accomplished with a soft brush and an air blower.

Whilst the results of the process can be extremely beneficial in aiding examination of the specimen, there are a number of drawbacks, which can be summarised as:

- Access to a laboratory is required and, in the workplace, usually extra health and safety documentation must be filled out.
- Coating specimens with ink will usually permanently alter their appearance. Whilst the ammonium chloride can usually be removed, this may limit its use to fairly robust samples, and in all cases any future chemical analysis of the specimen may be affected.
- Some loaning institutions do not allow coating of their samples, or require special permission to be obtained to do so.

A digital alternative?

In many cases, Reflectance Transformation Imaging (RTI) could be considered instead of, or at least before, coating is employed. It is essentially a composite digital imaging technique which produces an image where the end user can choose the direction of lighting, as well as other parameters, such as the

level of specular reflections and the colour saturation. Other commentators have looked at this and offered very in depth and thorough explanations of the process (Hammer and Spocova 2013) (Hammer *et al.* 2002). In the authors' view this is informative for the specialist but masks the essentially straight forward photographic process that lies behind it - good results can be achieved with a normal DSLR camera, and a good grasp of basic specimen photography techniques. Most researchers, laboratories and museums will already have access to the equipment required, barring a few items which can be obtained at modest cost. No chemicals or fume cupboard are required and the process is no more hazardous to either the specimen or the photographer than taking a regular image.

Basic overview of the process

It is not intended to give a full working description of the technicalities of how RTI may be practised. Instead the reader is referred to the Cultural Heritage Imaging (2017) website and the detailed PDF downloads and open source software available from them. In addition, the excellent paper by Sarah Duffy (2013) provides a detailed description of the technicalities and interesting case studies. The purpose of this section is to provide sufficient information about the process to assess its efficacy for the suggested application. Presented below is an extract from one of the authors' previous works by way of a compact description of the RTI process:

> The physical process of creating an RTI involves having the subject matter below or adjacent to a Digital SLR camera, the position of the camera and the subject remaining fixed throughout the process. A series of photographs are then taken with a light moved around a 360^0 circumference at a series of angles ranging from a raking light at 15^0 through 40^0 to an oblique angle of 65^0. This produces 24 photographs with 8 taken evenly around the circumference at each angle. Although the angles and the number of shots are not prescriptive the aim is to take a series of images which light the subject evenly from all angles and directions creating a 'dome' of light positions over the subject. Included in each one of these photographs is a shiny reflective ball. It is the reflection of the light source in this ball that allows the processing software (RTI Builder) to know what the light direction was in any one of the photographs in the set. It is then the job of the software to amalgamate the images into one interactive animation. From the known light positions the software records the colour and tone information of each individual pixel in the photograph and can then extrapolate what the colour/tone qualities would be for all the light positions that lie in between those taken with the photographs. The result is a seamless animation of a 'digital torch' which can be shone over the surface revealing fine topographical detail. In addition to this the display software (RTI Viewer) can adapt this information and allow a variety of 'rendering modes' dependant on which processing method has been selected. There are two processing methods or 'fitters' available. The first is Polynomial Texture Map or PTM. This offers the widest range of rendering modes but has some licensing restrictions placed upon it by its creators at Hewlett-Packard (Duffy 2013, p. 9). The second is Hemispherical Harmonics or HSH. This fitter was created by CHI (2015) and is available free with their RTI Builder programme without licensing restrictions. However, it is limited to only two rendering modes. Modes such as specular enhancement make the surface appear shiny, wet or metallic, making fine topography more apparent and a range of 'unsharp masking' modes amplify the tonal differences between the pixels to pull out more detail. However, the process is not without its limitations. It is essentially for the analysis of low topography and relatively flat surfaces. Highly three-dimensional subject matter causes a number of technical problems. It is also a requirement for the light source to be at a distance of four times the diameter of the subject to get an even light spread. In reality this creates a size limit for the subject matter in terms of the realistic distances that one can get from the subject with the light source. (CHI 2015) (Duffy 2013). (Pickup 2015, pp. 16-18)

Figure 1 shows the relationship between light angle and direction and the reflective target described above. In practical terms the above description generates the following workflow:

1. The camera and specimen must be set up with the camera at 90^0 to the plane of the specimen and must not move relative to each other during the entire sequence of images. This usually means the use of a copy stand or tripod.
2. A highly reflective black sphere is also placed in the image frame. For each exposure the position of the reflected highlight effectively records the position of the light source.
3. It is suggested the process is carried out in a dimly lit or darkened room.
4. A suitable exposure is sought where the ambient light in the room does not register on the camera sensor but the addition of the directional light produces an acceptable exposure at the 40^0 light

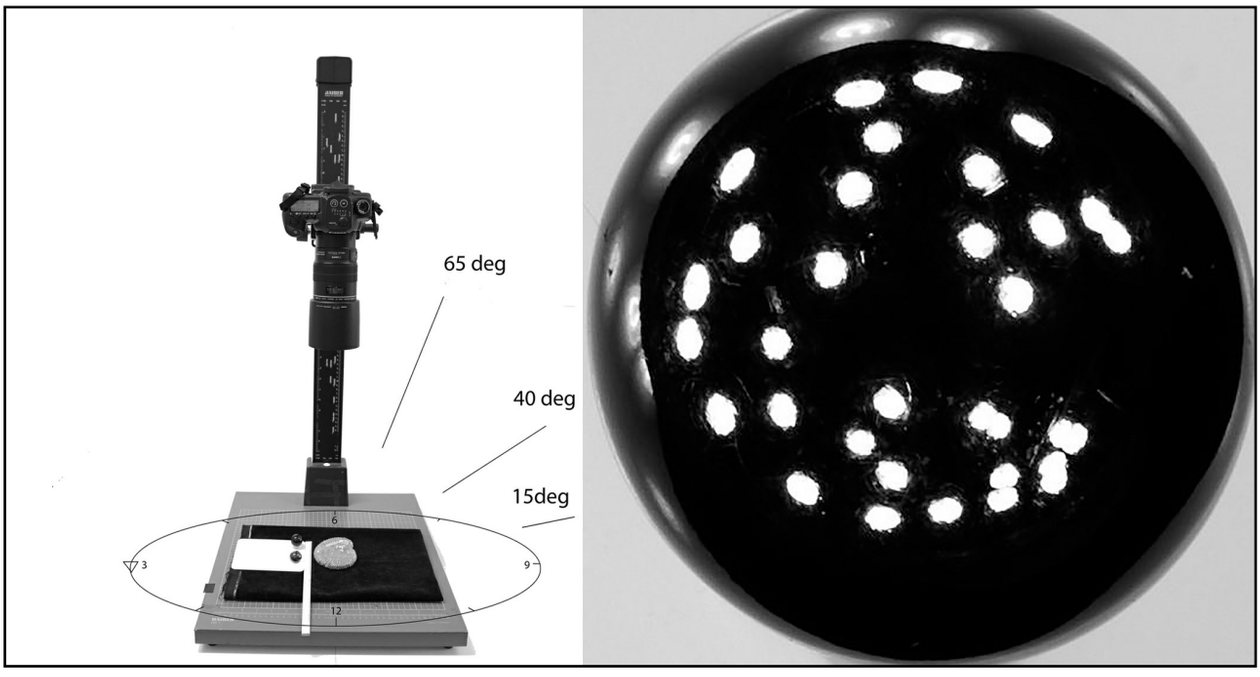

Figure 1: Left; a diagram showing a DSLR camera on a copy stand. A photo is taken with the light at 3 different angles in 8 different positions (or as close as is practicable) around the clock face. Right; as part of the processing workflow, the reflective target ball records the direction of the light as each photograph is taken. Note how there is a gap on the right-hand side where the column of the copy stand made it impossible to position the light.

angle.

5. The exposure and focus settings on the camera must be locked so that they do not alter during the process.

6. A series of images (at least six, but often around 24 or more) are taken using a point light source placed at a constant distance from the centre point of the specimen, forming a hemispherical dome shaped pattern of lighting points. The constant distance for the point light source is dictated as 4 times the diameter of the specimen. These points are randomly chosen, but should represent all possible lighting positions and angles from almost on-axis to very low raking light (*15^0, 40^0 & 60^0 degrees*).

7. A series of high resolution JPEG images are obtained through processing software such as Adobe Lightroom, or Adobe Photoshop (Adobe 2017) (Figure 2).

8. The open source JavaScript software (Oracle Corporation 2017) RTI Builder (Cultural Heritage Imaging 2017) is used to process the images, determine the lighting positions and normal directions of the surfaces, and finally produce a bundled file which can be opened in the open source RTI viewer (Cultural Heritage Imaging 2017). Note that JavaScript may need to be installed separately.

In all, the process should not take more than an hour to complete, with time savings obtained by imaging multiple specimens in batches.

Figure 2: Left; the photographic process in action. Right; a screen shot from the processing stage showing an image for each one of the light directions.

Equipment Required and Some Practical Solutions

The following equipment is required to undertake RTI photography:

- Camera support - either a tripod or a copy stand. Ensure that all fixings are properly tightened and no movement can occur. You will need access all around the specimen at a distance of four times the diameter of the specimen to generate a good RTI, so it is ideal to set up the stand in the centre of reasonable sized space. This requirement can make large specimens problematic.
- Camera - likely to be a digital SLR with, ideally a macro lens. Ensure that you are able to lock exposure, white balance, ISO, shutter speed, aperture and focal length, and set the correct exposure with the light at about the 40° position.
- Point light source - ideally in a professional situation this would be a portable camera flash unit or monobloc style studio flash head, but excellent results can be obtained with a variety of continuous light sources. The authors have proven that with some ingenuity, results can be obtained on a very low budget - see Appendix II.
- Remote camera trigger - it is essential that the camera can be triggered without moving it, and it is useful if the triggering can take place from some distance. If flash lighting is used, the unit should be triggered at the same time. We suggest a number of solutions to this problem in Appendix III.
- Reflective sphere - a variety of sizes will be required with the intention of the sphere showing in the final image being at least 200 pixels across. Appendix IV lists some conventional, as well as unconventional, sources.
- Background - a black velvet background helps avoid unsightly multiple shadows.

Imaging Approaches

For comparison, the specimen chosen is the holotype of the ammonite *Parkinsonia rarecostata* Buckman, 1923 (Buckman 1923) in the collections of the British Geological Survey, Keyworth, Nottingham, registration number BGS GSM 47152 (Appendix I). This specimen was imaged as part of the GB 3D Type Fossils Online project (Appendix I). In 2016 a coated image was produced of the specimen. At this time, RTI was considered as it would allow all of the imaging methods to be compared and the solution selected for the task. Figure 3 shows images of four possible imaging methods for the analysis of specimens such as *Parkinsonia rarecostata* Buckman. These specimens may be viewed in detail using the links provided in Appendix I.

Discussion and conclusion

It is the authors' assertion that RTI presents a real alternative to the complex and potentially damaging laboratory process of coating with ammonium chloride. However, it is only when the specimen is viewed in the RTI Viewer software, moving the digital light and using the various rendering modes, that its full advantage becomes apparent. It enables a thorough, yet desk based analysis of the specimen, magnified as required and with the advantage of a choice of lighting options. The set-up cost is relatively low with much of the equipment available in a normal museum or research institution. In addition, the software is available at reasonable cost or free.
This is not to say that other techniques do not have their value - a 3D scan enables a full 360^0 virtual 'handling' of the object. This is certainly not available with an RTI image which is essentially an animated photograph. The use of a higher specification (and more costly) scanner would have created a 3D model which is much sharper with more detail, although even scans from the highest specification hardware do not match the resolution of the photographs used to build the RTI.

Acknowledgements

The authors thank the National Geological Repository at the British Geological Survey in Keyworth, Nottingham, for providing the opportunity to write this paper through access to suitable specimens as well as to laboratory and photographic equipment. They also thank Dr Phil Wilby, also of BGS Keyworth, whose eagerness to adopt the use of RTI imaging enabled knowledge of the technique to be practised and refined. Data from the GB 3D Type Fossils Online Project is reproduced here under a Creative Commons Attribution-NonCommercial-ShareAlike licence.

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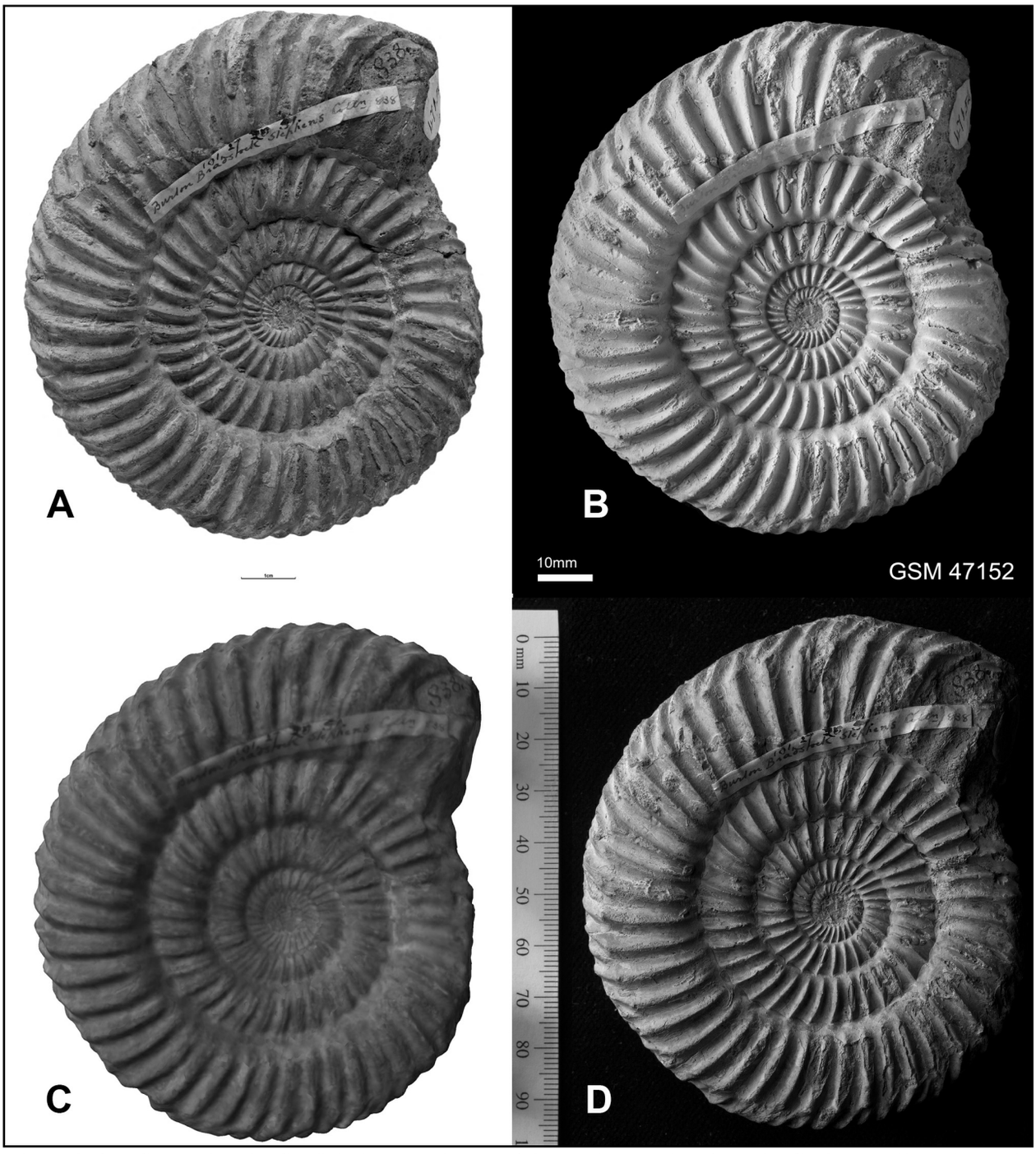


Figure 3: 3A; Conventional RGB digital camera image of the specimen, taken from the GB 3D Fossils project website and rotated slightly to match the angle of the images. 3B: Monochrome image, after lightly coating with sublimated ammonium chloride vapour. 3C: Screenshot of 3-dimensional laser scan of the specimen. 3D: Screenshot from the RTI produced of the same specimen employing the co efficient un-sharp masking rendering mode.

10.1017/s2475262200005323.

Hammer, Ø. *et al.* (2002) *Imaging Fossils Using Reflectance Transformation Imaging and Manipulation of Virtual Light Sources, Palaeontologica Electronica.* Available at: http://palaeo-elctronica.org/paleo/2002_1/Fossil/Issue1_02.html (Accessed: 8 September 2017).

Hammer, Ø. and Spocova, J. 2013) *Virtual Whitening of Fossils using Polynominal Texture Mapping, Palaeontologica Electronica*. Available at: palaeo-electronica.org/content/2013/465-virtual-whitening-of-fossils (Accessed: 8 September 2017).

Oracle Corporation (2017) *Java*. Available at: https://java.com/en/download/ (Accessed: 5 September 2017).

Pickup, C. (2015) *RTI and the Emerging Conservator*. University of Lincoln.

Appendix I

Readers are invited to view the results of our investigation

in digitally animated form by following the links below:
Specimen information:
http://www.bgs.ac.uk/Palaeosaurus/Record.cfm?sample_id=575422
RGB images, anaglyphs and 3d model: http://www.3dfossils.ac.uk/fossilType.cfm?typSampleId=575422
3D model, colour texture enabled: https://skfb.ly/IxFw
3D model, colour texture removed: https://skfb.ly/6txrG

All of these resources have been brought together, and can be viewed by visiting the Geological Curators' Group Website, and accessing the page for this issue of the journal: https://www.geocurator.org/

Appendix II - Some suitable light sources

Off camera flash unit - arguably the most versatile option, and you may already have one in your camera kit. We mounted ours on the end of a short monopod and taped a "pencil-beam" LED flashlight to the top to help in aiming the flash (Figure 4).
Mains powered studio flash - An ideal option for larger objects and has a modelling light built in. Some units can be quite heavy (3kg) when held at the end of an outstretched arm, so some kind of temporary support can be used.
Desk lamp - with a reasonably powerful tungsten bulb or LED equivalent, it should be possible to use a simple desk lamp. However, the room would need to be almost totally dark and the exposures will be quite long.
LED high power bike light or torch - These are ideal for starting out, they offer an extremely bright light which can be focussed into a beam of the desired size.

Appendix III - Building a selection of remote camera and flash trigger cables

The repeated need to trigger cameras from distances longer than that afforded by the conventional 50cm manufacturer cable release led to the modification of existing equipment to meet the demands. This is achieved through the use of inexpensive and easily available 3.5mm mono jack plugs and sockets, which can be soldered onto the ends of wires to make a modular extension kit. By convention sockets are fitted to the "end-points", allowing the use of jack-to-jack cables to connect them a suitable distance apart.

Radio frequency triggers are also available and two sets need to be used at different frequencies - one for the camera shutter and one for the flash synchronisation.

WARNING! Most camera electronics operate on low voltages and are not harmful. However older battery powered flashes can often have voltages of *several hundred volts* present on the trigger terminals and given a suitable exposed connection will easily find their way to ground through the end of your finger and down your arm (SJH speaks from personal experience here…). Mains powered

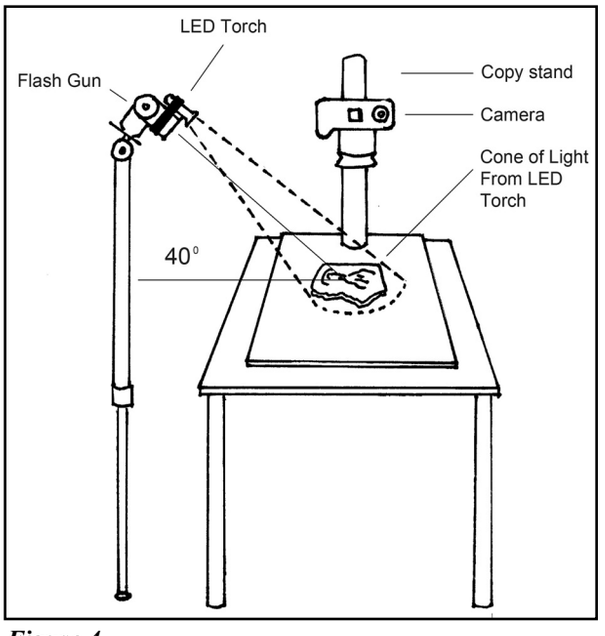


Figure 4

lights will of course involve domestic mains voltage and should be treated with appropriate deference. If in any doubt purchase the appropriate commercial system.

Appendix IV - Sources of reflective spheres

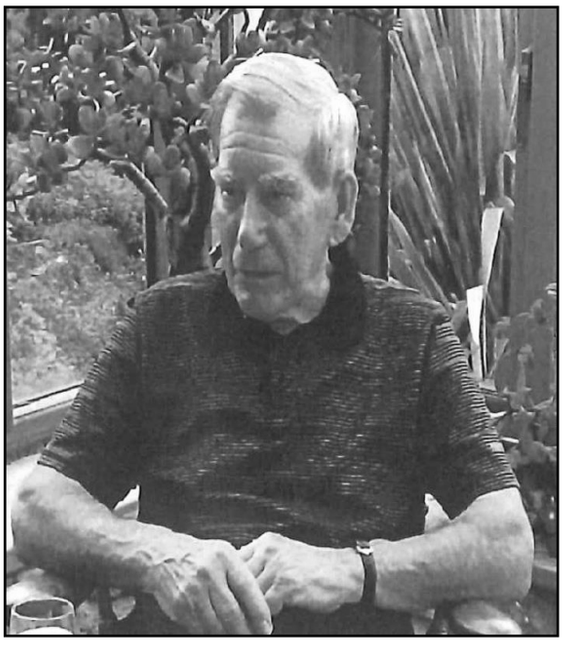
Silicon Nitride ball bearings - available from engineering suppliers, ideal for smaller sizes as they are very hard and shiny. Can get quite expensive in larger sizes.
Black snooker ball - an ideal target in fact, very round and very shiny.
Costume jewellery and beads - CP found a costume jewellery necklace in a charity shop which when unthreaded yielded a large number of spheres of differing sizes. When placed at right angles to the camera, the through-hole seems to make no difference to the results
Machine knobs - these are usually made from either Bakelite or HDPE/PP and can be obtained in diameters up to 50mm. They usually have a threaded hole in the base, which assists greatly in mounting them. In as-received condition they were not felt to be reflective enough, so each was screwed onto a short piece of threaded rod and turned slowly in a hand drill whilst smoothing the surface with successively finer grades of wet-or-dry grit paper and soapy water. Finally, the smoothed surface was finished with several sprayed coats of automotive clear lacquer which assured a highly reflective finish.

Appendix V -Technical notes

RTI
Camera: Canon 5D MKII
Lens: 100mm E2.5 Macro
Settings: 1/16 sec, F11, ISO100
Flash: Gemini GM400RX with Bowens 150mm reflector
Images: Shot in RAW format and converted to high quality Jpeg for processing in RTI Builder

3D Scanner
NextEngine 2020i desktop laser scanner.

RON CLEEVELY (1934 - 2017)



Ron Cleevely, former Senior Scientific Officer in the Department of Palaeontology, has died after a short illness, aged 82. For 30 years between 1961 and 1991, Ron was a stalwart of the Fossil Mollusca section, curating and advancing the taxonomy of Cretaceous gastropods and bivalves. He published extensively on Cretaceous molluscan faunas, for example, the Blackdown Greensand gastropods (with Noel Morris and John Taylor in *Palaeontology*) and made a considerable contribution to the Palaeontological Association Guide to Chalk fossils. His fame in palaeontological circles, however, lay more in his exceptional knowledge of 18th and 19th century collectors, their specimens and associated natural history works. His publications included several on the Sowerby family, beginning with a bibliography of their publications in 1974, and a biography of the famous Scottish collector, Elizabeth Gray, with details of her extensive collections held here in the Natural History Museum (1989). Amongst palaeontologists, he is perhaps best known for his encyclopaedic guide *World Palaeontological Collections* (1983), which has become the standard reference to fossil collectors and their collections. Unfortunately, as part of the major restructuring of 1990, Ron lost his job in 1991. He set up a consultancy, 'RonCAIRS' (Ron Cleevely Archive & Information Research Services), "providing assistance with natural history bibliography, biography and history, especially of 19th century geology and palaeontology, the curation of fossil collections, and the identification of fossil mollusca". After retirement to Devon he continued his research, which resulted in "Collecting the New, Rare and Curious - Letters selected from the Correspondence of the Cornish Mineralogists Philip Rashleigh, John Hawkins & William Gregor" (2009).

Colleagues last saw Ron on December 8th 2016 at a commemorative meeting to celebrate the life and work of Robert 'Bob' F. Symes OBE (1939-2016). Concerned about preserving historic data, Ron gave a talk entitled, "The use of archiving material to enhance our knowledge of mineral collecting in the past". His presentation, which generated good discussion, was about the changing nature of records and the ephemeral nature of electronic media, and its potential loss in the future. He made a tremendous effort to travel up from Devon to contribute to this meeting, because of the support and encouragement that he had received from Bob for his work on mineral collectors and dealers.

Ron will be missed - colleagues have fond memories of field trips with him and he was a kind and thoughtful person, always willing to impart some of his immense knowledge about collections and collectors.

Selected Publications

1) Taylor, J. D., Cleevely, R. J. & Morris, N. J. 1983. Predatory gastropods and their activities in the Blackdown Greensand (Albian) of England, *Palaeontology*, 26, 521-553.
2) Owen, E. & Smith, A. B. (eds) 1988. *Fossils of the Chalk*. Palaeontological Association Field Guide to Fossils, 2, 306 pp.
3) Cleevely, R. J. 1974. A provisional bibliography of natural history works by the Sowerby family. *Journal of the Society for the History of Natural History*, 6, 482-559.
4) Cleevely, R. J. 1974. The Sowerbys, the Mineral Conchology and their fossil collection. *Journal of the Society for the History of Natural History*, 6, 418-481.
5) Cleevely, R. J., Tripp, R. P. & Howells, Y. 1989. Mrs Elizabeth Gray (1831-1924): a passion for fossils. *Bulletin of the British Museum (Natural History), History Series*, 17, 167-258
6) Cleevely, R.J. 1983. *World Palaeontological Collections*. British Museum (Natural History/Mansell Publishing, 365 pp.
7) Cleevely, R. J. (Ed.) 2009. Collecting the New, Rare and Curious: Letters selected from the Correspondence of the Cornish Mineralogists Philip Rashleigh, John Hawkins & William Gregor, 1755-1822 (2009). *Publications of the Devon and Cornwall Record Society, New Series*, Vol. 52.

Compiled by former colleagues at the Natural History Museum, London.

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:

CHALMERS-HUNT - Chalmers-Hunt, J.M. (Ed.) 1976. *Natural history auctions 1700-1972: a register of sales in the British Isles*. Sotheby Parke Bernet, London, 189pp.
CLEEVELY - Cleevely, R.J. 1983. *World Palaeontological Collections*. British Museum (Natural History) and Mansell Publishing Company, London, 365pp.
FENSCORE - http://fenscore.natsca.org/
GCG - *Newsletter of the Geological Curators' Group*, continued as *The Geological Curator*.
LF - 'Lost & Found' reference number in GCG.
SHERBORN - Sherborn, C.D. 1940. *Where is the - Collection? An account* [...]. Cambridge University Press, Cambridge, 149 pp.

277. 19th Century plaster casts of Lower Jurassic ichthyosaurs and plesiosaurs in the Bristol Institution for the Advancement of Science, Literature and the Arts, and the Academy of Natural Sciences, Philadelphia

GCG 10(6), 277-281

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[2.] Research Associate, Department of Natural Sciences, National Museums Scotland, Chambers St., Edinburgh EH1 1JF
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Another example of a plaster cast of a Jurassic marine reptile produced by the mid-nineteenth century Bristol Institution for the Advancement of Science, Literature and the Arts (BIASLA) has been located in Derby Museum and Art Gallery (Figure 1A; Taylor 2016; Taylor and Clark 2016). This cast was kindly notified by Thomas Hartman, University of Nottingham, by way of Dean Lomax who identified the original ichthyosaur as a BIASLA specimen (pers. comm. 2016). The apparently original inscription clearly identifies the donor as Henry Riley M.D. (1797-1848), Bristol physician and anatomist (Taylor and Torrens 2017). This note describes the cast and suggests how it came to the now long closed museum at Burton-upon-Trent, and thence to Derby. Unless otherwise stated, personal information is from standard sources through www.ancestry.co.uk, familysearch.org, General Register Office and Probate Registry.
Derbyshire Advertiser and Journal

Riley's gift of the ichthyosaur cast must have been some time within 1838-1847, given Riley's final illness (Taylor and Torrens 2017) and the apparently original inscription with the name *Ichthyosaurus latimanus* Owen, 1840, just possibly notified by Owen to the BIASLA in advance of publication. This is within the known range of production of other casts of the same BIASLA ichthyosaur, from at least 1832 to 1847 inclusive (Anon. 1847; Taylor and Clark 2016). It is also exactly when such a cast would have been gladly received in the Derby Town and County Museum, newly founded (in 1836) and in its first flush of enthusiasm and expansion (Stanley 1976; Torrens 2013, p. 173; Elliott 2009). Alas, the early collections are poorly documented. However, no ichthyosaur cast is explicitly listed amongst the various 'Ichthyosaurus' or 'Icthyosaurus' remains loaned to the museum and listed in the specimen-level catalogue of a major temporary exhibition in 1843, though this is too early to be conclusive (Anon. 1843). The only possible near reference is '331. Icthyosaurus in Mahogany Case' owned by 'Mrs Jed. Strutt' (p. 27), but this should *a priori* be an actual fossil rather than a cast.

In fact, Riley's cast does not seem to have been given to Derby Museum (at least to begin with). Its current storage location strongly suggests that it was part of DBYMU 1981-260, a transfer of geological material from the museum at Burton-upon-Trent when this closed in 1981; no documentation has so far been

Figure 1. Casts of the now destroyed type specimen of* Ichthyosaurus latimanus *Owen, 1840, from the Lower Lias (Lower Jurassic) of Banwell, Somerset (City of Bristol Museum and Art Gallery Cb2464) (Taylor and Clark 2016). (A), cast in Derby Museum and Art Gallery (unnumbered pending backlog curation). The glossy and discoloured varnish makes it hard to photograph, but its identity is clear by comparison with Figure 1C. Note the integral plaque embedded in the plaster mount. (B), detail of plaque and apparently original inscription. The painted text reads 'ICHTHYOSAURUS *latimanus* (Owen) from the Lias Somersetshire. *The original specimen in the BRISTOL INSTITUTION.* Presented by H. RILEY Esq. M.D.' *The taxonomic identification, style of plaque bearing the lettering, and the wording used, are similar without being identical to those applied to another cast of the ichthyosaur, now in the Academy of Natural Sciences, Philadelphia (ANSP 17426; Taylor and Clark 2016, fig. 1a). This is to be expected of casts made by the same workshop at different times, or more probably lettered by the recipient museum using information from the same source. The cast in Philadelphia was received there in June 1847 after an unknown delay in transit, well within the 1838-1847 timing inferred in the text for the Derby cast (Anon. 1847). Both photos © Dean Lomax, by courtesy of Derby Museum and Art Gallery. (C), another cast (Oxford University Museum of Natural History J.10343/p), 149 cm long within inside edges of wooden frame. © and courtesy Oxford University Museum of Natural History. The Oxford and Derby casts, at least, were obviously made from the same multiple part mould as they have parting lines in the same places (the Philadelphia cast was either from different moulds or simply cleaned up to a much higher standard). This is not very clear in the photographs here, but one parting line can be seen running downwards from the bone which lies protruding downwards from the belly. Minor variations in the size of the frame, and exact location of the plaster replicas in the embedding plaster, may indicate that they were made at different times, or simply reflect natural variation in the craft process.

found to confirm this, but the ichthyosaur is not remembered as having been in Derby before then (Spencer Bailey, Derby Museum, pers. comm. 2016-2017, with the help of present and former staff Lucy Bamford, Bill Grange and John Crossling; Mick Stanley, pers. comm. 2017). Again, an 1838-1847 timing very well matches the formation of the Burton-upon-Trent Museum and District Natural History Society in 1841, the opening of its museum in 1842, and its early expansion with the support of

local gentry, especially Sir Oswald Mosley F.G.S. (1785-1871), the Society's original President (Anon. 1841, 1842a, 1844). No ichthyosaur cast is mentioned in an 1842 account of the Burton museum, but this is however too brief to be conclusive (Anon. 1842b).

This first Burton museum had a chequered history, as told by the noted natural history collector Philip Brookes Mason (1842-1903) (Mason 1896; Greenslade 1982, p. 151; Wain undated, 1979). The original society collapsed financially about 1858 and the collections were purchased by Sir Oswald Mosley and Mr Robert Thornewill, the Secretary, but Thornewill soon died and Mosley bought his portion (Anon. 1858). Mosley offered the collection to the town of Burton if it would provide a display space, and when this was rejected, he housed it in a purpose-built museum at his seat of Rolleston Hall. The Hall was partly destroyed in a fire in 1871, which did not affect the museum building (Anon. 1871), but probably destroyed the society records.

In 1923, the old collection at Rolleston, presumably including Mosley's own prior holdings and additions, was given to the second, and council-owned, Burton-upon-Trent Museum by Mosley's descendants, Sir Oswald Mosley (1873-1928) and his own son Oswald Mosley M.P. (1896-1980) (Anon. 1923; Francis 2015, p. 136). The collection therefore bypassed the era of Mason's activities and those of the revived Burton Natural History and Archaeological Society which so substantially built up this newer Museum's collections. But all were dispersed in 1981 when the museum closed (CLEEVELY, pp. 198-199; Francis 2015, pp. 135-136).

Riley's gift is almost certainly linked to his connections with the Burton area, as he was born at Hamstall Ridware in Staffordshire and his mother came from Burton (Taylor and Torrens 2017). For what it is worth, Hamstall Ridware is much closer to Burton (some twelve miles) than to Derby (some 36 miles). It is, of course, always possible that Riley gave the cast to an individual, such as Mosley (from whose collection it would naturally gravitate to Derby). However, the inscription so boldly proclaiming the donor suits a public institution better than a private collection. Most probably Riley made the gift because he was a member of the museum society, or because one of his Burton relatives or family friends, or a school-friend from his time at Repton School nearby, was involved with the Burton museum. This gives a large field to choose from, for Henry's Riley's maternal grandfather was the major brewer Henry Evans (1731-1805) of Burton-upon-Trent (Taylor and Torrens 2017). This gave him an entrée into the top levels of Burton society, themselves well represented on the museum and society committee (Anon. 1841). However, if forced to choose a candidate, one need look no further than the museum Treasurer, 'William Worthington, Esq.' (Anon. 1841), who must surely be the noted brewer William Worthington (1791-1871), Henry Riley's first cousin (Taylor and Torrens 2017).

Our study re-emphasises the value of studying the distribution of casts to reveal links, but also highlights a potential complication: that a donor need not always be the owner of the original fossil. Many museums have casts of the famous plesiosaur collected from the Lias of Street in Somerset about 1832 by Thomas Hawkins (1810-1889), and later designated the type specimen of *Plesiosaurus hawkinsii* Owen, 1838 (now *Thalassiodracon hawkinsii*). Such a cast was donated to the Geological Society of Dublin in May 1834 by the Dubliner Thomas Hutton (c. 1788-1865) (Anon. 1865; Wyse Jackson 2004, esp. pp. 12-13). The original plesiosaur had not yet been sold to the British Museum (McGowan 2002, p. 142), so Hutton probably purchased the Dublin cast from Hawkins, who about this time had an Italian plaster-worker on hand to deal with such things (Taylor and Clark 2016, p. 69). The BIASLA had already, in 1832-1833, obtained a 'superior Cast of a Plesiosaurus Dolichodeirus, found at Street, in Somersetshire', which can only have been this fossil, by exchange of 'duplicates' with Henry Beeke F.G.S. (1751-1837), Dean of Bristol (BIASLA *10th Annual Report*, tenth annual meeting on 14 February 1833; Bristol City Museum and Art Gallery, Department of Geology, Geology Manuscript No. 14, *Catalogue of fossil reptiles*, p. 31). This cast does not appear in published donations lists, doubtless because it was, in effect, purchased by barter. Presumably Beeke bought it from Hawkins, though his social status raises the possibility that the cringingly sycophantic Hawkins sent him the cast gratis. Riley must have purchased his own ichthyosaur cast from the BIASLA, or obtained permission for one to be made by an outside plaster-worker, in either case using the same moulds as extant casts given to other museums by the BIASLA (Figure 1; Taylor and Clark 2016). Of course, casts, at least of some taxa, would later become routinely available off the shelf from third party commercial dealers such as Ward's Natural Science Establishment in Rochester, New York (Rieppel 2015).

All those examples demonstrate that the donor of a cast was not necessarily the owner of the original specimen, which could be in a private collection or

an institution: an important practical point to bear in mind when researching an old collection.

Acknowledgements

As well as those already noted in the text, we are grateful to Patricia Francis for discussion and information, and Isla Gladstone and Deborah Hutchinson and their predecessors at City of Bristol Museum and Art Gallery, Deborah Elliott (Burton Library) and Anita Caithness (Lichfield Record Office) for locating and providing archival material. MAT acknowledges the support of the libraries of National Museums Scotland and the University of Leicester.

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280. Henry Riley M.D. (1797-1848) of Bristol

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An ichthyosaur cast donated by Henry Riley M.D. (1797-1848) of Bristol, apparently to the first Burton-upon-Trent museum, has recently been discovered in Derby Museum and Art Gallery (Taylor and Torrens 2017). This note reports the research which this has prompted into Riley's life and work, and especially his connections with the area. The nineteenth-century Bristol Institution for the Advancement of Science, Literature and the Arts (BIASLA, now Bristol City Museum and Art Gallery) produced plaster casts of ichthyosaurs and plesiosaurs, one of which Riley evidently purchased for his gift. Henry Riley himself was a Bristol physician and anatomist, best known today as co-describer, with the Institution's curator Samuel Stutchbury (1798-1859), of *Thecodontosaurus*, in retrospect one of the first dinosaurs discovered (Taylor and Torrens 1987; Benton 2012). Riley is of further general interest to historians of collections for his involvement with the BIASLA, its collections (to which he donated geological and zoological material), and its public and private lectures, and in founding Bristol Zoo. Those matters have been covered elsewhere (Green-Armytage 1964; Taylor and Torrens 1987 and refs. therein; Taylor 1994), but see also Neve (1984), now available online, while there survives a printed prospectus of the April 1833 course of lectures on comparative anatomy and the philosophy of zoology (Bristol Central Library B9717). Neve (1984) and newly searchable local newspaper databases confirm that Riley was actively lecturing up to 1846, speaking that year on fossil reptiles (Anon. 1846a). In this note, however, we focus instead on Riley's origins, family and training, showing that (contrary to what has been sometimes published) he was neither Bristol-born, nor did he obtain his M.D. degree in Paris. We confirm he family link with the Midlands hinted by the ichthyosaur, and show that his training in comparative anatomy seemingly began in Edinburgh, if not, indeed, Bristol itself. Unless otherwise stated, personal information is from standard sources through *www.ancestry.co.uk*, *familysearch.org*, General Register Office and Probate Registry, and newspaper articles from www.britishnewspaperarchive.co.uk. Abbreviations: bap., baptised; CCED: *Clergy of the Church of England Database*, http://theclergydatabase.org.uk/ (accessed 9 October 2017); d., died.

Henry Riley

Henry Ryley (note the spelling) was born on 20 June and baptised on 28 June 1797, son of Edward (c. 1742-1828) and Ann or Anne (bap. 1761-1846) Ryley who leased the large manor house in Hamstall Ridware, a village near Lichfield, Staffordshire, from the landowners, the Leigh family (Shaw 1798-1801, part I, pp. 150-160, plate B, figure 1, see p. 12; Anon. 1904-1906, p. 118). There is a pedigree in a much later edition of Burke's *Landed Gentry*, presumably from Riley's only known grandchild Major-General Sir (Henry) Guy Riley, K.B.E., C.B. (1884-1964), erstwhile Colonel Commandant, Royal Army Pay Corps (Pine 1952, pp. 2162-2163). This family link is confirmed by material compiled by Henry Riley's Bristol Infirmary colleague Richard Smith junior (1792-1843) (Bristol Archives 35893/36/m_i, Biographical Memoirs Volume 13, 'Biographical Sketches of the Founders, Officers and Students of The Bristol Infirmary', Mark Small, pers. comm. 2016; whence apparently Munro Smith 1917, pp. 303-304).

Edward had previously married Sarah Dawson in 1772, at St. Modwen's, the main church of Burton-upon-Trent, but she died in 1773, evidently after giving birth to their first son Edward (Anon. 1904-1906, pp. 94, 100). Edward senior next married Ann at St Modwen's on 26 or 28 December 1794 (Anon. 1795; *Gentleman's Magazine*, 1794 suppl., p. 1204). Her father was Henry Evans (1731-1805), a noted brewer of Burton-upon-Trent, as confirmed by his will (Barnard 1889-1896, vol. I, pp. 408, 411; PROB 11.1433, ff. 144-146, signed 17 September 1803, and proved 6 November 1805). He left, or had already settled on, the couple several thousand pounds at least in cash and other assets - at that time a very large sum, if paid out as he intended.

This windfall may be one reason, and Edward's presumed retirement from farming another, why the Ryley family apparently moved to Clifton, then as now a socially upmarket inner suburb of Bristol, in the 1810s or early 1820s. In 1822 they were at No 11, Windsor Terrace, also known as Windsor House (Anon. 1829; Matthew's *Bristol Directory* of 1822). This house and other Clifton addresses mentioned in this paper can be found in the 1828 Ashmead map of Bristol, which has the street numbers marked (currently available online on https://maps.bristol.gov.uk/knowyourplace/). Edward died in 1828 (Anon. 1828). His will of 23

December 1826, with a codicil of 17 July 1827, mentions his wife and (surviving) children Edward, Catherine, Ann, Henry, Sarah and Edmund (proved on 28 June 1828, PROB11/1742, ff. 243-245). His widow Ann died aged 86 at Clifton in 1846 (Anon. 1846b). Her will, signed on 23 November 1843, described her as Ann Ryley late of Clifton, and then of Hadley Cottage in Staffordshire (presumably the one near Yoxall; will proved 4 February 1847, PROB 11.2051, f. 69). By now, some family members evidently used the spelling Riley in everyday usage, keeping Ryley only for legal documents (e.g. Anon. 1824b, 1854).

We are dealing with a Staffordshire family leasing land in Hamstall Ridware, and wealthy enough to train their sons for the professions, and to move to Clifton, but retaining links with Staffordshire. Henry's half-brother Edward Ryley or Riley (1773-1831) and brother Edmund Riley (1804-1862) became Anglican clerics after attending the Universities of Cambridge and Oxford respectively (Foster 1891, vol. III, p. 1202; Venn 1940-1954, part II, vol. V, p. 395; CCED; Edward Ryley's will, PROB 11/1790, f. 324, proved 13 September 1831). Edward was, in fact, the resident curate of Hamstall Ridware itself from 1797 to 1807. This shows that the Ryleys would have known the Rev. Robert Augustus Johnson F.R.S. (1745-1799), Rector of Hamstall Ridware from 1791 to 1799 (CCED). This was despite Johnson being a pluralist and sinecurist who resided mainly in Kenilworth and Bath and for whom there is 'no evidence of his […] engaging in clerical life' (Shaw 1798-1801, part I, p. 160; Whyman 2009, pp. 191-217, esp. p. 192). Interestingly, one way in which Johnson filled his ample leisure was as a member of the Lunar Society of Birmingham, the famous informal learned society of Midlands intellectuals which met at various locations in and around Birmingham, including Lichfield. He has long been the least-known member, his interests being chemical, but with a short letter in a Royal Society paper on the Midlands earthquake of 1795 to his name (Schofield 1963, pp. 227-229, 378-379). However, Johnson's 1799 death rules out any direct scientific influence on the young Henry. Another intriguing connection is that Edward Cooper, Rector in succession to Johnson, was visited for several weeks in 1806 by his aunt, one Mrs Austen, and her two daughters Jane and Cassandra (Collins 2002, pp. 6, 12-13; Le Faye 2006, pp. 331-333). A little searching on the internet shows that this visit has prompted discussion in Janeite journals and blogs about whether Hamstall Ridware and its inhabitants appear disguised in Jane Austen's novels, perhaps as the village of 'Delafield' in *Sense and Sensibility*. We have not come across any suggestion that the Ryleys provided fodder for her pen. But it would be surprising if the Austens were not taken to pay a visit to the main local family outside the rectory, and vice versa.

Henry Riley was almost certainly the Henry Ryley of Hamstall Ridware who entered Repton School in Derbyshire in 1808 (Hipkins 1895, pp. 56-57; this has been verified with the original manuscript register, though nothing more is known as the records for that period are very incomplete, Paul Stevens, Archivist and Librarian, Repton School, pers. comm. 2017; the 'Parent, etc.' is given as 'H. Ryley' but this is presumed to be an error or a designation of a relative as local guardian).

Riley would not have stayed at Repton much beyond his 18th birthday in 1815, but does not appear in Oxford or Cambridge alumnus lists, unlike his brothers. This leaves a gap of several years before he went to Edinburgh in 1820, and the obvious possibility is that Riley then started his medical training, as the pupil or apprentice of a doctor, though more research is needed to confirm this. Interestingly, the two dedicatees of Riley's M.D. thesis (Ryley 1823, front matter) were George Wallis (1787-1869), who operated a private anatomical school in Bristol from 1813, and (almost certainly) George McDonald (c. 1783-1849), his assistant in this anatomical school (Anon. 1834d, 1849, 1869; Munro Smith 1917, pp. 301-302, 376-378). So perhaps Riley was apprenticed to one of them. But it is just as possible that they were family friends who had informally encouraged Riley in his choice of career. Either way, it seems relevant that Wallis came from Ockbrook near Derby, and maintained his links with his native village, and that he attended Repton and the University of Edinburgh, as well as Cambridge, while his wife Eliza Oakes came from Derby (Anon. 1869; Hipkins 1895, pp. 50-51; Munro Smith 1917, pp. 301-302; Venn 1940-1954, part II, vol., VI, p. 330).

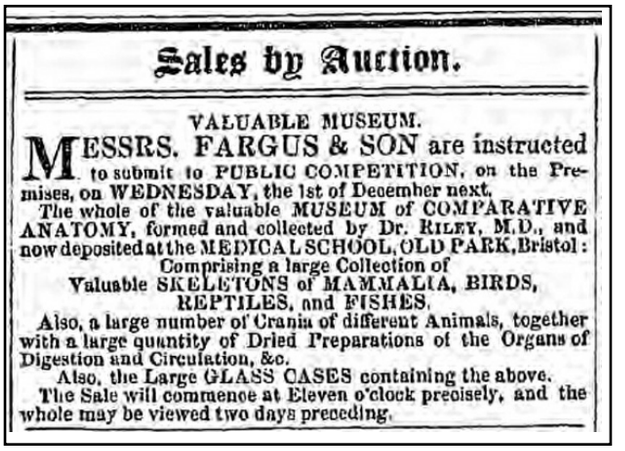
The next record known to us is that Henry Ryley of 'Clifton' matriculated at the University of Edinburgh in 1820, attending till 1823 (Rona Morrison, Special Collections, University of Edinburgh, pers. comm. 2017). He duly graduated M.D., his doctoral thesis being *De contextu generis humani cutaneo* ('Concerning the skin structure of the human race'; Ryley 1823; Anon. 1846c, p. 250). This doubtless helps explain why some of Riley's first donations to the BIASLA included geological specimens from Scotland (BIASLA *Annual Report* for 1823, p. 20).

Riley's mature medical career is summarised here only briefly, but some points are relevant to our story.

Riley returned to Bristol, and then went to study in Paris from 1824 to 1825 or 1826 (Riley 1824; Williams 1884, p. 35; Bristol Archives 35893/36/m_i, letter concerning change of Paris address from an hotel, April 1824, Mark Small, pers. comm. 2017). Riley came back to Bristol in 1827, after a gap which might have been spent training elsewhere. It was perhaps then that he gained his Licentiateship of the Royal College of Physicians in London (Anon. 1830; Green-Armytage 1964, p. 8), but we have not confirmed this. He took a house in Berkeley Square, Clifton, no later than 1830 (Anon. 1830). He was 'very like a Frenchman in appearance and manners', introducing the new French diagnostic tool of the stethoscope to Bristol (Prichard 1894, p. 6; Munro Smith 1917, p. 303). He had studied under its inventor R.T.H. Laennec (1781-1826), on whom he made enough of an impression to be amongst the British students whom Laennec particularly recalled in the second edition of his noted book *Traité de l'auscultation médiate* (Sakula 1981). This early stethoscope, a simple wooden tube, still gave better acoustic results than the previous method of applying the ear directly to the chest wall, which was then seen as unseemly. Riley also became Wallis's assistant in his private medical school, including collecting corpses for dissection from churchyards, for which he and Wallis were prosecuted in 1828 (Munro Smith 1917, p. 212). The link was doubtless publicly reinforced when, allegedly, a local 'resurrectionist' - professional grave-robber - left his body to Riley for it to be dissected and 'afterwards made into a skeleton' (Anon. 1831; it is not known whether this was a malicious joke, or simply in return for payment in advance, so to speak). The publicity cannot have been too bad as Riley was appointed physician in succession to St Peter's Hospital in 1832 and then the Bristol Infirmary in 1834, and a founding lecturer at the Bristol Medical School when it was created in 1833 from Wallis's school among others, opening its new rooms in 1834 (Anon. 1832, 1834b, 1834c, 1834d; Prichard 1894; Munro Smith 1917, esp. pp. 379-381).

On 19 May 1834 Riley married Cecilia Ann (or Anne), daughter of his Bristol medical colleague the surgeon Henry Daniel (d. 1859), at St George's parish church of Easton in Gordano northwest of Bristol (parish record; Anon. 1859). This says something for her given that he had allegedly already stood her up at the altar in 1832 with the excuse that it was too early in the morning (Munro Smith 1917, pp. 303-304). One wonders if it was accidental that local newspaper notices for this second and successful attempt carefully mentioned that the bride was from Clifton, but failed to specify which 'St George's' was meant, leaving the reader and one historian to infer the surely much more fashionable one in Clifton (Anon. 1834a; Munro Smith 1917, p. 303). The Rileys had three surviving children, Maria Cecilia (born 29 June 1836, baptised Nailsea 6 April 1837), Madeline (1 March 1838 and 13 February 1840), and Henry Whewell Daniel (15 January and 13 February 1840). Their son's second name may refer to William Whewell (1794-1866), Master of Trinity College, Cambridge, and philosopher and polymath much involved in the scientific community of the time. However, we do not know whether this simply reflects Riley's admiration for him, perhaps arising from the British Association meeting of 1836 at Bristol, or whether there was a friendship or family relationship unknown to us. The Prussian medical student F.W. Ludwig Leichhardt (1813-c. 1848), later explorer of Australia, was unfortunately so fascinated by the experience of English formal dinner *chez* Riley in 1837 - or thought this would interest his parents most - that he failed to say anything else about Riley in his letter home (Leichhardt 2010, vol. III, pp. 58-59, 66-67). The Riley family soon moved to 16 York Place in Clifton, probably around 1839, with a fine view over the Floating Harbour to Dundry Hill (not York Place in Bristol proper; earliest press reference is at the start of 1840, Anon. 1840, 1848a; 1841 census, mistranscribed on modern databases as 'Henry Puley').

Riley fell seriously ill in the late 1840s, having to resign his positions, and by November 1847 he had already become so incapacitated that he was unable even to follow his scientific leisure interests (Anon. 1847b). The family moved to Slough, probably in October 1847 when the contents of his house were put up for sale (Anon. 1847a), and the following month his comparative anatomical collection was advertised for sale by auction (Anon. 1847c; not listed in CHALMERS-HUNT). Riley soon died on 20 April 1848, supposedly from a brain tumour (Anon. 1848b; Green-Armytage 1964, p. 9; death cert. has 'Chronic Inflammation of the Brain'), so



Sales by Auction.

VALUABLE MUSEUM.

MESSRS. FARGUS & SON are instructed to submit to PUBLIC COMPETITION, on the Premises, on WEDNESDAY, the 1st of December next,

The whole of the valuable MUSEUM of COMPARATIVE ANATOMY, formed and collected by Dr. RILEY, M.D., and now deposited at the MEDICAL SCHOOL, OLD PARK, Bristol:

Comprising a large Collection of
Valuable SKELETONS of MAMMALIA, BIRDS, REPTILES, and FISHES.

Also, a large number of Crania of different Animals, together with a large quantity of Dried Preparations of the Organs of Digestion and Circulation, &c.

Also, the Large GLASS CASES containing the above.

The Sale will commence at Eleven o'clock precisely, and the whole may be viewed two days preceding.

perhaps the move was to get him away from Bristol, in consequence of personality change or dementia, while staying close to the new Great Western Railway, convenient for Bristol, and Cecilia's parents in London. Riley's coffin and mourners came to Bristol on the first down train on 27 April, delayed by a burst steam tube in the locomotive's boiler. The funeral and burial at Bristol Cathedral were attended by Stutchbury amongst others, and some of Riley's poor patients there to 'moisten his grave with their tears' (Anon. 1848b). Cecilia soon remarried, to John F. Rowlands (*c*. 1823-1878), a surgeon and mine-owner from her mother's native Monmouthshire; their theatrical son A.C.F.F. Rowlands (c. 1856-1914), as 'Cecil Raleigh', put on melodramas portraying, on the theatrical stage, such things as Lord's Cricket Ground, a horse race with real horses, and a fight in a hot-air balloon above Hampstead Heath (http://www.epsomandewellhistoryexplorer.org.uk/RowlandsMrMrs.html, accessed 11 October 2017).

This new understanding of Riley's training has implications for his activities at the BIASLA, including his lectures, which discussed various approaches to comparative anatomy, including the first exposition of transcendental anatomy in Bristol (Taylor and Torrens 1987, Taylor 1994). Transcendental anatomy, also known as philosophical anatomy, was an approach to comparative anatomy that sought to find common patterns and structures amongst animals and plants, often reflecting the presumed existence of an ideal plan in nature. Riley's interest and knowledge plainly stemmed in large part from his Paris years, and his lecturing on the new anatomy would have helped him present a Frenchified medical persona, Parisian style, quite apart from his evident personal enthusiasm. But the impact of his Edinburgh training must now also be considered.

Many Edinburgh medical students then attended the private schools of anatomy, the official university courses being so poorly taught. The most successful extramural lecturer, John Barclay (1758-1826), laid heavy emphasis on comparative anatomy. Informal and personal relationships were also important, as when Robert Grant (1793-1874) famously talked to the young Charles Darwin (1809-1882) about transmutationism later in the 1820s (Browne 1995, pp. 49-88). Compare Riley's near-contemporaries Robert Knox (1791-1862) and Richard Owen (1804-1892) , the two most important British transcendental anatomists of the nineteenth century: they also started in Edinburgh before going on to further study elsewhere (Rehbock 1983, esp. pp. 32-36, 75-76; Rosner 2004). But, unsurprisingly by the nature of such things, we lack positive evidence for what Riley did. We do know that he did not join the undergraduate Plinian Society which debated such matters, but this means little as it was founded in January 1823, not long before Riley's graduation (Jenkins 2016, p. 435, fn. 48; Bill Jenkins, pers. comm. 2017). What can be said is that Riley was seemingly a little too early to benefit from the full flowering of transcendental anatomy in Edinburgh in the second half of the 1820s. Knox, for instance, only returned in 1822 and did not lecture till 1825. Nevertheless, Edinburgh was a good place for comparative anatomy. As well as Barclay's lectures, which Riley was surely well off enough to afford, and relevant material in other lectures, Riley would have benefited from the University's Natural History Museum. Experience of it (and its Parisian equivalent) surely encouraged his later support for the BIASLA. But even before Edinburgh, Riley's (presumed) mentor George Wallis might well have encouraged his interest in comparative anatomy, if perhaps not its overtly transcendental form. Wallis would soon himself lecture publicly on comparative anatomy in 1825 under the aegis of the BIASLA, but seems to have taken a conservative approach by expounding natural theology and attacking phrenology, then often seen as a dangerously materialist doctrine (Anon. 1824a, 1825a, 1825b).

As sometimes happens, it proves hard to establish two of the most important things to know about any historical figure of the 19th century: personal wealth, and religious affiliation. Riley's natal family was obviously well off, as were his in-laws, and as a Clifton physician he could charge his wealthy patients hefty fees, but he had a high-maintenance lifestyle with a position, a wife, three children and a vehicle of his own to maintain, and his scientific interests too. So we do not have a clear sense of his actual wealth, though his final illness would have cut his income and drained the family coffers to some extent. We can so far say little more about Riley's religious belief. His birth, schooling (but not University), marriage and burial all show formal Anglican affiliation, but we cannot say how nominal this might be, though we have not come across any involvement of his with ecclesiastical matters. He certainly cannot have been an evangelical, at least of the Sabbatarian variety, as he supported the Unitarian minister Dr Lant Carpenter (1780-1840) in an unsuccessful attempt to offer the working classes wholesome recreation by opening the Zoo on a Sunday (Green-Armytage 1964, pp. 18-19).

Like his Cliftonian upbringing, Parisian training, and French manners, Riley's public lectures at the BIASLA, and involvement in local organizations

such as the Zoo, were doubtless deployed partly with an eye to his self-advancement. But that was part and parcel of making one's way in life, and he certainly seems to have been more successful at Clifton than another palaeontologically inclined medic, Gideon Mantell (1790-1852), was in equally socially upmarket Brighton (Torrens and Cooper 1986, p. 257). No doubt it helped that, unlike Mantell, Riley shared the burden of a collection and an institution with other members.

Riley's gift of the ichthyosaur cast to the first Burton-upon-Trent museum, however, seems too far from Bristol to have been part of such a campaign. Rather, it must reflect his personal links with the area. One obvious possibility arises from the fact that the museum Treasurer appears to have been Riley's cousin, the noted brewer William Worthington (1791-1871) (Taylor and Torrens 2017). This Worthington was the third of that name in the family business, son of William Worthington (1764-1825) and his wife Martha Evans, sister of Riley's mother Ann (Henry Evans's will, PROB 11.1433, ff. 144-146; Anon. 1791, 1871; Barnard 1889-1896, vol. I, pp. 410-413; Clark 2004).

This study has increased our knowledge of the early life and work of Henry Riley, an interesting figure in the early history of one of the most significant English provincial museums, though gaps remain in the story. We hope that our work may also be useful in programmes of public interpretation of science centred on Riley's *Thecodontosaurus*, the 'Bristol Dinosaur' (Benton *et al*. 2012).

Acknowledgements

As well as those already acknowledged in the text, we are grateful to Mike Benton for discussion and information, and Isla Gladstone and Deborah Hutchinson and their predecessors (City of Bristol Museum and Art Gallery) and Jane Bradley (Local Studies, Bristol Library), for information and archival material. MAT acknowledges the support of the libraries of National Museums Scotland and the University of Leicester.

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GEOLOGICAL CURATORS' GROUP

41st Annual General Meeting

41st Annual General Meeting of the Geological Curators' Group.
Birmingham City Museum, Birmingham.
2nd December 2014.

1. Apologies for absence.
Steve McClean, Rosemary Roden, Adrian Doyle, Patrick Wyse-Jackson, Simon Knell, Kate Andrew, Steve Etches, Paul Ensom, Tony Morgan, John Cooper, Monica Price, John Martin, Steve Howe, Nigel Monaghan, Kate Riddington, John Kington

2. Acceptance of the minutes of the 40th AGM held at Leicester.
Agreed. No amendments.

3. Matters arising.
No matters arising

4. Chairman's report. [Giles Miller]
My first year as Chairman has gone past very quickly but has been full of interesting and exciting activities. First I must extend my thanks to Mike Howe for his sterling job as Chairman over the previous three years and to the committee for their support during the past year. In this report I'd like to highlight four initiatives that we have engaged in recently.

Survey 2014 - what do people want and where are we headed?
Following our first committee meeting we developed a questionnaire to gauge the thoughts and feelings of our membership and the wider museum population who care for collections including geological material. A big thank you to everyone who replied and sent the comments that have helped us to develop a strategy for the GCG over the next three years or so. There were important questions we wanted to ask about how to deliver our workshops, training sessions and our publications over the next few years. One of the key outcomes is that we are going to deliver Coprolite electronically next year unless members specifically request paper copy. A move to deliver Geological Curator electronically may be delayed until the following year as many members expressed concern over our current ability to archive past and future copies electronically. Another outcome from the survey was a list of subjects that can act as a basis for planning future programmes and skills sharing networks. More worrying was the relatively low percentage of replies (64%) that said they see GCG as the first port of a call to answer questions on the management and use of geological collections. 'A louder voice for advocating geological collections' was considered the most important future role for the GCG. It was interesting to discover which organisations our membership also belong to and that over 91% welcomed closer collaborations with other collections related membership organisations. Finally we summarised 12 action points to illustrate our proposed direction over the next three years. These, along with the results of the survey, will be published in the next edition of Geological Curator.

Collaboration - MoU and SSN grant application
At the Society for the Preservation of Natural History Collections (SPNHC) meeting held jointly with the Natural Sciences Collections Association (NatSCA) and ourselves at Cardiff in June, we signed a Memorandum of Understanding between our three organisations agreeing to collaborate more closely in future. A big 'thank you' to committee members Helen Kerbey and Cindy Howells for playing a major part in the organization committee for this conference. Initially this collaboration will be taken forward by a small group of 6 "emerging professionals" including Emma Bernard and Sarah King from our own committee. The strategy document resulting from our survey has partly been written to help Emma and Sarah to identify ways in which we can collaborate but also as a result of discussions with Arts Council England (ACE) towards preparation for a major grant application joint with NatSCA to develop a more resilient and diverse subject specialist network. I have also been contributing to discussions at several meetings of a consortium of Natural History Museums in the UK about how our network will be shaped in the future, how we advocate and share skills. In early November we submitted a joint application with NatSCA to the ACE SSN Resilience Fund for 150K. Most of this funding will be allocated to hiring a part time administrator for three years to oversee many of the initiatives that we wish to push forward. Initially for the GCG this will entail a revamp of our existing web infrastructure to deliver a more resilient platform to deliver our journal, deliver information from past publications via a searchable portal and finally to develop an on-line directory of expertise. Subsequent years funding will help develop our network beyond the traditional membership by contacting professionals and institutions on the periphery of our network who may not have the specialist skills

required for managing geological and other natural science collections. On-line videos and other skills sharing advice documents will be developed in the following year. In the final year of the funding we will award small grants for visits from expert curators to institutions where there is a perceived lack of support and subject specialism and use the on-line resources we have developed to best match the skill providers with those that require support. We should be informed of the outcome of our application early in the new year.

English Geodiversity Charter launch - Houses of Parliament

Collaborations have also been ongoing this year with the Earth Science Education Forum (ESEF) and the English Geodiversity Forum (EDF). I was invited to present a talk about the GCG at the October ESEF committee meeting at the Geological Society and committee member Kate Riddington has been representing us on the EDF committee. I presented a short talk, illustrated by museum specimens, at the Houses of Parliament at the launch of the English Geodiversity Charter. It was a great opportunity to show the importance of museum specimens in inspiring and teaching the geoscientists of the future, illustrating issues of local importance, our heritage and most importantly that geodiversity affects us all. This has hopefully opened the door for future interactions with MPs and other people of influence that can make a difference to our community by supporting museums and museum collections. It is great to see that former GCG Chair Mick Stanley is to present the after dinner speech at our 40th Anniversary Dinner tonight as he was instrumental in organizing the Charter Launch at the Houses of Parliament.

Future Geological Curators - Public outreach

In September I helped with a GCG-BGS Yorkshire Fossil Festival stall outside the Rotunda in Scarborough. During the festival I was thinking about how we as a group are reaching out to our younger audiences at festivals like these. Quite rightly the 3-D Fossil printer grabbed all the attention and I believe that we should continue to publicise the 3D-fossils project as it is a great tool for inspiring young and old alike. I asked the younger visitors to our stall if they had collections of rocks and fossils at home and where they kept them? Many of them answered that they kept them on the windowsill, mantelpiece or in their garden sheds. One child even replied that they kept their collection in their mother's pockets! It struck me that as one of our remits is to encourage better standards of curation, that we should perhaps be running exercises at these festivals that encourage young geological collectors and the curators of the future, to curate their collections to the best standard possible. As the theme of this report is collaboration, I'll finish by mentioning that we are collaborating with RockWatch to offer an annual prize for a Young Geological Curator. Keep an eye out too for our Survey paper in the next Geological Curator and the outcome of our application to the Arts Council England.

5. Secretary's Report. [Helen Kerbey]

No report received.

6. Treasurer's Report. [John Nudds]

Income this year is down slightly due to a fall in subscriptions, but some institutional subscriptions are still outstanding. More worrying is the increase in expenditure, due firstly to a one-off sponsorship of £500 to the SPNCH/GCG/NatSCA Conference in June, and secondly to an increase in print costs for both The Geological Curator and Coprolite. The former normally costs approximately £2,000 for 2 issues, but this year totalled almost £2,700, while the latter normally averages at £1,500 for 3 issues, but this year cost £2,500 for 4 issues (one held over from last year).

Our end of year balance has remained very constant since 2008* and there has been no need to increase subscriptions; income and expenditure have both stood at approximately £4,500. However, this year our end of year balance is significantly down and has dropped below the Charities Commission recommendation of two times annual income. I have therefore recommended to Committee that subscriptions be increased from January 2016 in order to prevent further erosion of our assets.

*Year end accounts since 2006 (not including JISC money):

2006 - £6,258	2011 - £10,681
2007 - £8,628	2012 - £11,024
2008 - £10,924	2013 - £10,972
2009 - £11,202	2014 - £8,270
2010 - £10,875	

7. Membership Secretary's Report. [Cindy Howells]

Personal UK	154
Personal Overseas	25
UK Institutions	49
Overseas Institutions	24
Honorary	6
Total	258

Subscriptions for 2014 have been fairly stable. We have had 13 new members this year, which is encouraging, but that has been balanced by a few cancellations, and also a number of members and institutions who just fail to pay us, or to communicate in any way. So, please do everything you can to promote the group, and encourage all natural science and geological curators to join, in order that they, and their collections, might benefit from our support.

Last year I reported that curatorial geology posts were at an all-time low, and the situation hasn't improved this year. Museums are facing ever harder cuts, so it is more important than ever before that GCG continues to provide a service that can be seen to be relevant, by curators, and their managers. So I would encourage you all to let us know what you think we should be doing in the way of workshops, seminars, support, or training. If you think you and your museum could host a meeting, then please let us know!

Please let me know if you change your address, job or email, so that we can continue to contact you and to send out journals. Lastly, I will accept next year's subscriptions anytime - even today - cheque or cash. Don't forget we now have an optional rate for the unwaged, so it's no excuse to tell me you're retiring!

8. Programme Secretary's Report. [Jim Spencer]
For the first event of the year GCG sponsored a field-trip to the Glamorgan Heritage Coast in June as part of the international meeting of the Society for the Preservation of Natural History Collections (SPNCH) in Cardiff. Two hundred and eighty delegates attended SPNCH for a full week of talks and activities. The GCG trip proved to be the most popular of the trips offered during the week; Cindy Howells and John Nudds led the group of thirty-seven participants in glorious sunshine.

The 23rd SPPC meeting, jointly with the GCG, took place on Tuesday 2nd September in York in the York Medical Society Rooms with thirty-three people in attendance. Following the presentations there was a visit to the Yorkshire Museum and its storerooms. Later on there was a reception hosted jointly by the Yorkshire Philosophical Society and the Museum, followed by a lecture on the museum collections given by Stuart Ogilvy of the Museum. A field-trip to Saltwick Bay led by Dean Lomax, with thirty participants, took place the previous day.

On Thursday 11th September a joint meeting on "Geo-Materials Sample Preparation for Microscopy" with the Royal Microscopic Society and the Department of Earth Sciences was held at the University of Oxford. There was a day of talks ranging from advances in equipment and preparation techniques through to Darwin's lost thin sections. A number of companies demonstrated their latest geological preparation systems. The fifty delegates also toured the facilities in the department.

A joint meeting with NatSCA, the first such meeting, was held on Friday 17th October in Oxford University Museum of Natural History on the theme of hazardous geological materials. Topics covered radioactive specimens and asbestos. The event was very popular and was quickly fully booked. Another meeting for next year is being investigated.

Many thanks to all those who organised and participated in these events.

9. Journal Editor's report. [Matthew Parkes]
The Journal continues to be published in paper form however the committee and the Editor are looking into electronic delivery. There would not be a great saving from printing a smaller number of copies. A survey page has gone out with the latest Journal to ask members their views. A possible form of update to "Guidelines for the Curation of Geological Materials" is still being planned.

10. Newsletter Editor's report. [Helen Kerbey]
Three editions of Coprolite have been printed this year however they are quite costly. The downside to producing more news is that more pages cost more money. Postage is also high.

It is proposed that Coprolite is produced electronically in the same format and emailed to members. For the time being there will be an option to ask for a paper copy, and paper copies will be sent to institutions. We not only need to make some savings, but have other ways we could spend the money - such as Prize money, or advertising at the fossil festivals.

11. Collection Officer's report. [Mike Howe]
2014 has been a year of continued ongoing threats to Collections, with local authority budgets under increasing pressure. Torquay Museum is just one example of a museum under threat. I am pleased to report that through the efforts of our NatSCA representative, Emma Bernard, I have been in touch with Miranda Lowe, the NatSCA Collections at Risk Rep, and we hope to coordinate our support efforts more in the future.

We have had some successes. The Dr R.M.C. ('Michael') Eagar research archive has been rescued

from imminent disposal by John Nudds, and is now preserved in the National Geological Repository at the British Geological Survey, Keyworth. Population of the the Jisc-funded GB3D macrofossil types online database has continued, and the British types from most of the main British repositories are now online, including over 2000 3d digital models. The linking of databases is growing on an international scale, and the concept of virtual distributed repositories is increasing, for example within the UK Oil & Gas sector. One cannot help but suggest that the concept of a UK distributed virtual geosciences collection could increase access and impact, and raise a museum's significance within its local area.

Early plans to use information from the State & Status Report and local questionnaires to add content to the Collections page of the website have been put on hold while the NatSCA crowd sourced "Natural History Near You" Collections Map grows. I would appreciate feedback from the members on the type of content we should be providing.

12. Web Officer's Report. [Hannah Chalk]
No report received

13. NatSCA Representative's Report. [Emma Bernard]
The Facebook Group is going well (https://www.facebook.com/groups/376700195784835/) and Page (https://www.facebook.com/GeologicalCuratorsGroup).
The group is slowly increasing in numbers (roughly 1-2 per week).
202 'likes' of our page and 177 members of our Facebook Group.
People are now more actively engaging with them through posting stories, comments or links to Geology/Natural History related stories and research.

Twitter is also progressing nicely with different 'followers' than Facebook. We currently have 428 followers and again this is slowly growing, but we can do more. People/organisations are more actively engaging with us, copying us into tweets like #mineralmonday Please contact Emma Bernard (e.bernard@nhm.ac.uk), if you would like the password so you can tweet as GCG. I would encourage members to join both and become more involved in the social media side.

I have set up a googlemail account for the group, mainly to deal with the social media, but can be used for various things if needed. The address is geologicalcuratorsgroup@gmail.com contact Emma Bernard (e.bernard@nhm.ac.uk) if you would like the password. I have been checking the account and passing on any emails to the relevant person, but there has only been a couple.

A LinkedIn Group has just been set up and again it would be great if people can start posting comments, having discussions and sharing the group. Search 'Geological Curators' Group'.

I have continued liaising with NatSCA, updating them with relevant information at their committee meetings. We held our first join meeting with NatSCA this year. This took place at Oxford Natural History Museum in October entitled Hazards in Natural History Collections. Although I could not attend the meeting was a great success and the Programme Secretary has further details. We aim to run this workshop again in 2015. Thank you to Monica Price and Jana Horak for running the workshop and producing hand outs, Justine Aw from NatSCA for putting together the booking page and website and to Holly Morgenroth for dealing with the payments from delegates etc. Once Eventbrite have paid NatSCA and deductions for catering and Jana's travelling expenses has been deducted we should receive a cheque from NatSCA. It looks like delegates were fairly evenly spread between the two organisations, with some being members of both.

If anyone would like to suggest more topics, particularly if you know someone who would be willing to talk/provide course materials please contact Emma.

Myself and Sarah King are liaising with representatives from NatSCA and SPNHC about ways which we can all work together. We will be holding our first meeting on Thursday 4th Dec at the NHM. It has been a bit difficult trying to engage with each other via email so Sarah suggested meeting up. We have put to the group a summary of what came up from the survey. Once we have met we will be able to update the group more about this. If you have any suggestions please let myself and Sarah know.

The Reports were dealt with en bloc. Proposed: Cindy Howells, Seconded: Giles Miller
Accepted

14. Election of officers and Committee for 2013 and election of Auditors.
Election of officers.
Secretary: Sarah King has been proposed by Matthew Parkes. Seconded by Mike Howe.
Election agreed.

Programme Secretary: Kate Riddington has been proposed by Tim Ewin. Seconded by Emma Bernard. Election Agreed.

All other Committee officers have agreed to remain in post for another year. There were no further nominations.

Ordinary members of Committee. Two are needed this year. Luanne Meehitiya has been proposed by Jim Spenser and seconded by Nigel Larkin. Isla Gladstone has been proposed by Mike Howe and seconded by Matthew Parkes.
Election Agreed.

Election of auditors.
The current auditors, Caroline Buttler and Christian Baars have agreed to continue in this role. Agreed.

15. Any other business.
1. The production of Coprolite in an electronic format was discussed. It was agreed to email Coprolite to individual members unless they asked otherwise.

2. Membership fees for 2016 were discussed. It has been some years since membership fees were last changed. The new fees will be:
UK £20
Oversees £23
Unwaged £15

Vote: Agreed to increase prices by £5 across the board

3. Giles thanked the outgoing Programme Secretary, Jim Spenser, for his hard work and the auditors of the accounts Caroline Buttler and Christian Baars.

4. Despite asking different groups we still don't have a representative on Committee for ICON.

14. Date and venue of the next Annual General Meeting.
To be confirmed.

Giles Miller thanked all the organisers of the meeting for their work and hospitality. Meeting ended at 17.00.

GEOLOGICAL CURATORS' GROUP

42nd Annual General Meeting

42nd Annual General Meeting of the Geological Curators' Group.
Natural History Museum, London.
1st December 2015.

1. Apologies for absence.
Stuart Baldwin, Hannah-Lee Chalk, Isla Gladstone, Mike Howe, Steve Howe, Matthew Parkes, Mick Stanley, Steve Tunnicliff, Sue Turner.

2. Acceptance of the minutes of the 39th AGM held at Leicester.
No amendments. Accepted.

3. Matters arising.
No matters raised.

4. Chairman's report.
I have just finished my second year as chair of the GCG. At the start of my Chairmanship we held a survey to see what our members require from us. We published a paper in Geological Curator in January 2015 outlining 12 action points. I would like to highlight our activities this year by showing how we have made a good start in addressing six of them.

a. Become a louder voice advocating geological collections
In early 2015 in Ludlow, I spoke at a public meeting in support of the Ludlow Museum and Resource Centre. The council did not reverse their initial decision to cut funding, but the local MP was instrumental in supporting a successful Libor Fund application for 250K to digitize the collections there. Other high profile museums put at risk this year include Reading and Dudley. We have written or replied to public consultations regarding the future of these museum collections. Other museum collection related issues that we have responded to include the Jurassic Coast Acquisition Strategy. I attended a meeting at UCL organized by GCG member Nick Booth in September on the subject of challenging unethical disposals of collections. A group of SSNs including NatSCA agreed to share details of collections at risk when they become known.

b. Seek funds from bodies such as ACE to support GCG activities including outreach and skills sharing.
Our joint bid with NatSCA to Arts Council England Resilience Fund was unsuccessful. However, we have received some excellent feedback from ACE and from Nick Poole. Now that ACE have seemingly escaped major funding cuts we are looking to submit a much more focused application to the next round of funding.

A successful application to the Geologists' Association Curry Fund has provided us with a magnetic board for our outreach project 'Be a Curator'. I must thank Isla Gladstone for developing the concept, ordering the materials and delivering the activity in Lyme. A follow up bid to the Palaeontological Association has been submitted so we can continue to run this at venues like Scarborough and Lyme Regis. We have also been talking to Rockwatch about redoing the "Thumbs Up" leaflet and launching a competition for young geological curators.

c. Investigate building better links with other closely related societies, particularly The Geological Society and HOGG.
Our Geological Society Representative Sally Thompson joined us for our last committee meeting and made some excellent suggestions as to how we can develop links and get more support from the Geological Society. I have been asked to sit on their Geoconservation Committee and we continue to send Kate Riddington as GCG rep to the Geodiversity Committee meetings in Burlington House. We attended the Geological Society Open Day at BGS Keyworth this November with the help of Mike Howe, Simon Harris and Sarah King. As Meetings Secretary, Kate has also been in contact with HOGG and we are planning a joint meeting in 2017.

d. Plan our meetings programme for at least a year in advance and encourage attendance.
Thank you to Kate Riddington for organizing the talks schedule for today and for the training session at Keyworth along with Mike Howe and Simon Harris. Kate has put together a suggested set of training sessions and seminars leading into 2017, but has indicated she wishes to step down from this committee position so again thank you to Kate for all the time and energy she has put into this important GCG function. We have been corresponding with the organisers of the SVPCA meetings and Cindy Howells has kindly offered to take on the role of GCG Representative on the committee that organizes the GCG/SPPC part of the meeting. I think that the

attendance at the last two AGM meetings is certainly a good sign that we are encouraging better attendances at our meetings so a big thank you to all of you for coming today.

e. Publish both Coprolite and Geological Curator electronically as pdfs with paper copies still available on request.
This year we distributed Coprolite electronically for the first time thanks to our Newsletter Editor Helen Kerbey. If you have any articles or announcements you wish to publish then please get in touch with Helen. Our survey indicated that the membership is slightly skeptical of our capacity to permanently host and distribute electronic copies of our Journal. Journal Editor Matthew Parkes has provided a report highlighting the results of a subsequent survey that indicates we may be a little way off from offering the Journal on-line only. I can assure members that we will continue to print both Coprolite and Geological Curator on request.

f. Encourage members to communicate with us via our JISCmail list and to follow us on Twitter and Facebook.
Finally, a massive thank you to Emma Bernard for keeping Members informed of the latest happenings in collections management and geology by regularly tweeting and posting on Facebook. If you do not already follow either of these feeds, then look up us and follow us! There have been some great discussions on the JISCmail recently too.

Of our 12 points there are some still to do but I hope that applying for funds to set up a skills sharing network joint with NatSCA will help us to push many of these forward. We would also like to re-establish an ICON rep on GCG committee so that we can strengthen our links with geological conservators. If anyone knows of any ICON members that might fit the bill then please let us know.

5. Secretary's Report. [Sarah King]
a. Committee administration.
New Trustee declaration forms have been designed as Committee members are legal Trustees of GCG as a registered charity. These set out our responsibilities. They will be available to all new members who join Committee.
I am the administrator for the geo-curators JISCmail service. There are currently 251 subscribers. I am also working on the GCG Advisory group list.

b. Geological Society.
The Geological Society has been proactive in engaging with their Specialist Groups and asking what support they would benefit from. Our representative with them is Sally Thompson. We hope to get GCG events listed on the Geological Society website and email newsletter.

c. Public liability insurance.
GCG has taken part in several public events this year, which has raised questions about insurance cover, what level of cover is needed and if we are covered by the Geological Society as a Specialist Group. GCG is asking the Geological Society for clarification. There is online guidance for charities here:
https://www.gov.uk/government/publications/charities-and-insurance-cc49/charities-and-insurance We will pursue this latter choice if the Geological Society are unable to cover us. In the meantime, we have been added to some organisers insurance policies.

d. Memorandum of understanding (MoU) with NatSCA and SPNHC.
This was signed in June at the SPNHC meeting in Cardiff. A working group with representatives from each group has been organised. It met in December 2014 and published an initial document in early 2015.

e. SVPCA/SPPC/GCG annual meeting.
Richard Butler (Birmingham) has started an overhaul of the AGM. We have expressed an interest with Cindy Howells as our representative.

f. Jurassic Coast Acquisition Strategy (Dorset)
GCG have been asked to comment on this initiative.

6. Treasurer's Report [John Nudds]
Balance sheet circulated.
Subscription income this year is similar to last year, with several institutional subscriptions received since the accounts were finalised, so the situation is quite healthy. We made a profit on workshops, in part due to our raising the registration fee for last year's AGM in response to a very poor turnout the previous year at Canterbury. In the end the 2014 AGM was well attended, partly due to the 40th anniversary celebrations, and we covered our expenses. We also made small profits from two meetings/workshops during the year, one jointly with NatSCA who traditionally charge more for their meetings than we do.

We were awarded £1000 from the Curry Fund, which went towards covering the cost of an interactive board and pop-up banner, purchased for our

attendance at fossil shows such as Lyme Regis and Scarborough.

Expenditure was down on last year particularly in relation to prints costs for Geological Curator and Coprolite. The journal normally costs approximately £2000 for two issues, but this year was only £1635, while the latter is normally averages £1500 for 3 issues, but this year was £841, due in part to electronic delivery of Coprolite to many members. Committee expenses continue to rise worryingly. Most of the JISC money has been used, with £780 left in the accounts. It is planned to use this to fund our attendance at Lyme Regis is 2016.

Last year our end of year balance fell below the Charities Commission recommendation of two times annual income and the AGM voted to raise subscriptions from January 2016, the first increase in ten years. In fact our balance has recovered somewhat since last year, but the subscription increase will stand us in good stead for the next decade.

Questions.
Adrian Doyle: No objection to making a profit for the group, but is there something in the GCG Constitution which rules this out?
John Nudds: No, the general philosophy is to break even, but any surplus is used to help fund other activities.

7. Membership Secretary's Report. [Cindy Howells]
Circulated.

	2015	2014
Personal UK	155	154
Personal Overseas	20	25
UK Institutions	36	49
Overseas Institutions	24	24
Honorary	6	6
Total	241	258

In 2015 we gained 8 new individual members however, subscriptions are lost each year through members not bothering, or forgetting, to renew. There is always a reminder in each issue of Coprolite, and I send reminders to some members. Some members are paying the old rate of £12 by Standing order, and are in arrears. Those who are contacted but do not reply will be retained as members but their payments treated as donations to the group rather than subscriptions.

2016 subscriptions will rise by £5 for all categories of membership (our last rise was in 2008). Members should contact their own bank and modify their Standing order notice accordingly. For the unwaged there is an optional £15 concessionary rate.

Last year I reported that curatorial geology posts were at an all-time low. The situation has not improved. Museums are facing ever-harsher cuts, so it is more important than ever that GCG continues to be seen providing a relevant service by curators, managers and funding bodies. I would encourage you all to let us know what you think we should be doing in the way of workshops, seminars, support or training. If you think you and your museum could host a meeting, then let us know. Please promote the group and encourage all natural science and geology curators to join, in order that they, and their collections, might benefit from our support.
Let Cindy Howells know if you change your address, job or email address, so that we can continue to contact you and send out publications.

Questions.
Simon Harris (BGS). GCG membership forms were given to students at the recent Careers Day. Has this produced new members?
CH. No forms have been returned to date. Perhaps we should consider a workshop aimed at students in an attempt to gain new members.

8. Programme Secretary's Report. [Kathryn Riddington]
Circulated.
GCG ran a successful photography and scanning training session at the British Geological Survey (BGS) in October. Eleven people attended on the first day (Photography) and twelve on the second day (3D technology). Feedback showed that attendees learnt a lot and thought the sessions were good and well delivered. Thanks to Simon Harris and Chris Pickup at the BGS for running this session.

GCG helped with SPPC at Southampton. We have been involved in discussions over the future of SPPC/SVPCA and a GCG representative will attend the steering group meetings. SPPC 2016 is in Liverpool.

2016 events:
Meteorites workshop. NMW, Cardiff. Tuesday October 11th 2016.
GCG AGM and Seminar. 6-7th December 2016. Location to be confirmed.

We hope to arrange a session on mineral identification and conservation. There are also plans to re-run the joint NatSCA hazards workshop.

GM thanked Kate Riddington for her work during this year.

9. Journal Editor's report. [Matthew Parkes]
Geological Curator Vol. 10, No. 3 was published in July 2015. Vol. 10, No. 4, to complete the issues for 2015, is in production for year-end publishing. Submissions are vital to the continued health and viability of the journal and the authors are thanked for their contributions, along with the reviewers who ensure a good standard is maintained.

In view of increasing costs, in 2015 the Committee discussed the issue of the journal and how it is delivered. Following the 2014 survey of members (Miller et al. 2014, Geological Curator 10(2), 77-92) we conducted an additional survey looking into whether our journal options could be improved. The survey showed an audience for digital delivery of Geological Curator, but the majority still prefer a printed copy by post. From Vol. 10, No. 5, we expect to offer both options. However, as a voluntary group with limited resources, the choices will be limited and on a trial basis.

Ongoing work on the Guidelines for the Curation of Geological Materials II has been hindered by various issues, but it is a priority to complete it. It will be published as an incremental online publication.

10. Newsletter Editor's report. [Helen Kerbey]
Three editions of Coprolite were published this year, in electronic and printed forms. This is saving on postage and packaging. Around 100 printed copies are still sent. There have been slight changes in quality and formatting of the printed newsletter.
Please send in any items of news for publication to Helen Kerbey. These can include exhibition notices and reviews, gallery renewals, new staff and changes in posts, new acquisitions.
If you prefer a printed version of Coprolite instead of the electronic form, please let Cindy Howells know.

Questions.
Adrian Doyle. Would there be any advantages to working with NatSCA publications to share information more widely, for example, by including material from Coprolite in NatSCA news and vice versa?
GM. An idea to consider. GCG could publish things in the NatSCA blog.
Emma Bernard. A joint meeting of GCG/NatSCA and SPNHC discussed this. One idea was for the Chairs of each group to write an introduction about themselves for inclusion in the publications of the other groups.

11. Collection Officer's report. [Mike Howe]
Circulated.
2015 has been another year of continued ongoing threats to collections, with local authority budgets under further increasing pressure. Snibston Discovery Park, Coalville, Leicestershire has closed and a number of collections are under threat, including the Shropshire Museums Resource Centre in Ludlow, the Dudley Museum and Art Gallery, and Stockport Museum. It seems unlikely that any museum or collection, local or national, will escape some level of cuts. The situation seems particularly disheartening as the Arts Council England published a report in February 2015 on the Economic Impact of Museums in England (Report PN01114R), in which it showed that across the sector, for every £1 of public of public sector grant, an additional £3 of income was generated.

After the intervention of Philip Dunne, MP for Ludlow, The Friends of Ludlow Museum are to receive £250k to facilitate publication online of the unique and historically important collections held in Ludlow. Arrangements are progressing to recruit and train the necessary staff, enabling the Resource Centre to stay open. The grant was funded from LIBOR fines.

The JISC GB-3D fossil Types online project, which included GCG as a partner, was awarded the 2015 International Data Rescue Award in the Geosciences. Sponsored by Elsevier, it highlights projects that have improved access to data, either by digitising analogue data or by rescuing data in obsolete formats. Further information is available at https://www.elsevier.com/physical-sciences/earth-and-planetary-sciences/the-2015-international-data-rescue-award-in-the-geosciences

The move to digitise and database collections at an international level continues to grow. Many view scientific research increasingly as the multidisciplinary combining of large datasets. With rigorous curatorial procedures and standards developed over more than a century, geological collections are well placed to be part of this. We already use most of the principles of good practice that the digital world is only just discovering - "MDA" codes (unique object identifiers) are an excellent example.

12. Web Officer's Report. [Hannah Chalk]
No written report available, but a copy of the web usage statistics was available for consultation.
GM thanked Hannah-Lee Chalk for keeping the website running and up to date. This is a vital job as it is one of the public faces of GCG, and regular updates keep the site high in lists of usage statistics. The flickr photostream on the homepage is underused, so this may be replaced with a Twitter feed
If you have any information or pictures you think would be suitable for use on the website, please submit it to Hannah-Lee Chalk or to the Committee.

13. NatSCA Representative's Report. [Emma Bernard]
The Facebook Group is going well (https://www.facebook.com/groups/376700195784835/) and Page (https://www.facebook.com/GeologicalCuratorsGroup). The group is slowly increasing in numbers (roughly 1-2 per week) and stands at 196 members. People are now more actively engaging with them through posting stories; comments or links to Geology/Natural History related stories and research. Twitter @OriginalGCG (https://twitter.com/OriginalGCG) is also progressing nicely with different 'followers' than Facebook. 636 followers here and slowly increasing. People and organisations are actively engaging with us, copying us into tweets like #mineralmonday. Please contact Emma Bernard (e.bernard@nhm.ac.uk), if you would like to get involved in tweeting as GCG.
I would encourage members to join both and become more involved in the social media side.

I have continued liaising with NatSCA, updating them with relevant information at their committee meetings. We are looking to hold another joint meeting, re-running our successful Hazards in Natural History Collections workshop. This is likely to take place at Oxford Natural History Museum date yet to be decided. If anyone would like to suggest more topics for joint meetings, particularly if you know someone who would be willing to talk/provide course materials please contact Emma.

Sarah King and myself are liaising with representatives from NatSCA and SPNHC about ways we can all work together. A series of recommendations went to all the Chairs of the groups concerned and it is currently with SPNHC. Progress on this has been rather slow this year, but we hope things can progress further next year.

14. ICON Representative's Report.
No report available as GCG currently has no representative from ICON. Volunteers are welcome.
Adrian Doyle reported that at the ICON AGM in November, a new Chair was elected. AD will send contact details to GM.

Acceptance of all reports. Proposed: Adrian Doyle. Seconded: John Cooper.
Agreed.

15. Election of officers and Committee for 2016 and election of Auditors.
Election of officers.
Programme Secretary post is vacant. GM outlined the main duties of the post. No nominations have been received. No nominations came from the floor of the meeting. Post remains vacant, but can be filled by co-opting a member.

All other Committee officers have agreed to remain in post for another year. There were no further nominations.
Proposed: Alan Howell. Seconded: Tom Sharpe.
Agreed.
Chairman's post becomes vacant at the next AGM. Nominations or suggestions are welcome.

Election of auditors.
The current auditors, Caroline Buttler and Christian Baars have agreed to continue in this role. Agreed.

15. Any other business.

16. Date and venue of the next Annual General Meeting.
December 2016. Date and venue to be confirmed.

BOOK REVIEWS

***Rocks: A Very Short Introduction*. Jan Zalasiewicz. Published by Oxford University Press, Oxford. 2016. UK£7.99, paperback, xviii+140. ISBN 978-0-19-872519-0.**

This is the introductory text that any or all of us would have liked to have written. I thank Jan Zalasiewicz for not only writing it, but writing it so very well. A book half as good as this would still have been a most worthwhile contribution; this is the Rolls Royce, yet at the price of a secondhand Volkswagen. It is highly readable, well-illustrated and bang up-to-date. I suggest that anyone with a passion for geology will find much that is interesting in Jan's book and it is worthy of recommendation to anyone from A-level students to the dustiest of professors.

The structure of *Rocks* is much as you might expect from this author, logical yet slightly racey, with an interesting twist or two. Rocks formed between the Big Bang and the origin of the Solar System (Chapter 1) are followed by ancient rocks of a new Earth (Chapter 2), that is, igneous rocks and their relationship to plate tectonics. Sedimentary and metamorphic rocks are also explained (Chapters 3, 4). We are then diverted from our fixation with the crust to look at the mantle and core (Chapter 5). Rock-forming fossils (Chapter 6) are followed by rocks on other planets and moons, both within and without the Solar System (Chapter 7). The surprising final chapter concerns man, the rock maker, whose refined ores, concrete and plastic bottles are the rocks of a new era. 'Further reading' is altogether too brief and the index appears adequate. Illustrations, both line drawings and photographs, are uniformly good. Zalasiewicz also makes excellent use of imagery in the text that bring his story alive, such as "… the gateway to the Earth's chemical underworld" (p. 38).

I found only a few points of disagreement with the author. Surely the carbonate rock is a dolostone, not dolomite (p. 39), a term which I limit to the mineral. Sea urchins per se were not part of the 'Cambrian Explosion' (p. 85) and did not evolve until the Ordovician - better to say primitive ancestors of the sea urchins and starfishes. Rudists did not build reefs (p. 90). There is now a large body of literature correcting this misconception from the 1970s; Jan, I recommend a chat with Pete Skelton. The invasion of the land by plants in the Silurian (p. 94) undoubtedly had a Late Ordovician precursor from the available evidence from spores. And Titan is a moon, not a planet (p. 113). Spelling errors are few, but I enjoyed "… each now discovery" (p. 99), which seems much more immediate than the correct 'new'.

This is an excellent book, truly one of the best on geology that I have read over the past 40 years. Everyone should have it on their shelf, everyone should read it and everyone can afford it. Go out and buy it now. Read it as soon as you have bought it.
…
Why are you waiting? Get going!

Stephen K. Donovan, Naturalis Biodiversity Center, Leiden, the Netherlands

***Storm: Nature and Culture*. John Withington. Published by Reaktion Books, London. 2016. UK£14.95, paperback, 190. ISBN 978-1-78023-661-2.**

The 'Earth Series' published by Reaktion Books now includes 18 titles varying through what a geologist might consider core subjects - caves, earthquakes, meteorites, volcanoes - to topics that have more of a leaning towards physical geography, such as storms, the subject of this book and review. The books in this series are broad in concept, highly informative and beautifully produced, and *Storm: Nature and Culture* continues this admirable pattern. As an editor, I could only admire this book, a rarity, as I found no spelling mistakes or similar errors, highly unusual in the 21st Century. The paper is high quality, and the many photographs and paintings, mostly in colour, are beautifully reproduced.

The organization of *Storms* is logical, with an introduction, and seven chapters covering the range of influence and occurrence of this subject - religion, nature, effects, events, literature, spectacle and futures. These are supported by a short appendix of notable storms, references and a bibliography, a list of relevant organizations and websites, and an index. I was surprised that 'Religion' (Chapter 1) should open the discussion, but this is an exploration of how men have tried to understand storms by involving them in their superstitions and myths; surely, we have all seen Thor, God of Thunder, at the movies. 'Nature' (Chapter 2) moves from belief to science, examining extremes of physical phenomena and illustrating them with some of the most breath-taking images in the book; see, for example, pages 34 and 45. The emphasis is on how storms occur and propagate, particularly the more severe events such as ice, snow and dust storms, tornadoes, waterspouts and cyclones. Part of the fascination of this chapter is reliving the spectacle of a major storm, and partly in marvelling at their sheer size and energy; "A fully developed cyclone can release energy equivalent to exploding a 10-megaton nuclear bomb every twenty minutes" (p. 61).

'Effects' (Chapter 3) examines the tempests in history that had a coincidental influence on major events, such as the stormy summer of 1588, where the foul weather was a key factor in the failure of the Spanish Armada. 'Events' (Chapter 4) continues in a similar vein, but examines great storms that were also major natural disasters. These include the Saffir-Simpson Hurricane, or Bhola Cyclone, of 1970, which killed over 300,000 people in East Pakistan and led to the civil war that led to separation as Bangladesh. Storms in 'Literature' (Chapter 5) are many and varied - think of *The Tempest, Robinson Crusoe, A*

High Wind in Jamaica and *Typhoon*. On a personal note, I was living in Jamaica in September 1988 when Hurricane Gilbert struck and the aircraft stuck in a tree (pp. 114-115) is an iconic image from that event. This hurricane also demonstrated to me how people turn an event into a person - Gilbert was someone who visited your house and took the roof off, disconnected the electricity, flooded the ground floor (Barker and Miller 1990).

Storms in art, both paintings and film, are examined in 'Spectacle' (Chapter 6). It is particularly the former which is served by the excellent colour reproductions; personal favourites include Monet's *Storm Off the Coast of Belle-Île* (p. 142) and *The Day after Tomorrow* (pp. 147-148). 'Futures' (Chapter 7) looks at the many major storms of the recent past and discusses the problems of extrapolating these patterns into the future.

What a fine book. Well written, beautifully illustrated, and a subject to which we can all relate and be fascinated. It has my full recommendation.

Reference

BARKER, D. and MILLER, D. 1990. Hurricane Gilbert: Anthropomorphising a natural disaster. *Area* **22**, 107-116.

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***Bedrock and Building Stones: Geology Exposed in the City of Sunderland*. Andy Lane. Published by Andy Lane Publishing, Sunderland, 2014 [reprinted 2016]. UK£12-00, paperback, 104 pp. ISBN 978-0-9929555-0-2.**

Some people collect stamps, football programmes or, indeed, fossils. I seem to have a penchant for accumulating geological field guides whether relevant to my current research or not. In truth, I enjoy reading them as if they were a virtual fieldtrip. *Bedrock and Building Stones* is the latest addition to my collection and a fine one, too. It is over 30 years since I was last in the field in Sunderland, collecting crinoids at Tunstall Hill, and Andy Lane tempts me to go back. But I nearly missed Andy's guide - only because this reprint was on sale at a Yorkshire Geological Society meeting early in 2017 did I even know it existed. My first impression was one of surprise. The guide is well produced on glossy paper and with lots of colour, but the size of it baulks most norms. Field guides typically (but, I admit, not invariably - see those produced by the Geological Society of America) come in a size that fits a jacket pocket, facilitating easy reference when the rocks are in front of you. In contrast, *Bedrock and Building Stones* is the size of a thick issue of the *Geological Curator*. Not too convenient for the field, but maybe a photocopy of a relevant excursion might be a suitable substitute and would save your book from too much travel in your backpack?

The text is neatly done and a lot is packed in, perhaps too much. The four fieldtrips and a wall game only take up about a third of the guide. I wonder if some diligent editing might have trimmed down some of the text, apart from the eight pages of glossary, which will be so useful for novice geologists? My one complaint about the writing, apart from being a little too long, is the author's overuse of exclamation marks. Really! And often I was left wondering why? Photographs are good and many are in colour. Lines in line drawings seem to be a little thick, but this is rarely to the detriment of detail. 'Suggestions for further reading' are good, but I would have included Hollingworth and Pettigrew (1988), perhaps a little long in the tooth, but still a fine introduction to fossil invertebrates of the Magnesian Limestone.

The four field excursions each describe a different area of Sunderland in detail, and deserve to be exploited by everyone and anyone who can find time for fieldwork in the city. Each excursion is graced with a detailed map on which localities are plainly numbered and principal features illustrated. The supporting text is detailed; for example, the author is at pains to ensure that you look at the correct side of a building to see the features of the building stones that are being described. Clarity is further enhanced by each of the four including several colour photographs of key rocks and building stones.

In conclusion, *Bedrock and Building Stones* has been fun to review and should be on the bookshelf of anyone with an interest in the geology of north-east England. It leaves me plotting how to squeeze an extra day out of my next trip to the north-east so I can renew my acquaintance with the rocks of Sunderland.

Reference

HOLLINGWORTH, N.T.J. and PETTIGREW, T. 1988. *Zechstein Reef Fossils and their Palaeoecology*. Palaeontological Association Field Guides to Fossils **3**, iv+75 pp.

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***The Strange Case of the Rickety Cossack and other Cautionary Tales from Human Evolution.* Ian Tattersall. Published by Palgrave MacMillan, New York. 2015. US$27.00, hardback, xiii+244. ISBN 978-1-137-27889-0.**

What does the general reader look for when they purchase a book on palaeoanthropology? This is the third volume on the subject that I have reviewed in 2016 and I am delighted to say that they have not all been the same, far from it. Tattersall's book might be accused of following an old path, but he is wearing new boots and looking through new glasses. *The Strange Case …* is a history of the science of ancient man, but has a novel focus of how the science has struggled in the face of prejudices inflicted from without and within. Tattersall has been observing these developments from the front row for 50 years or so, and is thus ideally positioned to look back on the tangled development of some of the ideas that underpin the subject today.

The title is not explained at any great length and Tattersall does not really discuss its relevance enough; 'cossack' does not even appear in the index. The Cossack is, of course, the holotype of *Homo neanderthalensis* King and is first mentioned on p. 33, in a minimal explanation of the book's title. Tattersall's knowledge of Piltdown Man is 25 years out of date and lets him down badly. He does not know whodunit, yet Russell (2003), for example, provided ample evidence that Charles Dawson (1864-1916) was a serial archaeological forger. The assumption of the palaeoanthropological intelligentsia that a single amateur archaeologist could not have pulled the wool over their eyes was no more than conceit; Dawson could and did (De Groote *et al.* 2016). Where Tattersall considers the "… motive for this elaborate scientific hoax is unclear" (p. 43), he is signally uninformed. Dawson used his hoaxes to attain a FSA and FGS, and Piltdown Man would most likely have won him a FRS if not for his untimely death (Donovan 2016).

Tattersall's book emphasizes that what was once significant can fade into the background. For example, in *Bones of Contention*, two chapters were devoted to the dating of the KBS tuff in Kenya (Lewin, 1989, pp. 189-252), whereas Tattersall dismisses it on p. 116. I would mention that, although Tattersall stresses the importance of radiometric dates (he uses the tautology 'years dates' in places, e.g., pp. 35, 36), particularly in the first half of this book, he might have made more of how the original 2.6 Myr date was later corrected to 1.95 Myr. The biostratigraphy got it right in the first place. If there is any controversy of data, biostratigraphic correlation should be preferred to absolute dates if there is any perceived divergence of opinion, but people prefer the 'accuracy' of numbers.

The nature of such books is that they become lists. Relevant finds in the 19th and early 20th centuries were relatively few, and each is examined in adequate detail for their importance to be resolved. By the late 1960s and after, the rate at which discoveries were being made was prodigious and there is no space to take a breath between reports (see, for example, Chapter 8, 'Turkana, the Afar, and Dmanisi').

Overall, a fascinating book that has kept me enthralled. I give it a general recommendation to anyone who wants to bring their knowledge of palaeoanthropology up to date. Although there are no photographic plates, the many illustrations of key specimens are excellent.

References

DE GROOTE, I., FLINK, L.G., ABBAS, R., BELLO, S.M., BURGIA, L., BUCK, L.T., DEAN, C., FREYNE, A., HIGHAM, T., JONES, C.G., KRUSZYNSKI, R., LISTER, A., PARFITT, S.A., SKINNER, M.M., SHINDLER, K. and STRINGER, C.B. 2016. New genetic and morphological evidence suggests a single hoaxer created 'Piltdown man'. *Royal Society Open Science* **3**, 160328 [14 pp.].

DONOVAN, S.K. 2016. The triumph of the Dawsonian method. *Proceedings of the Geologists' Association* **127**, 101-106.

LEWIN, R. 1989 [first published 1987]. *Bones of Contention: Controversies in the search for Human Origins*. Penguin, London, 348 pp.

RUSSELL, M. 2003. *Piltdown Man: The Secret Life of Charles Dawson & the World's greatest archaeological Hoax*. Tempus, Stroud, 288 pp.

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The Story of Us. Edited by Kate Wong. **Published by Scientific American, Special Collector's Edition, volume 25, no. 4, Autumn 2016. US$9-99, paperback, 112 pp. ISSN 1936-1513.**

The popular science book-magazines published by *Scientific American* and *New Scientist*, among others, have only made tentative inroads into palaeontology, but I welcome the latest contribution. Perusing my own bookshelves, of the three most popular areas of the science with the public, I am not aware of any issue devoted to Ice Age mammals, but dinosaurs (Stover 2014) and fossil man (Lawton 2014) have certainly received previous attention. And here is a further contribution on our own fossil and cultural record.

My review will be slanted more towards those articles relevant to geology and palaeoanthropology. The high standard attained over the years by *Scientific American* is maintained in *The Story of Us*. The text is lucid and the illustrations mouth-wateringly good. I give particular praise to the abstracts of each chapter, 'In brief', which give concise summaries of the essential facts and theories of each chapter in just three or four sentences. These would provide excellent instruction for anyone struggling to write an abstract for their first research paper.

The 15 chapters are clustered into three sections; the first, 'Where We Came From', is the most geological. Wood in 'Welcome to the family' provides a succinct overview of the nature of the hominin fossil record. Yet he is a medic by training, and appears to have little appreciation of the intricacies of and necessity for biostratigraphy. Working out the shape of the human evolutionary tree before absolute dating techniques were adequately refined was solely the preserve of the biostratigrapher, yet Wood dismisses this as a "rough-and-ready time sequence" (p. 9). The brouhaha around the misdating of the KBS tuff at Lake Turkana, bad radiometric dates being preferred to good pig biostratigraphy, seems to have been forgotten (Lewin 1989, pp. 189-252). "These features [geomagnetism, radiometric dating] mean that at each site researchers have ways of establishing the age of the strata independent of the fossils they contain" (p. 10) is not only ungracious, but also ignores the fact that only biostratigraphy can give an answer in the field without laboratory processing. Wood is good when discussing the bushiness of the human family tree, but should leave assessment of the geology to the geologists.

My criticisms of Wood receive strong support from the next chapter, Wong on 'Mystery human' *Homo naledi* from

South Africa. It is a species that is super-abundant at the type locality, but is not preserved with other fossils and - surprise, surprise! - it has yet to be dated. Wood's buffoonery is exposed. One of the best known fossil species of *Homo*, known from 1,550+ specimens and counting, is known to be, er, oldish. Dating apart, *H. naledi* is truly impressive, but its occurrence is a taphonomic conundrum. All specimens are preserved in a deep cave in a truly impossible situation, the palaeontological equivalent of a 'locked room' problem so loved by readers of mystery stories. What is more, it is a 'locked room' with a taphonomic filter, a site with abundant hominins, but no other macrofossils. The taphonomy of *Homo naledi* is not a problem for geologists, but for Gervais Fen or Hercule Poirot.

De Menocal ('Climate shocks') wants us to believe that he has something important to say, but his assertions are let down by the data. He states that "… major shifts in African climate coincide with two moments … that mark significant changes in our family tree" (p. 24; see also caption of figure on p. 26). But just how long are those geological 'moments'? Between 2.9 and 2.4 Myr, and 1.9 and 1.6 Myr, that is, not moments at all, but broad swathes of hundreds of thousands of years. The weakness of de Menocal's position is further emphasized by the figure 'Key ancestors' on p. 26. *Australopithecus afarensis* is determined to have gone extinct slightly after 3.0 Myr. There is a gap between this demise and the genesis of the earliest *Paranthropus* about halfway through the first 'moment, at *c*. 2.7 Myr. Surely the features of this 300,000 year-gap are crucial? Did *Australopithecus* actually survive into the first 'moment', perhaps well into it, or did *Paranthropus* appear earlier than can be currently determined? These are the simplest explanations that can be determined from this pattern; whichever is shown to be more correct will determine how this evolutionary transition is perceived subsequently. De Menocal's pattern is based on weak stratigraphic data - this is too big a gap - but instead rides on the back of the patterns shown by other large mammal lineages, such as antelopes and bovids. He may be right, but until the transitions between hominid taxa can be based on less 'gappy' distributions in time, it remains speculative.

Who is not fascinated by stone tools? They reach us across the years, and were made and handled by ancestors who were gone long ago, but whose handiwork we, too, can manipulate. Stout ('Tales of a Stone Age neuroscientist') is a contribution to stone tool *Aktuo Archaeologie*. He runs courses for flint nappers, and measures related changes in neurological development and neurological pathways. Not only can Stout and his collaborators use modern scanning techniques to determine which areas of the brain are activated and enhanced by napping, but they have shown that making Oldowan-style tools (2.6 to 1.6 Myr BP) activates fewer centres of the brain than manufacturing an Acheulean hand axe (1.6 Myr to 200,000 years BP).

Marean ('When the sea saved humanity') takes an interesting idea and makes it a compelling scenario. Between 195,000 and 123,000 years BP, populations of *Homo sapiens* in Africa were greatly reduced, most probably due to deterioration to a dry and cold climate that must have severely affected vegetation. Abundant field data from the southern coastline of South Africa supports a hypothesis that *H. sapiens* survived by moving to the coast. The strongest support comes from cave PP13B, inhabited by *H. sapiens* 164,000 to 35,000 years BP, yielding evidence of feeding on shellfish; they probably also ate tubers of common plants. Local silcrete is suitable for napping after treatment by fire, first used over 100,000 years earlier than suspected hitherto. Red ochre was carved and (probably) used as paint. In short, this South African refuge shows an advanced *H. sapiens* at a much earlier time than evidence had indicated hitherto.

Hammer's explanation of 'Human hybrids' is particularly lucid. Available genetic evidence shows that *H. sapiens* interbred with the Neanderthals, the Denisovans and … who else? The molecular data does not support a simple out-of-Africa/replacement model of human migration to Eurasia and elsewhere. Rather, replacement with hybridization is likely.

The second section, 'What makes us special', includes six chapters. Many of the papers in this volume rely on evidence of the fossil record supplemented by other sources leading to some relevant, but at times flimsy extrapolations. The ideas that the authors expound are internally consistent, but there is not one that would not benefit from more or better data, or both. Jablonski ('The naked truth') is perhaps an extreme example of this, discussing the evolution of the human skin and hairlessness. This is done without having a single example of ancient fossil skin on which to work. Nonetheless, using multiple lines of evidence, she makes a fascinating series of deductions on body hair and skin colour. This is based on a particularly well thought-out suite of ideas. The author even includes one of my pet dislikes - boxes of supporting information (the scientist's footnote) - and I can only praise them. I value the concise debunking of the aquatic ape theory (p. 55) and evidence for the evolution of lice (p. 58); both are worthy of review articles in their own right.

Slix ('The IT factor') compares and contrasts the psychology of interactions within groups of young chimpanzees and groups of young humans. Each group generates essentially similar scores for general reasoning, but humans have a much higher success in using social-cognitive skills ('What are you thinking?') than chimps. The interpretation of the available data is debated, but future field and laboratory studies are likely to clarify the issue.

As will be apparent to readers of this review, by this halfway point *The Story of Us* is moving away from geology and physical anthropology to more speculative fields such as psychology and art. Wong ('Neandertal minds') is an exposition of what can (and cannot) be determined about the life and culture of Neanderthals. The evidence for their art(?) and ritual(?) is summarized in a figure (p. 70) which shows the distribution of some of the artefacts that are known from pre-*H. sapiens* Neanderthal sites. There is enough indication to strongly suggest that they

were no strangers to personal decoration and other symbolism.

Edgar ('Powers of two') suggests human monogamy may have been an important change from our polygamous ape ancestors. The reason(s) why remain poorly understood, but may be the result of females adapting broad foraging areas, making it more difficult for polygamous males to maintain control of his wives; to reduce the likelihood of infanticide by maintaining a single, stable relationship; and/or an increased contribution by the male to the care of his offspring.

Grandparents were rare in ancient populations of hominins (figure on p. 83; 'The evolution of grandparents' by Caspari). Old individuals of early modern *H. sapiens* may have been sources of both experience and cultural innovation that had not been available hitherto.

Pringle ('The origins of creativity') provides abundant evidence that hominins were innovative long before the commonly recognized increase in creativity about 40,000 years ago. Of the many examples given (figure on p. 89), the most fascinating is a bed made from insect-repellent plants, 77,000 years ago. Developing cognition and creativity may have thrived in the increasingly connected populations of humans.

Section 3, 'Where are we going', consists of three papers on modern humans and their evolution. An interview by Fischetti ('The networked primate') with Sherry Turkle of the Massachusetts Institute of Technology discusses the enigma that social networking makes us less social. Hawks ('Still evolving (after all these years))' examines rapid evolutionary changes that have occurred in modern humans such as lactose tolerance. And Smith ('Starship humanity') looks at the problems and prospects of *Homo extraterrestralis*.

This book is reasonably priced, well-produced on high quality paper, highly readable and beautifully illustrated. Buy it, you will enjoy it.

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***From Rocks to Ridges. The formation of the mountain landscapes of the north of Ireland*. Published by Mountaineering Ireland. 2015. Free on request from Mountaineering Ireland.**

This is not a book but more of an annotated map, but I felt it was well worth reviewing in the *Geological Curator* as it is a great example of an outreach type of product that many museum geologists are potentially capable of delivering for their own area. The map is produced by a team primarily from the Geological Survey of Northern Ireland and Ulster University, for Mountaineering Ireland (the umbrella body for mountaineering in the Island of Ireland). It presents the simplified geology of the northern part of Ireland, including Donegal, Sligo and many border counties. The geological map is simplified into six basic rock types or 'packages' (schist/gneiss, greywacke sandstone and mudstone, sandstone and mudstone., limestone/sandstone and mudstone, basalt, granite and gabbro) with different colours for the broad swathes of the land where the rock category is predominant. The focus is not on the rocks themselves but the character of the terrain they create. There is also good linkage to the soils that form on the different rocks.

The coloured map is also enhanced by the digital elevation modelled relief. This has the effect of bringing out the immense imprint of glaciation by showing up the drumlins and the ribbed moraine that dominates the landscape of much of the lowland areas of Ireland. Landforms are very much a feature of this publication as the reverse is given over to generally well-illustrated descriptions of the different types of landforms which form in different glacial and periglacial settings. The map is folded to DL size and made of a strong but flexible and thin laminated paper that is assumed to be waterproof or at least water repellent. For its purpose and intent of making the story of the geodiversity of the north of Ireland accessible to those who enjoy outdoor walking and climbing this map must be commended. It is also to be praised for the quality of the content and production.

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***Geoheritage and Geotourism. A European perspective*. Edited by Thomas Hose. Published by Boydell Press, Woodbridge, 2016. £60, hardback or ebook, xv + 336 pages. ISBN 978-1-78327-147-4**

I approached this book as someone with an extensive background in geoheritage, coupled with some involvement in geotourism and an existing awareness of Geoparks and of the situation in many European countries, through a long term involvement in ProGEO, the European Association for the Conservation of Geological Heritage. In many respects it met my expectations. It is an academic text for geologists and other professionals involved in geotourism and geoheritage or geodiversity in a wide sense, but not one that you need to be a geologist to read and understand. It comes from the International Centre for Cultural and Heritage Studies in Newcastle University, and is No. 19 in a series on 'Heritage Matters'. It could, or selected chapters could and probably should belong on the required reading lists of many museum studies and heritage management courses.

Eight of the eighteen chapters are authored by the book editor, Thomas Hose, a long-time proponent of geotourism

and good interpretation. Two are by Hose and a co-author, with a selection of other authorities contributing the other eight chapters. The first five chapters, after an introduction, all by Thomas Hose look at geoheritage in different contexts. One is an overview of Britain and Europe's geoheritage, another takes a historical perspective on geological inquiry in Britain and Europe. Chapter 5 on museums and geoheritage is potentially of most interest to *Geological Curator* readers. Synopses of many major European museums include many long established favourites, but also more recent developments like Terra Mineralia in Freiberg, Germany which only opened in 2008. The following chapter on geoheritage for sale concerning collectors, dealers and auction houses is also of interest, with a historical perspective, as did the chapter focused on fieldwork.

Jonathan Larwood provides an introduction to principles and practices of European geoconservation, and Thomas Hose then looks at historical and modern perspectives on geotourism in Britain and Europe. After a chapter looking solely at the geoheritage of south-eastern Europe, the remainder of the book is essentially a series of case studies on geoheritage. These include the Isle of Wight (Martin Munt), the Antrim Coast of Northern Ireland (Kevin Crawford), GeoMon in Anglesey (John Conway and Margaret Wood) and Scottish Geoparks (John Gordon) all in the UK. European cases include the Ruhrgebiet National Geopark in Germany, Andalucia in Spain, Canton Valais in Switzerland and the Danube Region in Serbia.

Whilst the overview chapters and the case studies are interesting reads, I felt the book was let down in two essential elements. Knowing something of the extensive efforts to develop and promote geotourism in Ireland, stemming back to the 1990s, it was a conspicuous absence, either in the various overview perspectives or as an individual chapter in its own right. The Geological Survey of Ireland initiated geotourism projects that very quickly became European funded joint projects with the Geological Survey of Northern Ireland and a raft of products and resources deserves to be analysed or at least mentioned in the pantheon of geotourism based on geoheritage. Indeed, a very early conference on geotourism took place in the Ulster Museum in 1998 but has been ignored, despite the editor being a keynote speaker.

The other weakness of this book is in the production quality regarding figures. There are no colour images at all, and the relatively sparse figures in each chapter are reproduced as quite small images and in many instances, they are of low resolution and so really do not add anything to the reading experience. Many of the diagrams and maps are also quite low resolution and have a dated feel to them. It is hard not to believe that a little more effort could have made them much more attractive and easier to read. Shades of grey for different reserves, parks, and features can be difficult to visually separate!

The book is well indexed, has a long list of all the abbreviations such a work necessarily includes and the paper and binding are good, but the cover itself is not especially likely to grab your attention and demand that you pick it up. Despite my criticisms of the failure to document Irish geoheritage and geotourism advances, and the figures which let the book down, I would recommend it as an academic text for anyone with interests in heritage, museums, geoconservation or tourism, both geo and 'ordinary'. It probably would not be something to stock for a general audience in a volume sales-driven museum shop, unless it has a major focus on books. As the publisher's website succinctly states this title can 'provide a timely introduction for anyone interested in natural history museums, countryside management, and landscape-based tourism.'

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THE GEOLOGICAL CURATOR

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