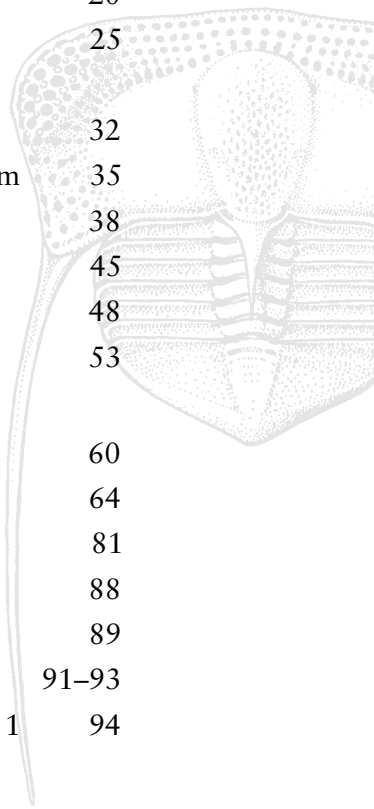
The Palaeontology Newsletter

88

Contents



Reminder: The deadline for copy for Issue no 89 is 8th June 2015.

On the Web: <**http://www.palass.org/**>

ISSN: 0954-9900

Editorial

I have been a big fan of the Newsletter ever since I signed up to join the Palaeontological Association almost a decade ago. Whenever the Newsletter came in the post I would always sit down with a nice cup of tea and enjoy reading about what was going on with the other PalAss members and feel a real connection to the community. This was particularly true during a postdoc position in Germany working in a mineralogy department; the PalAss Newsletter arriving in my pigeon-hole was a joyous triannual event, helping me to feel part of a larger network of palaeontologists with research values and interests more in line with my own than those of my immediate colleagues.

It is very much down to previous Newsletter editors and contributors helping to draw together this focus that keeps us connected between Annual Meetings. This is no easy feat with an ever-expanding membership that grows globally each year. Currently the Association has over 1,000 members hailing from a total of 47 different countries, from Austria to Zambia, with the Newsletter representing a hub that connects us. With this in mind it is quite daunting to be taking the reins and following in the footsteps of those who have gone before me. I am very grateful to Al McGowan for his help with the transition as he relinquishes the role of Newsletter Editor to me, and hope that the Newsletter will continue to flourish during my editorship with the enduring interest and enthusiasm of our contributors.

The Newsletter has changed in appearance over the years but has kept the same fundamental nature, representing the broad scope of palaeontology and all of its various sub-fields. With such a diverse worldwide membership of both amateur and professional palaeontologists from an array of research backgrounds and interests it is impossible to please "all of the people all of the time", as the saying goes. However, I do hope that there is at least something of interest for everyone among the content. As usual we have pieces from our correspondents, details of medal winners, grant reports, book reviews and meeting notices ('R for Palaeontologists' will return next time). In addition, we have a new round-up of recently published articles featured in the press, a behind-the-scenes tour of a regional museum, a look at a pioneering palaeontologist and one that is forging ahead in her career today.

This is your Newsletter and if you would like to contribute to future editions or have ideas for content you would like to see then please get in touch. For now I would like to thank all of the contributors for their hard work and I hope that you enjoy the new content.

Jo Hellawell
Newsletter Editor
<newsletter@palass.org>

Association Business

Annual Meeting 2015

Notification of the 2015 Annual Meeting, AGM and Annual Address

The 2015 Annual Meeting of the Palaeontological Association will be held at Cardiff Museum and Cardiff University, UK, on 14–17 December, organised by Dr Caroline Buttler, Dr Lesley Cherns and Dr Lucy McCobb.

At the AGM in December 2015, the following vacancies will occur on Council:

- President Elect
- Vice President
- Treasurer

Nominations are now invited for these posts. (Brief 'job descriptions' for each of these roles are included below.) Please note that each candidate must be proposed by at least two members of the Association and that any individual may not propose more than two candidates. Each nomination must be accompanied by the candidate's written agreement to stand for election, and a short personal statement (less than 200 words) describing their interests.

All potential Council Members are asked to consider the following:

> 'Each Council Member needs to be aware that, since the Palaeontological Association is a Registered Charity, in the eyes of the law he/she becomes a Trustee of that Charity. Under the terms of the Charities Act 1992, legal responsibility for the proper management of the Palaeontological Association lies with each Member of Council'. Further information on the responsibilities of Trustees can be obtained from <**secretary@palass.org**>.

The closing date for nominations is **7th October 2015**. They should be sent to the Secretary: Prof. Richard J. Twitchett, Department of Earth Sciences, Natural History Museum, Cromwell Road, London, SW7 5BD; e-mail: <**secretary@palass.org**>.

The following nomination has already been received:

Treasurer: Mr Paul Winrow (second term)

Council vacancies: 'job descriptions':

President (two-year term)

The President is usually a senior member of the palaeontological community, with wide experience of the Association, its Council and committees. The President represents the Association externally and is responsible for the overall management of Council and its many activities.

Vice-President (two-year term)

The Vice-President is one of the more loosely defined Council offices. Vice-Presidents are normally long-serving Council members who have previously held one of the other offices. They have no formal portfolio or duties other than to deputize for the President if and when required, but are present on Council to provide independent input on all matters, backed up by experience arising from their long service. They are also expected to lead or at least participate in important sub-committees, particularly those tasked with making recommendations for the awards of grants.

Treasurer (five-year term)

You might think the Treasurer looks after Council's money but thankfully that task is undertaken by the Executive Officer and an independent accountant. The Treasurer's main role is to act as a sounding board for the Executive Officer and Council on financial matters, along with practical things like counter-signing large cheques and signing the Association's accounts on behalf of Council, having reviewed the accounts prior to their approval. The Treasurer also meets with the Association's investment managers once a year to discuss our investment portfolio, receives the investment reports, and sits on sub-committees and working groups as required, *e.g.* reviewing grant applications.

Awards and Prizes

The Palaeontological Association recognises excellence in our profession by the award of medals and other prizes. The Association sees its lists of medal and award winners as a record of the very best palaeontologists worldwide, at different career stages, and offering different kinds of contributions to the field. The Association stresses the importance of nominations, and encourages all members to make nominations.

Lapworth Medal

The Lapworth Medal is the most prestigious award made by the Association. It is awarded by Council to a palaeontologist who has made a significant contribution to the science by means of a substantial body of research; it is not normally awarded on the basis of a few good papers. Council will look for some breadth as well as depth in the contributions, as well as evidence that they have made a significant impact, in choosing suitable candidates.

The medal is normally awarded each year. Candidates must be nominated by at least two members of the Association. Nominations should include a single page that summarises the candidate's career, and further supported by a brief statement from the two nominators. A list of ten principal publications should accompany the nomination. Letters of support by others may also be submitted. Council will reserve the right not to make an award in any one year.

The career summary, statements of support and publication list should be submitted in MS Word or PDF format, ideally as a single document if possible.

Nominations should be sent to <**secretary@palass.org**> by **31st March**.

The Lapworth Medal is presented at the Annual Meeting.

President's Medal

The President's Medal is a mid-career award given by Council to a palaeontologist who has had between 15 and 25 years of full-time experience after their PhD, in recognition of outstanding contributions in his/her earlier career, coupled with an expectation that they will continue to contribute significantly to the subject in their further work.

The medal is normally awarded each year. The candidate must be nominated by at least two members of the Association. Nominations should include a single page that summarises the candidate's career, and further supported by a brief statement from the two nominators. A list of ten principal publications should accompany the nomination. Letters of support by others may also be submitted. Council will reserve the right not to make an award in any one year. If a candidate has taken time out from their professional career for family and other purposes, this should be highlighted.

The career summary, statements of support and publication lists should be attached in MS Word or PDF format, ideally as a single document if possible.

Nominations should be sent to <**secretary@palass.org**> by **31st March**.

The President's Medal is presented at the Annual Meeting.

Hodson Award

The Hodson Award is conferred on a palaeontologist who has had no more than ten years of full-time experience after their PhD, excluding periods of parental or other leave, but not excluding periods spent working in industry, and who has made a notable contribution to the science.

The candidate must be nominated by at least two members of the Association and the application must be supported by an appropriate academic case, namely a single page of details on the candidate's career, and a brief statement from each of the two nominators. A list of principal publications should accompany the nomination. Letters of support by others may also be submitted. If a candidate has taken time out from their professional career for family and other purposes, this should be highlighted.

The academic case, statements of support and publication list should be attached in MS Word or PDF format.

Nominations should be sent to <**secretary@palass.org**> by **31st March**.

The award will comprise a fund of £1,000, and is presented at the Annual Meeting.

Mary Anning Award

The Mary Anning Award is open to all those who are not professionally employed in palaeontology but who have made an outstanding contribution to the subject. Such contributions may range from the compilation of fossil collections, and their care and conservation, to published studies in recognised journals.

The candidate must be nominated by at least one member of the Association. Nominations should comprise a short statement (up to one page of A4) outlining the candidate's principal achievements, as well as one or more letters of support. Members putting forward candidates should also be prepared, if requested, to write an illustrated profile in support of their nominee for inclusion in the Newsletter.

Nominations should be attached in MS Word or PDF format and should include the full contact details of the candidate.

Nominations should be sent to <**secretary@palass.org**> by **31st March**.

The Award comprises a cash prize of £200 plus a framed scroll, and is presented at the Annual Meeting.

Golden Trilobite Award

Golden Trilobite Awards are awarded at the discretion of Council for high-quality websites that promote the charitable aims of the Association. Nominations for websites should consist of a link to the site and a brief supporting case from a member of the Association.

Nominations should be sent to <**secretary@palass.org**> by **31st March**. The award comprises a "Golden Trilobite banner" and links to the Association's own website. Awards will be announced in the Newsletter and on the Association website.

Honorary Life Membership

To be awarded to individuals whom Council deem to have been significant benefactors and/or supporters of the Association. Recipients will receive free membership.

Nominations should be sent to <**secretary@palass.org**> by **31st March**.

Honorary Life memberships are announced at the Annual Meeting.

Annual Meeting President's Prize

Awarded for the best talk at the Annual Meeting. All student members of the Palaeontological Association, and all members of the Association who are early career stage researchers within one year of the award of a higher degree (PhD or MSc), excluding periods of parental or other leave, are eligible for consideration for this award, which consists of a cash prize of £200. The prize is announced at the end of the Annual Meeting.

Annual Meeting Council Poster Prize

Awarded for the best poster at the Annual Meeting. All student members of the Palaeontological Association, and all members of the Association who are early career stage researchers, that is, those within one year of the award of a higher degree (PhD or MSc), excluding periods of parental or other leave, are eligible for consideration for this award, which consists of a cash prize of £200. The prize is announced at the end of the Annual Meeting.

GRANTS

Palaeontological Association grants are offered to encourage research, education and outreach through different means. Undergraduates, early stage researchers, and otherwise unfunded persons are given special encouragement to apply. All of these awards and grants are core to the charitable aims of the Palaeontological Association. A full list of the Association's grants may be found on the Association's website (<**www.palass.org**>). Grants with deadlines in the next six months are detailed below.

Grants-in-aid: meetings, workshops and short courses

The Association is happy to receive applications for loans or grants from the organisers of scientific meetings, workshops and short courses that lie conformably with its charitable purpose, which is to promote research in palaeontology and its allied sciences. Application should be made in good time by the scientific organiser(s) of the meeting on the online application form. Such requests will be considered by Council at its March and October meetings each year. If the application is successful, we will require that the support of the Association is acknowledged, preferably with reproduction of the Association's logo, in the meeting/workshop/short course literature and other media. Inquiries may be made to the Secretary (e-mail <**secretary@palass.org**>).

Applications should be made through online submission via the appropriate page on the Association's website, for which you will need the following information:

- Title of meeting / workshop / short course
- Date and Place proposed
- Name, position and affiliation of the organiser(s)
- Brief description (not more than ten lines) of the rationale behind the meeting / workshop / short course
- Anticipated number of attendees
- Amount requested (also whether the request is for a loan or a grant)
- Other sources of funding applied for
- Specific use to which the requested funds will be put

Note: If funds are requested to support one or more keynote speakers, then full details of their names, affiliations and titles of presentations should be included. The application will be strengthened if keynote speakers agree to submit their papers as review articles for possible publication in *Palaeontology*.

The deadlines are **1st March** and **1st September** each year.

Engagement Grants

Awards are made to encourage educational outreach, public engagement, and related initiatives in palaeontological themes. Normally the budget for an individual grant would be less than £5,000. However, under exceptional circumstances, a budget of up to £15,000 for an individual application will be considered. Grants can support either stand-alone complete projects, or they can be 'proof of concept' case studies that have their own outcomes but that form the groundwork for a larger bid elsewhere. The award is open to both amateur and professional palaeontologists and the principal applicant must be a member of the Association. Preference will normally be given to candidates who have not previously received a grant.

Proposals must fit with the charitable aims of the Association and preference is given to applications for a single purpose (rather than top-ups of grants for existing projects). We particularly encourage applications with an innovative aspect, such as engaging with new media, and especially cases that will disseminate good practice. Successful applicants must produce a report for the Palaeontological Association *Newsletter*, and any publicity associated with the activity should mention the support of the Association. Full details of application procedures, terms and conditions are available on the Association's website at <**www.palass.org**>.

For more information please contact the Association's Outreach Officer, Dr Fiona Gill, School of Earth and Environment, University of Leeds, Leeds LS2 9JT, UK; e-mail <**outreach@palass.org**>.

The deadline is **1st September** each year. The awards will be announced at the AGM, and funds will normally be available from 1st January.

Awards and Prizes: AGM 2014

Lapworth Medal: Prof. Richard Fortey

Derek Briggs writes: Richard Fortey is one of the world's leading palaeontologists. His research is remarkable for its breadth, covering topics as diverse as Palaeozoic biostratigraphy and biogeography (with a focus on the Ordovician), the evolutionary history and biology of trilobites and graptolites, and the explosion of major groups during the Cambrian explosion. He made major contributions to the use of faunal evidence for reconstructing the former position of the Palaeozoic continents. He led efforts to correlate the Ordovician internationally. Following the death of his PhD advisor Harry Whittington, he is arguably the leading international authority on trilobites. He was involved in seminal attempts to quantify the nature of the Cambrian radiation based on arthropod relationships and morphology. He has published more than 200 papers, and his work continues to have a major impact on the development of biostratigraphy and palaeobiology. He has served as president of the Palaeontological Association, the Geological Society of London, and the Palaeontographical Society.

In addition to his scientific publications, Richard Fortey is the author of seven major books that communicate scientific ideas to the public. *The Hidden Landscape* (1993), an account of the

topography and scenery of Britain explained in the context of the underlying geology, won the Natural World Book of the Year Award. *Life, an unauthorized biography* (1998), which tells the story of the evolution of life on Earth as seen through Fortey's scientific experience, was shortlisted for the Rhone Poulenc and listed as one of the ten books of the year by the New York Times. *Trilobite! Eye witness to Evolution* (2000), based on one of the most familiar and popular groups of invertebrate fossils, and one upon which Fortey is a leading expert, was shortlisted for the Samuel Johnson award for non-fiction. *The Earth: an Intimate History*, which develops the ideas of *The Hidden Landscape* on a global scale, was shortlisted for the Aventis Prize. More recently *Dry Store Room No. 1* and *Survivors: the animals and plants that time has left behind* have also been the subject of critical acclaim. Not only have Fortey's books won recognition, so too has their author, with a string of awards, including the Royal Society's Michael Faraday Prize (2006), as well as numerous other accolades and honorary degrees. Through his popular science writing and presentations to lay audiences Fortey has done more than any professional palaeontologist since Steve Gould to bring palaeontology and Earth science to public attention. I can think of no one more deserving of the Lapworth Medal than Richard Fortey.

Photo courtesy of Anthea Lacchia.

President's Prize: Prof. Philip C.J. Donoghue

Howard Armstrong writes: Phil has distinguished himself as one of the leading palaeobiologists in the UK and is rapidly building himself an enviable international reputation. He is a clear equal to the previous recipients of the President's Medal. Phil's main characteristic is to challenge orthodoxy, whilst pushing the analytical boundaries and supporting his students.

Phil's research career began with work on conodonts, under the supervision of Dick Aldridge and as a member of the highly successful Leicester group. There he developed new ideas on the function, evolution and palaeobiology of conodont animals; particularly the functional morphology of the feeding apparatus. He was first to explain how this occluded, and that led to his 1999 paper in *Paleobiology*. Phil has since developed three main areas of expertise that have given him a strong international reputation:

- Molecular palaeontology. After taking time out to retrain, Phil has established a molecular lab, cloning genes for phylogenetic and developmental studies. He is working on dating the molecular tree of life, new genes, including micro-RNAs, for resolving long-term unresolved questions about the origin of metazoans, exploring gene duplication events, the role of fossils in phylogenies, and numerous other themes.

- Evolutionary-developmental aspects of early animal evolution. With his move to study Cambrian embryos from China (2004, *Nature*), Phil has entered the fray squarely. The origin and relationships of metazoan (= animal) phyla is a heated field, with claims and counter-claims being published monthly in *Nature* and *Science*. The 'hot' research themes concern molecular phylogenies and dates for major early branching points, new exceptionally preserved fossils, and developmental aspects. He focuses on the brain and sensory systems to resolve outstanding debates.

Photo courtesy of Dave Marshall.

- The histology of the hard tissues of early vertebrates. Understanding the microstructure of the bone, teeth and other hard tissues of early vertebrates is a fiendishly complex subject, and Phil has mastered the arcane topic. He has been able to show that many other practitioners are downright wrong in their determinations and descriptions. This is more than mere semantics: on determinations of particular hard tissues depends our understanding of phylogeny, and of the origin of vertebrates.

- The phylogeny of basal chordates. This is a 'hot' topic, attracting considerable interest, and Phil's review (2000, *Biological Reviews*) is already a 'citation classic', attracting ten or more citations a year, and regarded as the best current statement on the cladistic relationships of basal chordates. In producing this paper, Phil and his co-authors re-studied a broad range of obscure Cambrian organisms, re-tested previous work, and incisively reviewed the current state of knowledge. His cladistic analysis is a masterpiece of thoroughness and thoughtfulness.

Phil has supervised 20 PhD students and 13 post-docs. He enthuses bright young researchers from around the world with his vision, and has the knack of finding them funding from a variety of sources. Phil has secured substantial funding from a variety of sources for his own work – certainly at the high end of the range for a European palaeontologist. Further, he publishes extensively, being author or co-author of 5–10 papers a year, and totalling ~100 so far in Web of Science. His most cited paper is one with Mike Benton in 2007 about new approaches to using palaeontological data to date the tree of life (*Molecular Biology & Evolution*, cited 374 times), followed by "MicroRNAs and the advent of vertebrate morphological complexity" (139) and a string of others in the 30–115 range. With an *h*-score of 25, he has achieved a great deal in a relatively short time.

Phil has already been awarded seven prizes for promising young researchers from the Geological Society of London, the Palaeontological Association, and the British Association for the Advancement of Science. He was awarded the Philip Leverhulme Prize in 2004. This is a substantial honour, open to competition across all fields, and rarely awarded to a palaeontologist. This award provided the funds for Phil to take a sabbatical and undertake training in molecular techniques.

Phil has also shown leadership in the wider palaeontology community, fulfilling a variety of roles for internationally respected learned societies, not least the Palaeontological Association. He has achieved all of this whilst maintaining a full teaching load and whilst performing a variety of substantive Departmental administrative tasks.

Hodson Award: Dr Maria McNamara

Mike Benton writes: This award recognizes a palaeontologist who has made a notable early contribution to palaeontology. I cannot think of any young palaeontologist working today who fits this description better than Maria. She has been a stalwart of the Palaeontological Association annual meetings, and has won the 'best talk' award twice (2003, 2005), a rare achievement. Her talks are always *tours de force*, thoroughly prepared, beautifully illustrated, delivered with verve, and illuminating difficult interdisciplinary themes in taphonomy.

Maria has forged a novel research area in palaeontology, combining knowledge of fossils, sedimentology, geochemistry and, increasingly, advanced analytical instrumentation. For example, her recent studies on the preservation of original coloration in fossil insects have employed electron microscopy, synchrotron scanning, and controlled temperature-humidity experimentation. As well as original research papers, she has written stunning review papers, including her 2013 review, 'The taphonomy of colour in fossil insects and feathers' in *Palaeontology*.

Maria has published 15 papers since 2006, not a huge number, but each has made a substantial impact. Her publications have been in standard palaeontological journals, but also in *Science*, *Proceedings B*, *Royal Society Interface*, *Biology Letters*, and *Geology*. They delve into arcane areas of geochemistry and physical nanostructures, and illustrate her seriousness as a scholar, and her ability to master a diverse array of techniques that address some currently highly novel and promising fields in taphonomy, especially addressing the exceptional preservation of proteins such as keratin and collagen, as well as the chemistry and physics of colour. Maria's work on exceptional preservation of ultrastructural components in vertebrate skin and nanostructural mechanisms for colour generation in insect cuticles and feathers is seminal.

Photo courtesy of Dave Marshall.

Maria has recently been appointed to a permanent post at University College Cork, and she is rapidly building her research group. Through her various post-doctoral positions in Ireland, the UK and the USA, Maria has shown her ability to plan and fund her research highly successfully. In addition, the quality of her work has been repeatedly recognised by prizes (several 'best paper' awards, from 2003 to 2010). Further, she spearheaded a highly successful exhibit at the Royal Society Summer Science Exhibition in 2013, and then at the SE

Asian Science Fair in Bangkok, taking her work on colour in insects and birds to tens of thousands of members of the public.

Maria has pioneered a broad array of highly novel techniques and developed a strong reputation in the field of taphonomy of exceptional tissues. This she has done with vigour, and always aiming for the highest quality in her presentations. She is an asset to the science of palaeontology, so I am delighted to recommend her for the Hodson Award.

Mary Anning Award: Dr Christoph Bartels

Photo courtesy of Dave Marshall.

Derek Briggs writes: Dr Christoph Bartels is a historian of mediaeval and post-mediaeval mining and metal production. After teaching for a number of years at the Rheinisch-Westfälische Auslandsgesellschaft College in Dortmund, he undertook PhD studies at Carl von Ossietzky University, Oldenburg, on the history of slate mining (1985). From 1986 to his recent retirement he worked at the German Mining Museum (Deutsches Bergbau-Museum) in Bochum, leading the Mining History research department from 1999.

Christoph Bartels started collecting and preparing fossils from the Devonian Hunsrück Slate in the 1960s as a teenage high school student. In his late 20s and 30s he was in close contact with the international research group on the Hunsrück Slate organized by Prof. Wilhelm Stürmer, Erlangen, who produced iconic X-radiographs of the fossils, and Prof. Fritz Kutscher, Wiesbaden. Stürmer died in the same year that Bartels was appointed to the German Mining Museum and interest in the Hunsrück Slate fossil reached a low ebb, particularly in German universities. Bartels, recognizing the importance of the fossils, continued to champion the cause of the fauna, in spite of the disadvantage of being outside the German palaeontological establishment. Together with Günter Brassel, a retired German naval captain, he published *Fossilien im Hunsrückschiefer – Dokumente des Meereslebens im Devon* with the Museum Idar-Oberstein in 1992, the first comprehensive book-length treatment of the fauna. A collaboration with Derek Briggs began as a result of the latter's interest in pyritization as an agent of exceptional preservation, and led to publication of *The Fossils of the Hunsrück Slate – Marine life in the Devonian*, by Cambridge University Press in 1998, a revised version of the 1992 treatment.

In 1997 Bartels and Dr Michael Wuttke (Department of Cultural Heritage Rhineland-Palatinate) established Project Nahecaris, to undertake a major excavation of the Hunsrück Slate and to retrieve a core from the major quarry at Bundenbach. This led to a special publication of the German Mining Museum in 2002 summarizing the results of the project: *The Nahecaris Project – Releasing the marine life of the Devonian from the Hunsrück Slate of Bundenbach*. In the meantime, Bartels

developed very precise air abrasive methods using iron filings to expose the fossils. The results of his remarkable skills are beautifully illustrated in a 2012 volume on the Hunsrück Slate published in German (Quelle and Meyer) and English (*Visions of a vanished world: The extraordinary fossils of the Hunsrück Slate* – Yale) and based largely on the major collection of specimens that he himself assembled and prepared, and which he has made available to the international research community and donated to the German Mining Museum. Bartels is now collaborating with Professor Jes Rust of the University of Bonn who has initiated a new project on the Hunsrück Slate. As research on this famous Konservat-Lagerstätte continues to burgeon it is no exaggeration to identify Christoph Bartels as the individual who made it all possible.

Small Grant Awards: AGM 2014

The small grants awarded by the Association for funding in 2015 include the Sylvester-Bradley, Callomon, Whittington and Wood awards. Council agreed that the following applicants should receive Sylvester-Bradley awards: Jinyuan Huang (£1,500), Dr Breandán MacGabhann (£750), Elizabeth Martin (£1,500), Luke Parry (£1,500), and Nicola Stone (£784). The Callomon Award was awarded to William Foster (£1,500), the Whittington Award to Dr Allison Daley (£1,500), and the Wood awards to Kelly Richards (£1,442) and Davide Foffa (£1,467).

Middle Triassic conodont apparatus reconstruction from China

Jinyuan Huang
Chengdu Institute of Geology and Mineral Resources, China

I recovered a large number of exceptionally well-preserved articulated skeletons of conodont elements from the Middle Triassic Luoping Lagerstätte from Yunnan, China. The Luoping biota is characterised by exceptional preservation and high diversity of fossils. It is one of the most diverse Triassic marine fossil Lagerstätten, showing full recovery of marine ecosystems after the end-Permian mass extinction. Included among the biota are exceptionally well-preserved articulated remains of conodont skeletons, known as 'fused clusters'. These fused clusters are very rare and are the foundation for establishing homology and, therefore, phylogenetic relationships among conodont species. Hence, conodont systematics is in a very rudimentary state.

Sylvester-Bradley funding will allow me to undertake a seminal study of the clusters using synchrotron tomography, allowing me to characterise the morphology of all of the elements in the apparatus, as well as their homological positions, and the architecture of the apparatus, using computed tomography. I will use these data to revise the taxonomy of the component species, identify homologies among related species known only from disarticulated remains, and establish their evolutionary relationships using parsimony and Bayesian phylogenetic analysis. This will serve as a foundation to better resolve the phylogenetic systematics of conodonts, and their pattern of decline leading to their ultimate demise at the end of the Triassic.

Community ecology of Cambrian deep marine scratch-circles

Dr Breandán A. MacGabhann
Edge Hill University, UK

The early Cambrian witnessed not only the rise of biomineralised organisms but a fundamental change in marine ecology, including the evolution of widespread bioturbation and a shift from Neoproterozoic-style microbial matground seafloors to more typical Phanerozoic-style bioturbated mixgrounds. However, this latter shift was delayed in deep marine environments, and the ecology of deep marine Cambrian communities is not well known. Did Ediacaran-like community ecology persist into the Cambrian in deeper settings, or were these occupied by more typical Cambrian communities, simply lacking vertically-bioturbating forms? Here, it is proposed to address this question by investigating one deep marine Middle Cambrian community in unprecedented detail. The Booley Bay Formation (SE Ireland) contains bedding sole surfaces covered by millimetre-scale scratch circles (arcuate scratches left in the substrate by the current-forced rotation of tethered epibenthic organisms) with densities reaching 30,000 individuals per square metre. Surfaces will be photographed at high resolution, with Image Analysis techniques used to collect positional and morphological data on scratch circles. Morphological analysis will be accompanied by mathematical analysis to describe, model, and determine the cause (environmental or biological) of the observed spatial distributions. Comparison to Ediacaran and Cambrian communities may enhance our understanding of the ecology of the Cambrian explosion.

Pterosaur body mass, pneumaticity, and flight mechanics

Elizabeth Martin
University of Southampton, UK

Pterosaurs are both the first and the largest animals to achieve flapping flight, and as such are important in our understanding of the evolution of flight. However, basic questions of pterosaur body mass and flight mechanics, including reliable body mass estimates and flight capabilities, remain unanswered. In my PhD, I will be developing a method of estimating bone mass, investigating and quantifying pneumaticity (air space within hollow bones), and flight mechanics. This will be done with a combination of traditional fossil analysis, and modern methods including computed tomography (CT) and 3D reconstruction. Specifically, this financial support will enable a visit to the American Museum of Natural History in order to view the collections and specimens in a special pterosaur exhibit on now. This special exhibit is the first of its kind where pterosaur specimens from around the world are on display temporarily in one place. This study is the first large-scale biomechanical and anatomical study on pterosaurs using a mixture of CT scans and traditional methods.

Fossil polychaetes from the Palaeozoic of North America

Luke Parry
University of Bristol, UK

Annelids are rarely preserved as whole-body fossils apart from in exceptional circumstances. This project aims to describe new taxa and assess the annelid biotas from two deposits from North America: Mazon Creek and Bear Gulch. Many annelid groups first appear in these deposits but their full potential has yet to be realised. The project will focus on a large and previously unstudied collection from the Royal Ontario Museum, Toronto.

Biomechanical impact of skull sutures in Palaeognathae

Nicola Stone
University of Bristol, UK

The Palaeognathae are one of two clades (the other being the Neognathae) that comprise the avian crown group. Palaeognaths include the secondarily flightless ratites (extant ostrich, emu, rhea, cassowaries, kiwis and their extinct relatives, and the extinct elephant birds and moa) and the aerial tinamous and extinct lithornids. Ratites may be paraphyletic, as recent molecular evidence places the moa as sister taxa to the tinamous (Mitchell *et al*. 2014; Baker *et al*. 2014; Phillips *et al*. 2010), and nesting aerial and flightless clades within palaeognath phylogeny has profound implications for the potential origin of flightlessness across the group. Molecular dating and the presence of Late Cretaceous neognath taxa places the origin of palaeognaths prior to the K–Pg boundary (Mitchell *et al*. 2014; Clarke *et al*. 2005), yet the earliest unambiguous fossils are lithornids known from the Palaeocene (Houde 1988). One of the diagnostic features of the Palaeognathae is said to be open sutures in their skulls persisting into adulthood resulting from heterochrony. My research will look at the biomechanical implications of these open sutures in Tinamous (two subfamilies represented by *Eudromia elegans* and *Crypturellus soui*) and *Lithornis* by way of modelling using Finite Element Analysis. Observation of suture closure sequences in the Tinamous and other Palaeognaths will add to my existing data sets to enable me to test for heterochronic shifts across the Palaeognathae.

Evolution of the oldest Mesozoic platform margin reef

William J. Foster
University of Plymouth, UK

Climate warming during the late Permian caused an extinction of up to 74% of benthic invertebrates, and the extinction of the main reef-building animals (rugose and tabulate corals).

Although metazoan reefs reappear in the fossil record during the Early Triassic, reefs were not common until the Illyrian, *i.e.* 11 million years after the extinction. The recovery of reefs after the late Permian extinction event is described as having a three-stage development: first during the Early Triassic with microbial reefs, next in the Middle Triassic with Wetterstein reefs (dominated by calcisponges) and finally in the Late Triassic with Dachstein reefs (dominated by corals). An important but largely neglected tool in reconstructing recovery processes is that of quantitative palaeoecology, studies of which are currently lacking for reef ecosystems that follow the Late Permian extinction. The oldest Mesozoic platform margin reef is located in the Aggtelek-Rudabanya Mountains, NE Hungary, where a diverse suite of fossils including brachiopods, conodonts, sponges, algae, cyanobacteria, foraminifera, radiolarians and echinoderms have been described. To better understand the recovery and development of reefs following the late Permian mass extinction event, samples from the Aggtelek reef will be collected and analysed quantitatively to investigate how the taxonomic and ecological structure of the Wetterstein reef stage evolved during the Middle Triassic.

What is the Cambrian "muscle worm"?

Dr Allison C. Daley
University of Oxford, UK

The early Cambrian Emu Bay Shale in South Australia yields diverse fossils with exceptional soft-part preservation, providing important insight into understanding early animal evolution during the Cambrian Explosion. An enigmatic fossil from this locality known as the "muscle worm", or *Myoscolex*, preserves some of the earliest muscle tissues known in the fossil record, but its affinity is unknown. It has been variously regarded as an annelid, an arthropod or even an early chordate. This project aims to redescribe *Myoscolex* and determine its affinity using a new collection of hundreds of fossils from a recently excavated quarry on Kangaroo Island, South Australia. Funding is sought for travel expenses supporting a collections visit to the South Australian Museum. The new *Myoscolex* fossils are more complete than previously described specimens, and several display new anatomical features such as head shields, biramous limb exites, segmentation, and digestive systems. These features seem to suggest an arthropod affinity, which will be evaluated with a phylogenetic analysis. In-depth analysis of *Myoscolex* musculature, using SEM imaging, will include comparisons to modern and fossil arthropods to gain a broader understanding of the evolution of musculature during the Cambrian Explosion.

Tournaisian chondrichthyans from the Scottish Borders

Kelly R. Richards
University of Cambridge, UK

The end-Devonian extinction event marked the beginning of the 20 Myr hiatus in the tetrapod fossil record named "Romer's Gap". It is clear that chondrichthyans do not suffer from the same

"Romer's Gap", and by the end of the tetrapod hiatus they are a diverse and proportionally dominant component of the marine vertebrate fauna. The pattern and timing of the radiation that chondrichthyans must have undergone is currently unclear, as known Tournaisian sites tend to be of low diversity. Recent fieldwork in the Borders, by the late Stanley Wood and by Dr Timothy Smithson and Prof. Jennifer Clack, has uncovered new Northumberland Basin localities yielding chondrichthyan teeth of unexpected diversity, size, preservation and abundance. The majority of the teeth found are bradyodont and compose a fauna with a crushing dentition, but they occur alongside a population of elasmobranchs with more typical non-crushing dentitions. Fieldwork in 2015 will revisit the discovered localities and prospect a number of promising new localities. New fossils are needed to expand the localities geographically and palaeoenvironmentally. The resulting basin-wide study of chondrichthyan diversity will be supported by a strong chronological framework. This will allow us to improve our understanding of early chondrichthyan evolutionary history, response to ecological pressure and, ultimately, success as a component of the Early Carboniferous marine fauna.

Ecology and evolution of British Jurassic marine reptiles

Davide Foffa
University of Edinburgh, UK

Britain boasts a rich record of Mesozoic marine reptiles, including diverse Middle-Late Jurassic faunas of ichthyosaurs, plesiosaurs and thalattosuchians. These animals ranged from ~2 m stealthy fish-eaters, to >12 m-long apex predators, and filled many ecological roles today dominated by teleosts, sharks and cetaceans. Hundreds of marine reptile specimens have been recovered from two world-famous Jurassic rock units: the Oxford Clay (~165–163 Ma) and the Kimmeridge Clay (~157–152 Ma) formations. Interestingly, these fossil assemblages show that often many species were able to coexist in the same environment. This may indicate niche partitioning, as in modern marine ecosystems. The aim of this project is to understand the evolution and the ecological structure of these remarkable fossil assemblages. This will be done in a quantitative way. Skull, lower jaws, teeth and limb elements for individual specimens will be measured and studied, and similarities and differences in shape and function will be assessed with numerous quantitative and phylogenetically-grounded methods. This will help infer whether coexisting species had analogous or different behaviours. On a broader scale, this study will be used to explain the co-existence, ecology and evolution of ichthyosaurs, plesiosaurs and thalattosuchians of the Jurassic British seaway.

Palaeontological Association Undergraduate Prize Scheme, 2015 onwards

We are making some changes to the way that this scheme is operated because our current practice of writing to individual British and Irish departments in May is not as inclusive as we would like.

The scheme annually invites all departments where a palaeontology course is taught after the first year as part of a degree programme, to recommend one of their undergraduate students to receive this award. The award consists of free membership of the Association for the rest of the year in question, plus the following year. It provides electronic access to both our journals, paper copies of the Newsletter, and all the other advantages of membership. Receipt of the award also looks good on a recipient's CV.

The award scheme will continue and, from this year, will be extended to undergraduate students in other countries, but we shall no longer send out invitations to individual departments. They are invited to contact us at <**palass@palass.org**> with a nomination (name, address and e-mail) and we will then sign up the student as a member and let them know. Departments may use any criterion for selection, though most prefer to use the scheme as an acknowledgement of best performance in a relevant exam or project.

If you are a staff member who is involved with exam assessment at UK and Irish universities you will know about the scheme and be familiar with the selection process. Please ask your department to carry on making recommendations to us in the normal way. If you are a teacher of palaeontology, and a PalAss member, in a university further afield who is unfamiliar with the scheme, then we invite you to join the scheme and tell people in your department about it. The award is available to only one person per year in any one institution, who should be an undergraduate student, not a postgraduate, when they are selected.

We will repeat this Newsletter announcement periodically as a reminder.

Tim Palmer
Executive Officer

Palaeontology and *Papers in Palaeontology*

Content Alerts

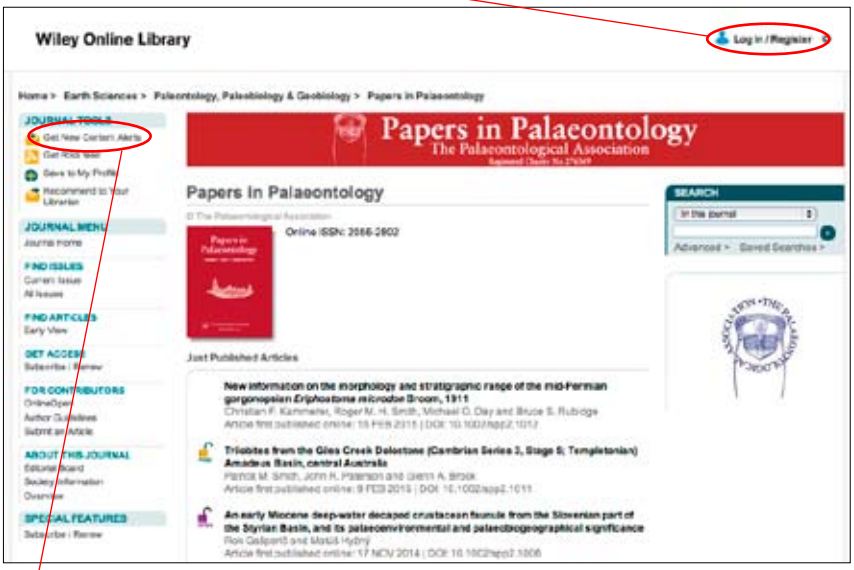
Find out about the latest articles and journal issues as soon as they are published by signing up for Wiley's 'Content Alerts'. To do this, you need an account for Wiley Online Library.

1. Visit the journal homepage:

Palaeontology: <**http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1475-4983**>

Papers in Palaeontology: <**http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)2056-2802**>

2. Click on Log in/Register



3. Return to the journal home page and click on Get New Content Alerts.

Unfortunately PalAss cannot automatically register members who request online-only access to journals as part of their subscription, so please sign up for free alerts today.

Sally Thomas
PalAss Publications Officer
<editor@palass.org>

ASSOCIATION MEETINGS

59th Annual Meeting of the Palaeontological Association
Cardiff, Wales, UK *14 – 17 December 2015*

The Annual Meeting of the Palaeontological Association will be held at Cardiff University and Amgueddfa Cymru – National Museum Wales, organised by Caroline Buttler, Lesley Cherns and Lucy McCobb.

Symposium
The meeting will begin with a symposium in the afternoon of Monday 14th December at Amgueddfa Cymru – National Museum Wales, followed by an evening reception with the opportunity to look around the Evolution of Wales galleries and the William Smith exhibition.

The topic for the Annual Symposium this year is 'Palaeobiotic interactions'.

Conference and Annual Address
The conference will be held at Cardiff University and will commence on Tuesday 15th December with a full day of talks and posters. The Annual Address will be given by Prof. John Hutchinson (The Royal Veterinary College). In the evening there will be a reception and the Annual Dinner at Cardiff City Hall.

Wednesday 16th December will be a full day of posters and talks in parallel sessions (depending on demand). Talks for both days will be allocated 15 minutes including questions.

The Association AGM will take place after lunch.

Field-trip
A field-trip to explore some local geology is planned for Thursday 17th December. We will also be including a trip to Big Pit National Mining Museum with lunch and an underground tour.

Venue and travel
All conference venues, including the Annual Dinner, are within 5–10 minutes' walk of each other, located in Cardiff city centre. The train station is a *c.*20 minute walk.

Accommodation is available within walking distance of the University and the city centre.

Getting to Cardiff

By Train
Cardiff Central Station is a *c.*20minute walk from the conference venues and close to many hotels. Booking early will get the best rail ticket prices, especially from London Paddington. From Cardiff Central Station there is also a frequent train service which stops at Cathays Station (located on the Cathays Park campus).

Rail services connect Cardiff with London, Bristol, Birmingham, Southampton, Manchester and Liverpool as well as many other cities and towns.

By Coach
Cardiff is served by regular coach services from towns and cities across the UK; these are often cheaper than trains. For information see National Express Coaches (<**www.nationalexpress.com**>) and Megabus (<**www.uk.megabus.com**>).

Local bus services also operate from Cardiff Central Station.

By Car
There is limited parking around the University, and almost none on campus, so driving to meeting venues is not the best option. There is pay-and-display car parking on Park Place and in the civic centre (along College Road, City Hall Road, King Edward VII Avenue and Museum Avenue) but this fills up very quickly, especially just prior to Christmas. This typically costs around £6/day, payment is by coin or debit/credit card. Charges for city centre multi-storey car parks vary considerably, up to £12 per day.

By Plane
Cardiff Airport is approximately 12 miles from the city centre. There are bus and train links to Cardiff city centre, as well as a taxi service (taxi fare to Cardiff city centre approximately £31). From other airports such as Bristol, Heathrow and Gatwick there are rail and bus links to Cardiff.

Taxis
Taxis can be found at the front of Cardiff Central Station and a number of other locations around the city centre.

Registration and booking
Registration, booking and abstract submission will commence in June 2015. Abstract submission will close in September (exact date to be confirmed) and abstracts submitted after that date will not be considered. Registration after that date will incur an additional administration charge of approximately £30, with the final deadline in November 2015. Registrations and bookings will be taken on a strictly first-come, first-served basis. No refunds will be available after the final deadline.

Registration, abstract submission, booking and payment (by credit card) will be available online via the Palaeontological Association website (<**palass.org**>) from June 2015.

Accommodation
Accommodation should be booked separately. Cardiff has a wide variety of hotels, hostels and guest-houses at a range of prices, which can be booked through the usual online resources. Most of the well-known hotel companies are represented. It is recommended that delegates look for reviews and ratings such as those at <**www.tripadvisor.co.uk**> to decide which would suit them best. <**visitcardiff.com**> lists a number of providers of accommodation from budget to luxury.

In the Spring, a brand new YHA Youth Hostel is opening in Cardiff city centre with parking and private rooms, close to the rail and coach stations; see <**www.yha.org.uk/hostel/cardiff-central**>.

There are large numbers of B&Bs on Cathedral Road near Cardiff Castle. You are advised to check their ratings on review sites as they do vary.

Travel grants to student members

The Palaeontological Association runs a programme of travel grants to assist student members (doctoral and earlier) to attend the Annual Meeting, in order to present a talk or poster. For the Cardiff 2015 meeting, grants of less than £100 (or the euro equivalent) will be available to student presenters who are travelling from outside the UK. The actual amount available will depend on the number of applicants and the distance travelled. Payment of these awards is given as a disbursement at the Meeting, not as an advance payment. Students interested in applying for a PalAss travel grant should contact the Executive Officer, Dr Tim Palmer (e-mail <**palass@palass.org**>) once the organisers have confirmed that their presentation is accepted, and before **1st December 2015**. Entitle the e-mail "Travel Grant Request". No awards can be made to those who have not followed this procedure.

Cardiff

Cardiff is the capital city of Wales with many cultural and entertainment attractions (see <**http://www.visitcardiff.com/**>). During the conference there will be a Christmas market in the centre of the city and ice-skating outside City Hall. There are also many restaurants and bars in the city centre.

We look forward to seeing you in Cardiff in December.

Progressive Palaeontology

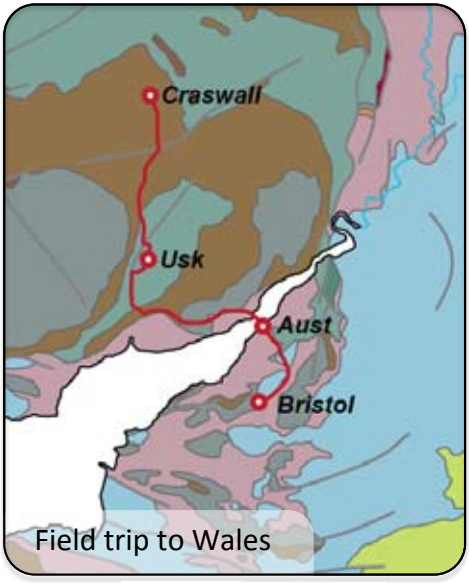
Bristol 2015

April 9th - 11th

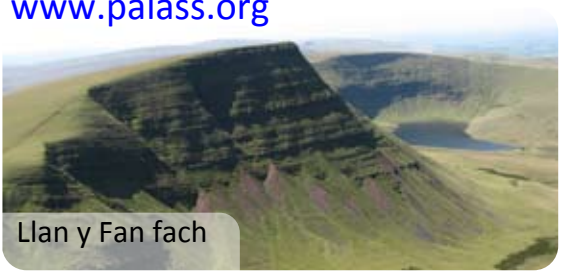
Email: progpal15@palass.org

Last Chance to Register

www.palass.org



Field trip to Wales



Llan y Fan fach

Usk

University of BRISTOL

SSP SIRI SCIENTIFIC PRESS

LYME REGIS

FOSSIL FESTIVAL

1–3 May 2015

■ Grand Marquee ■ Hands-on Art and Science
■ Art and music ■ Theatre
■ Walks ■ Talks ■ Fossil Fair

www.fossilfestival.com

news

PalAss welcomes a new President

Our new President, **Dave Harper**, is Professor of Palaeontology and Principal of Van Mildert College at Durham University. His initial research on the stratigraphy and palaeontology of the Ordovician rocks of northwest Europe was largely field-based and taxonomic, but during the last fifteen years his focus has moved to target some of the larger-scale processes in the history of life. Together with various colleagues, new models for biotic change and distributions through the Early Palaeozoic, particularly targeting the Cambrian Explosion, Great Ordovician Biodiversification Event and the end-Ordovician extinction, are being developed and their relationships to climatic and environmental changes being assessed using a range of multidisciplinary techniques. These projects have involved fieldwork on the Lower Palaeozoic rocks in northern Greenland, Chile, China (including Tibet), Denmark, Estonia, Norway and Russia, together with the UK and Ireland. He has co-authored a number of textbooks in palaeontology, revised various groups of Brachiopoda for the *Treatise on Invertebrate Paleontology*, and with Dr Øyvind Hammer (University of Oslo) is co-author of the highly-cited software package 'PAST'. Dave has previously served on Council as an Editor, Vice President and Chair of the Publications Board. He is a foreign member of the Royal Danish Academy of Sciences and Letters and the Royal Swedish Physiographic Society, and is an Einstein Professor in the Chinese Academy of Sciences. We warmly welcome Dave to his new position at the PalAss helm.

David Ward takes up the reins as Vice President after serving on Council previously, and **Andrew Smith** is now Editor-in-Chief after completing his term as Vice President. The PalAss Council welcomes new members **Maria McNamara** and **Imran Rahman** as Ordinary Members, **Jo Hellawell** as Newsletter Editor, and **Tom Challands** as Book Review Editor. We are very grateful for the time and efforts of departing Council members Mike Benton, Al McGowan, Bob Owens and Charlotte Jeffrey-Abt.

Annual Meeting content online

The 58th Palaeontological Association Annual Meeting in Leeds was a great success thanks to the organisational skills of Crispin Little and Fiona Gill. You can read a detailed report of the Meeting later in this Newsletter, and for those who were unable to attend (or those who wish to re-live the experience) many of the talks are now available online at <**Palaeocast.com**>, the excellent online resource featuring palaeontology podcasts.

<**http://www.palaeocast.com/the-palaeontological-association-58th-annual-meeting/**>

The Year of Mud has begun

2015 has been designated the 'Year of Mud' by the Geological Society of London, to highlight the importance of mud in its many forms, from recent soil, through shale, to ancient slate. As mentioned on the Geological Society's website, mud represents both an end and a beginning of the rock cycle: the end of the cycle of erosion and transport, and the beginning of the generation of new rocks. Mud is of course very important for the fossil record, enabling exceptional preservation which in turn has led to our understanding of the evolution of biota throughout life history. The relative stratigraphic completeness of most mudrock successions makes them ideal for high-resolution studies of both marine and terrestrial settings. The 2015 Lyell Meeting (co-sponsored by the Association) and some evening lectures held at the Geological Society have been and will be focused on the importance of mud for the fossil record. For those unable to attend, talks are made available shortly after each event on the Society's YouTube channel.

<**https://www.youtube.com/user/GeologicalSociety**>

Palaeontology *in the news*

Every issue of our flagship journal features fabulous new discoveries from the fossil world, and both the Association and Wiley-Blackwell try to publicize these (see more from our Publications Officer on author promotion later in this Newsletter). Here we feature papers that have broken free from the clutches of academia and made it out into the public domain; there were three papers that made the news in recent months.

Javier Luque's study of the earliest true crab, from the Early Cretaceous of Colombia, became available online at the end of October, though is yet to feature in an issue: <**http://onlinelibrary.wiley.com/doi/10.1111/pala.12135/abstract**>. Thanks to a press release from the University of Alberta, the discovery appeared in the *Edmonton Sun*: <**http://www.edmontonsun.com/2014/12/22/university-of-alberta-researcher-finds-fossil-of-110-million-year-old-crab**>. It announced, quite correctly if over-simply, that "University of Alberta researchers have found a very, very old crab". There was also coverage in *Heritage Daily*: <**http://www.heritagedaily.com/2014/12/110-million-year-old-crustacean-holds-essential-piece-evolutionary-puzzle/106270**>, which emphasized that the discovery provided "critical information that would shift the paradigm from the previously accepted hypothesis of high latitude origin [for higher crabs] in the Late Cretaceous".

In early December, *New Scientist* (<**http://www.newscientist.com/article/dn26669-giant-fossil-hints-at-the-diversity-of-early-primates.html**>) picked up on **Richard Fox** and colleagues' identification of a large new Palaeocene primate, *Ursolestes*, from Montana: <**http://onlinelibrary.wiley.com/doi/10.1111/pala.12141/abstract**>. They noted that it indicates a "remarkable diversity" in early primates and suggests the group probably evolved in the Late Cretaceous, rather than in the early Cenozoic. Surviving an extinction rather than simply flourishing

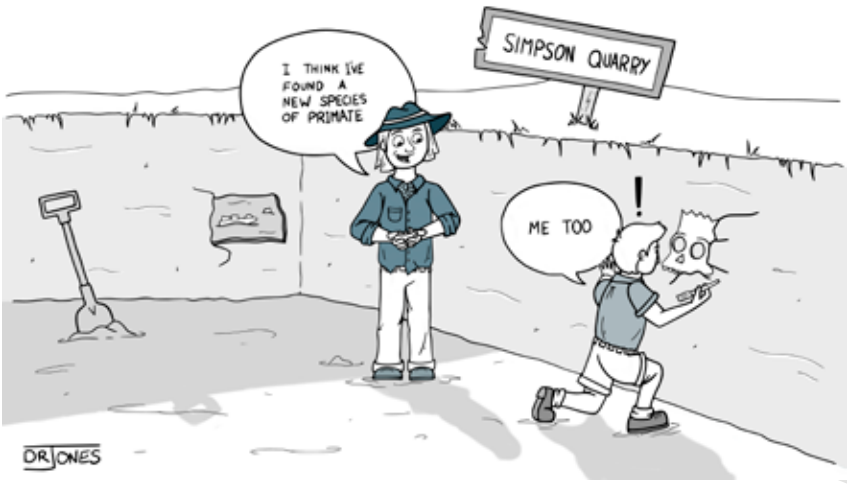
afterwards is an important difference to determine and, as you will read next in this issue of the Newsletter, early primates from Montana are a hot topic at the moment. It's great to see publications in our journals contributing to this.

It's also great to see research by undergraduates making the news. Bristol student **Fiann Smithwick**'s paper showing that the Jurassic fish *Dapedium* was a shell-crusher (<**http://onlinelibrary.wiley.com/doi/10.1111/pala.12145/abstract**>) caught the eye of various popular science websites at the start of this year, such as <Phys.org>: <**http://phys.org/news/2015-01-jaw-mechanics-shell-crushing-jurassic-fish.html**>. Trawled from the Lower Jurassic shales of Lyme Regis by Mary Anning, this is an iconic ichthyan, but its feeding behaviour had never been determined. Fiann's work put it back into the Lyme-light, which, with the project having been funded by a Palaeontological Association bursary, was an even richer reward.

Mike Benton, who'd supervised Fiann's research, then wrote a behind-the-scenes article about the discovery for *The Conversation* (<**http://theconversation.com/how-a-student-beat-top-scientists-to-first-reveal-the-power-of-jurassic-jaws-36444**>) explaining just how notable it is to see degree-level studies making it into press. It is a salutary – and encouraging – lesson for all students. Hopefully we can look forward to seeing many more such fruits of the Association bursary scheme.

Those are the highlights we spotted, but if any member notices coverage of a *Palaeontology* article from the last few months that didn't get a mention, please do let us know (e-mail: <**publicity@palass.org**>).

Liam Herringshaw
Publicity Officer



<**www.ratbotcomics.com**>

Featured article

The Palaeocene is normally a bit too recent for me – I'm still coming to terms with reaching the giddy heights of the Triassic – but if there's one thing a palaeontologist can't resist, it's an "oldest known" headline. It's hard to achieve such a superlative in the academic literature these days: when colleagues and I tried to extend the range of the retroceramid bivalves back by 100 Myr into the Permian of Svalbard, one reviewer pointed out that they were actually rather common Permian atomodesmatids. Knowing your taxonomy is key! Bivalves are one thing, but throw "oldest" and "primates" into a title and you have a pretty sexy paper. Thus, when Stephen Chester and colleagues presented evidence for the "Oldest known euarchontan tarsals and affinities of Paleocene *Purgatorius* to Primates" in PNAS recently (Chester *et al*. 2015), I hoped that they were better at taxonomy than I!

Purgatorius by Nobu Tamura, used under the Creative Commons Attribution license (CC BY 3.0).

The euarchontans are a grandorder of mammals that today includes the treeshrews, flying lemurs, and primates. The genus *Purgatorius*, first described by Van Valen and Sloan in 1965, has uniquely similar, but more primitive, dentition than all known living and fossil primates, and it has long been touted as the ancestor of all primates. However, fifty years since its discovery, its status and classification remain questionable, with recent cladistical analyses placing *Purgatorius* outside of the primates alongside the condylarths *Protungulatum* and *Oxyprimus* (Wible *et al*. 2007).

The problem is that the fossil record of *Purgatorius* was hitherto restricted to teeth and jaw fragments, but Chester *et al*. describe ankle bones from the 65 Myr old Garbani Channel fauna of Montana (the same sediments that have yielded abundant dentitions over the past half century). The paper includes some beautiful Micro-CT scans of ankle bones that differ significantly from those of *Protungulatum* and *Oxyprimus*, and appear to derive from a much more mobile taxon. The authors attribute these bones to *Purgatorius* based on size and diagnostic euarchontan and plesiadapiform (closely related, or ancestral to the primates) features, and on the lack of other euarchontans at Garbani Channel (a circular argument?). Incorporating these "first nondental remains" into three independent phylogenetic analyses lends new support to a primate affinity for *Purgatorius*, thus confirming its status as the "geologically oldest primate".

The enhanced mobility that *Purgatorius*' ankle bones afforded it suggests that arboreality played a key role in earliest primate evolution. Thus, the major radiation of angiosperms in the Late Cretaceous and earliest Palaeocene of the North American Western Interior provided a suitable habitat for the leaping, grasping *Purgatorius*, and access to resources that were simply out of reach for its contemporary, *Protungulatum*. Chester *et al*.'s study goes to show that half a century of poking around for old bones in the unpromising-sounding Garfield County, allied with cutting-edge palaeontological techniques, can yield exciting knowledge about our own primitive ancestors.

David Bond
University of Hull

REFERENCES

CHESTER, S. G. B., BLOCH, J. I., BOYER, D. M. and CLEMENS, W. A. 2015. Oldest known euarchontan tarsals and affinities of Paleocene *Purgatorius* to Primates. *Proceedings of the National Academy of Sciences*, **112**, 1487–1492.

VAN VALEN, L. and SLOAN, R. 1965. The earliest primates. *Science*, **150**, 743–745.

WIBLE, J. R., ROUGIER, G. W., NOVACEK, M. J. and ASHER, R. J. 2007. Cretaceous eutherians and Laurasian origin for placental mammals near the K/T boundary. *Nature*, **447**, 1003–1006.

New ichthyosaur named after Mary Anning

Nigel Larkin (who prepared the specimen) and Dean Lomax examine the new species of ichthyosaur. The specimen is now on permanent display in the Doncaster Museum. Photo courtesy of Dean Lomax, used with permission of Doncaster Museum and Art Gallery.

In 2008 I rediscovered an ichthyosaur specimen at the Doncaster Museum that had been hidden away for almost 30 years, misidentified as a plaster copy. I identified that it was from the Pliensbachian stage of the Early Jurassic and represented the world's most complete Pliensbachian ichthyosaur. Teaming up with Prof. Judy Massare (New York, USA), we determined it had unusual features and, following four years of extensive research examining over a thousand ichthyosaur specimens, determined that the Doncaster specimen was a new species (Lomax and Massare 2015).

Four additional ichthyosaurs were referable to the new species and we looked at ontogeny and sexual dimorphism in more detail. The latter included comparisons with other groups of reptiles (extinct and extant) whose humerus bones are different between males and females, something that had never before been applied to ichthyosaurs. We suggest that it may be possible to differentiate between males and females, at least in this species.

This is the first valid new species of the genus *Ichthyosaurus* in almost 130 years; the last being described in 1888. We named the new species *Ichthyosaurus anningae* in honour of early fossil collector Mary Anning, who worked tirelessly to bring the ichthyosaurs, among other fossils, to the attention of the scientific world.

Dean R. Lomax
University of Manchester/Doncaster Museum and Art Gallery

REFERENCE

LOMAX, D. R. and MASSARE, J. A. 2015. A new species of Ichthyosaurus from the Lower Jurassic of West Dorset, England. *Journal of Vertebrate Paleontology*. DOI: <**10.1080/02724634.2014.903260**>.

New stegosaur for the NHM

In December 2014, the Natural History Museum in London (NHM) unveiled its latest dinosaur acquisition: a specimen of *Stegosaurus stenops* that is the most complete of its kind. Only the left arm is missing, while some vertebrae at the base of the tail and a plate were destroyed during discovery. The specimen, nicknamed Sophie, is on permanent display at the Earth Galleries entrance. In contrast to most of the specimens in the Museum's dinosaur gallery, all of the original bones are on display with the exception of the skull, which is a cast of the original, and a few foot bones.

Sophie the new stegosaur. Image copyright NHM.

Although *Stegosaurus* is one of the most iconic dinosaurs, its fossils are surprisingly rare and very few remains are anywhere near complete. Two other specimens of *Stegosaurus stenops* rival Sophie in completeness, but both are 'roadkill' specimens, meaning they are flattened, obscuring many anatomical details. Furthermore, the skulls of these specimens, although complete, are preserved in articulation and the sutures are obscured, meaning that some aspects of the skull anatomy of *Stegosaurus* have remained a mystery.

I first came across Sophie in 2005 while studying in the Sauriermuseum, a private museum in Switzerland run by Kirby Siber, whose team aided in the excavation of the specimen and also prepared it. I got to examine the specimen and quickly realized that it was entirely unique, preserving not only a complete set of plates and spines, almost the entire postcrania in three dimensions, but also a complete, disarticulated skull. I was delighted and very excited, therefore, when Paul Barrett at the NHM told me that he was attempting to acquire the specimen for the Museum, in order that this important fossil could be in the public domain. Due to a number of generous donations, the Museum was able to purchase the specimen in 2013.

Sophie arrived at the NHM over a year ago, in late 2013. Since then, Paul Barrett, Charlotte Brassey and I have been working on a number of projects to help us better understand stegosaurian palaeobiology. Aside from new anatomical descriptions, the first on *Stegosaurus* for 100 years, we have produced a 3D model of the skull and entire skeleton, and are carrying out bite force and body mass modelling. We're carrying out some computational fluid dynamics on the plates to test hypotheses about whether stegosaurian dermal armour could have been used for thermoregulation, and we're also modelling fore- and hind-limb locomotor muscle moment arms in 3D to better understand locomotion in stegosaurs.

Sophie is not only a great display specimen, with the potential to excite and inspire the thousands of children who come through the NHM's doors each year, but is also shedding new light on the palaeobiology of these iconic yet enigmatic dinosaurs.

Susannah Maidment
Imperial College London

The Palaeontological Association Funding and Information for PhD students

The Palaeontological Association is an international charity that exists to promote the study of palaeontology and allied sciences through publications, sponsorship of meetings, provision of web resources, and a programme of annual awards and grants.

Membership is open to all, but subsidised for students, for whom it costs only £15 per year. In return, you will receive the Association's Newsletter, online access to the Association journals *Palaeontology* and *Papers in Palaeontology*, a discount on other publications (*e.g.* field-guides), and eligibility for Association awards and grant schemes. The Association provides particular support for postgraduate students through:

Small Grants Scheme
Grants of up to £1,500 are available to students wishing to undertake clearly defined research projects. These may be used to augment PhD studies, although a case for why funding cannot be obtained from existing project monies must be made. The deadline is 1st November.

Postgraduate Travel Fund
Grants of up to £200 are offered to postgraduate student members for travel to international meetings not directly supported by the Association. Apply online at least two months before the meeting.

Progressive Palaeontology
Progressive Palaeontology is an annual Association-supported conference run by PhD students for PhD students. It provides a forum for postgraduates in palaeontology to meet their peer-group, obtain experience with presentations, and discuss their projects with the community. Progressive Palaeontology normally takes place in April or May, and registration is free.

Subsidy of Other Meetings
The Association subsidises international palaeontological meetings which postgraduate students are likely to attend; these subsidies are often used to reduce student registration or accommodation costs.

Outreach Events
The Association participates actively in many outreach activities (*e.g.* the Lyme Regis Fossil Festival and British Science Festival); there are many opportunities for student involvement in these events.

Annual Meeting and Prizes
The Association's flagship Annual Meeting is a major international conference in December with several hundred delegates. Registration is subsidised for students, and contributions to travel costs may be made for students giving a presentation who are based overseas. Presentations are given by palaeontologists at all career-stages, but postgraduate students wishing to present talks and/or posters are prioritised. The President's Prize (best presentation) and Poster Prize are awarded to PhD students or early-career postdoctoral researchers at each meeting; these prizes provide peer-recognition and a cash sum of £200.

See <**www.palass.org**> for further information. including details of and eligibility for grants and awards.

From our Correspondents

Legends of Rock

Miss Phillips the trowel-blazer

This September, after a successful debut – and thanks to the generous support of the Association – the Yorkshire Fossil Festival (<**www.yorkshirefossilfestival.org**>) is returning to Scarborough, and the picturesque grounds of the town's wonderful Rotunda Museum.

The Museum was built to a design suggested by a local resident, a certain William Smith, and the 2015 Festival will celebrate the bicentenary of the publication of Smith's extraordinary map. As palaeontologists we should make sure to emphasize the primacy of his astute and judicious use of fossils.

Smith's nephew, John Phillips, is less well-known, at least to the public, but was arguably an even more important figure, rising from a position as his uncle's orphaned apprentice to become the first keeper of geology at the Yorkshire Museum and, later, a professor at Oxford. He too was a palaeontological pioneer, most notably with his biostratigraphic definition of the Paleozoic, Mesozoic and Cenozoic eras.

There is, however, a third member of the family whom almost no-one has heard of, yet one who also caught the geological bug in a remarkable way. We don't know a great deal about Anne Phillips – William's niece and John's sister – but from what little we can currently determine, she too was a precocious Earth scientist.

Celebrating geology in Yorkshire provides a fine opportunity to appraise Anne's life, as she lived much of it in the county, in York, as John's housekeeper, and is buried in the city alongside her brother.

The Philips' grave in York cemetery.

The grave is very simple and unassuming. One might be consequently misled into thinking the persons interred beneath it were just ordinary citizens. We've known for some time that John Phillips was nothing of the sort and, as Tori Herridge and I explained on the Trowelblazers website (<**http://trowelblazers.com/anne-phillips/**>) last year, geologist and science writer Nina Morgan has shown that this isn't true of Anne either.

Morgan has spent many years transcribing John Phillips' letters to his sister, and has published two popular accounts highlighting their correspondence (Morgan 2006; 2007). As a result of her work, the extent of Anne's contributions to geology has begun to come to light.

The only surviving photograph of Anne is from 1860, but as the library that owns it wanted £55 for it to be reproduced here, I'm afraid I have politely declined. Thankfully, the portrait is reproduced on the Trowelblazers website. It was taken just two years before Anne's death, so might not capture Anne in her prime, but she certainly has a look of quiet determination.

In her 2007 article for the Geological Society, Nina Morgan focuses on Anne's contributions to her brother's research, and it makes her importance abundantly clear. John was unstinting in his adoration for his sister. In a letter from 1838, quoted by Morgan, John tells Anne: "Whatever I possess is as much yours as mine, for without you I should not have won it."

We don't currently know a great deal about Anne's life. She was three years younger than John and became her uncle's ward along with her brother when they were orphaned as young children, but what limited information we have indicates a scientist of intellect and rigour. This can be demonstrated from Anne's most notable geological achievement: proving Sir Roderick Impey Murchison wrong about the origins of the Malvern Hills in Worcestershire.

Murchison – a man rarely short of bold opinions – had argued that the hills were created by an igneous intrusion into Silurian sediments. As the period's progenitor, Murchison was always keen to claim Silurian territory. John Phillips had other ideas, interpreting the sedimentary succession as having been deposited *after* the igneous rocks had formed, but it took Anne to prove that this was the case.

In 1842, with John working in Worcestershire, Anne moved to the area for a few months. With John otherwise engaged, she carried out her own reconnaissance of the region. In Lower Dingle Quarry, Malvern, Anne located an outcrop that yielded a sedimentary rock containing marine fossils, along with fragments of the igneous hills. This proved that the intrusion had indeed happened first – in the Precambrian, we now know – and had been followed later by the weathering and deposition of sediments. The rock that wronged Roderick became known as Miss Phillips' Conglomerate; it soon became a site of geo-pilgrimage.

Trying to find the famous lithology now is tricky, as John Payne's paper for the Herefordshire & Worcestershire Earth Heritage Trust makes clear:
<**http://www.geo-village.eu/wp-content/uploads/2013/01/PAY07.pdf**>
<**http://www.geo-village.eu/wp-content/uploads/2013/01/Miss-Phillips-Figures.pdf**>

I recently visited The Dingle, briefly, on my way to a wedding in Worcester, hoping to find an outcrop. My appreciation for Anne's geological detective skills was rubber-stamped: I could only locate igneous rocks and a bus stop.

The bus stop at Lower Dingle.

It is likely that Anne did a good deal more geological research, but little investigation has been carried out. If you fancy addressing this with a bit of digital rummaging, the Oxford University Museum of Natural History has recently finished digitizing the William Smith Archive, which can be explored online. A letter from uncle to niece is even quoted on the front page: <**http://www.williamsmithonline.com/catalogue/index.html**>.

Their next digitization project will be to get John Phillips' own archive – which is vastly larger than Smith's – online too. Within this, there are more than 230 letters from brother to sister, which Nina Morgan has examined and interpreted. Sadly, Anne's letters to John have not been found, but Nina hopes a dusty case will turn up one day in the attic of the Oxford Museum. If it ever does, maybe then we'll begin to get a fuller picture of Anne, her life in Yorkshire, and the pioneering work she carried out in the early years of British geology.

If not though, just come up to Scarborough via Malvern in September and you can at least follow in the footsteps of the foremost family in 19th Century geology.

Liam Herringshaw
Publicity Officer

REFERENCES

MORGAN, N. 2006. Anne Phillips and the Mystery of the Malverns. *Geoscientist,* **16**, 6–15.

MORGAN, N. 2007. Anne Phillips: John Phillips's geological companion. *Geological Society, London, Special Publications*, **281**, 265–275.

Behind the Scenes at the Museum

Fossils at the Nottingham Natural History Museum, Wollaton Hall, UK

Wollaton Hall is a magnificent Elizabethan mansion surrounded by 500 acres of deer park on the outskirts of Nottingham (Figure 1). Built in 1588 for the Willoughby family, the building has been home to the Nottingham Natural History Museum for almost a century and houses one of the largest provincial natural history collections in the UK (~750,000 specimens). Since appearing prominently in the film 'The Dark Knight Rises' (2012), the building has also become known to some as 'Wayne Manor'. However, Batman and other previous inhabitants aside, the most well-known current resident is a gorilla named George, one of the oldest artefacts in the collection and the museum's mascot.

Figure 1. Wollaton Hall, an Elizabethan mansion built in 1588, and home to the Nottingham Natural History Museum geology collection since 1926. Photo by Adam S. Smith, used with permission of Nottingham City Museums & Galleries.

Nottingham Corporation established the Natural History Museum in 1867, and the nucleus of the collection was material transferred from the Nottingham Naturalist's Society and the Mechanics Institution. The resulting Nottingham Free Museum opened to the public (in cramped conditions) at Wheeler Gate in 1872. Here, Robert Etheridge Snr of the Geological Survey named and systematically arranged the fossils, a portion of which were also purchased from him.

Additional fossil material was acquired between 1877 and 1880 with the intention of displaying it in more spacious accommodation in the new Nottingham University College buildings being built in central Nottingham. The new museum displays opened to the public in 1881, and several more important geology collections were acquired throughout the 1880s under the

curatorship of the Rev. J. F. Blake, Professor of Natural History at the University and a geologist by training. Blake's successor, Prof. J. W. Carr (also a geologist), continued to donate material to the Museum, including specimens he had collected himself. Carr arranged the fossils on display in the University College building, but eventually, demand for teaching and lab space led to a large portion of the natural history collection being transferred to other less accessible buildings. In 1925, Nottingham City Council purchased Wollaton Hall and park, into which the geology collections were moved in 1926, and they have remained there ever since.

In the 1990s and 2000s an exhaustive specimen database and retrospective accession register were created. The fossil collection consists of approximately 40,000 objects including a small number of type specimens. It contains a taxonomically and stratigraphically diverse array of mostly British material. Notable portions of the collection include Pleistocene mammals, Jurassic marine reptiles, Permo-Triassic footprints, Coal Measures plant fossils and Silurian invertebrate fossils.

Many of the Pleistocene mammal remains belong to local cave faunas. A large donation of material from Creswell Crags was received in the 1870s from Rev. J. M. Mello, who directed the excavations of the cave deposits there. A collection of about 170 mammal bones from Steetley Wood Cave, near Worksop, Nottinghamshire, was received in 1926.

Marine reptiles from the Lower Jurassic (Lower Lias) and Middle Jurassic (Oxford Clay) are well represented, including several partial skeletons of ichthyosaurs, plesiosaurs and crocodiles. Some of these are locally significant, such as the small partial plesiosaur skeleton (NOTNH FS3455) from Cropwell Bishop, south Nottinghamshire, collected and donated by W. Stafford in 1884 (Figure 2).

Figure 2. Partial plesiosaur skeleton (NOTNH FS3455) from Cropwell Bishop, Nottinghamshire. The head is a model and other missing parts are indicated by white paper cutouts. These, along with the small blue plesiosaur model, are part of a student video project to reconstruct the animal. Scale bar in cm. Photo by Adam S. Smith, used with permission of Nottingham City Museums & Galleries.

A strong collection of local Permo-Triassic footprints includes several type specimens, although these ichnotaxa are considered invalid today. *Chelichnus hicklingi* (NOTNH FS13249), a trackway from Mansfield, Nottinghamshire, was the first reptilian footprint trackway to be discovered

in the Permian of the Midlands. Several footprints collected by Prof. H. H. Swinnerton from a temporary exposure of Middle Triassic Sneinton Formation in the Mapperley Park area of Nottingham were donated to the Museum in 1971. Among this material, the apparently three-toed holotype of '*Swinnertonichnus mapperleyensis*' (NOTNH FS12398), originally thought to have been made by a small theropod dinosaur, was later re-identified as part of a *Chirotherium* print modified by erosion.

Coal Measures fossils, including some from Wollaton Park, are also well represented in the collection. *Caudatocarpus monospora* (NOTNH FS3486) was erected based on a lycopod cone from the Upper Carboniferous of Pleasley, Derbyshire.

Hundreds of Silurian Wenlock Limestone fossils from the Dudley area were amassed by E. J. Hollier and purchased from him in 1896. One controversial specimen is a trilobite, described as a new species with eye-stalks, '*Calymene ceratophthalma*' (NOTNH FS4053) (Figure 3). In all other regards this specimen is identical to the common *Calymene blumenbachii* and alternative explanations for this unusual 'eye-stalked' morphology have since been suggested. Perhaps the 'stalks' are really the cephalic border of a second specimen, or maybe the specimen has been artificially modified.

*Figure 3. The holotype of '*Calymene ceratophthalma*' (NOTNH FS4053) with controversial 'eye-stalks', from Dudley, West Midlands. Scale bar is 10 mm.*
Photo by Adam S. Smith, used with permission of Nottingham City Museums & Galleries.

Today the Nottingham Natural History Museum continues to promote its fossil collection as a resource for education and research. Fossils contribute a relatively small part of the current public displays but it is intended that they play a more significant role in future exhibitions. Inquires are welcomed and research visits to the collection can be arranged by appointment.

Official web page:

<**http://www.nottinghamcity.gov.uk/article/22178/Wollaton-Hall-and-Park**>

Follow Nottingham Natural History Museum's mascot, George the Gorilla, on Twitter:

@george_gorilla

Nottingham Natural History Museum's Facebook page:

<**https://www.facebook.com/nottingham.natural.history.museum**>

Adam S. Smith
Collections Access Officer (Natural History)
<adam.smith@nottinghamcity.gov.uk>

Change in the Air

Where to begin the story of blood rain, if not with an evil star? The expedition of Heinrich von Minutoli – traveller, Orientalist, and a persuasive man in the company of kings – was undoubtedly ill-fated. Bankrolled by Friedrich Wilhelm III and the Prussian Academy of Sciences, the expedition arrived in Egypt in 1821, seeking antiquities. Some seventeen-strong, it included a couple of promising young scientists, Christian Gottfried Ehrenberg and Wilhelm Hemprich, both of whom were seeking adventure and knowledge. They found both, and tragedy too.[1]

A few months later, the expedition had collapsed in fever-stricken Alexandria, with several members dead. Von Minutoli had already abandoned it to pursue his own travels through Egypt. Ehrenberg, ill with typhus, was nursed back to health by Hemprich. Once recovered, they set off together on their own five-year odyssey – a story that has never been properly told – through the Nile Valley, Nubia, the Red Sea, Syria, Lebanon, and Arabia. In Abyssinia, typhus struck again, and Hemprich, by now physically exhausted, died. Ehrenberg was the last surviving scientist of von Minutoli's expedition, and the spirit of adventure, for now, had left him. He set off back to Berlin, and never found the heart to systematically study the 114 crates that contained the 80,000 scientific specimens that Hemprich and he had collected. He left that to others. Instead, he set off into the world of the very small.

In truth, he had resided in that world for quite some time. As a student, working on his thesis on the fungi of Berlin, he saw that they reproduced via tiny spores, and so were not "spontaneously generated" from rotting vegetation, as people then thought. In his epic journey to the East, he found time to study the tiny "animalcules" that teemed in the waters of the Mediterranean, the Nile, and the Red Sea. In 1829, he focused on these tiny organisms, too, as he travelled

[1] See the Ehrenberg website: <**http://palynology.org/christian-ehrenberg**>.

through Russia with Alexander von Humboldt and Gustav Rose. This was a much better planned expedition, held up as a model of its kind – though Alexander Herzen noted mischievously that one of the main dangers to scientific progress was the well-meant, if excessive, hospitality of their Russian hosts (Naumann 2007). Ehrenberg marvelled at the complexity shown by these organisms (to a fault, indeed, as he inferred within them nervous and digestive systems akin to those of higher animals) and by their ubiquity, present and past. The Chalk, he said – a stratum one kilometre thick – was literally made up of the skeletons of such creatures. They had fallen to the sea floor in countless numbers, over countless years, in ages past: the grains of this rock had once been alive. He realized, too, that these skeletons could occupy other realms. They could take to the air.

The news reached the pages of the *Nelson Examiner* and *New Zealand Chronicle* of Rorahi XX11, Putanga 9, 28 Kohitatea (in the Maori calendar) of the year 1863. It had taken something over fifteen years to cross the world from Berlin, where Professor Ehrenberg had made a report to the Academy of Sciences on blood rain that had fallen on Lyon. Blood rain, now, had been described from the times of Homer and Pliny. Such occasional showers of red-coloured rain had generally been taken to be falls of *real* blood – and hence a warning from the heavens, and a portent of bad things to come.

Ehrenberg's interpretation brought the blood rain to Earth. It was, he said, African dust from the trade winds that had fallen with the raindrops, and this dust contained forty-three organic species that "leave no room to doubt of its origin." The brief summary from the Antipodes was worth waiting for. It gives the story in a nutshell, as an executive summary for modern times.

Ehrenberg's own account was published as *Passatstaub und Blutregen* in 1847. It is an altogether richer, even mysterious, concoction, written to be mused on in a less frantic age than now. Lyon's violent windstorm of 17th October 1846 is described from correspondence sent to him with a sample of the dust. The dust had covered the passing postage-carts "one or two lines high," having fallen amid dark skies "of frightening appearance," wind in "stifling blows," and horizontal bolts of lightning "of astounding strength." These had so maddened the migrating birds that they – blackbirds, fieldfares, nightingales, flycatchers – could easily be caught. It is a melancholy footnote to a natural phenomenon: a tiny but distressing human impact, the Anthropocene in microcosm.

The grains of dust, to Ehrenberg's microscope and questing eye, yielded no less than seventy-three species. He referred many of these to the polygastrica, an antique category acting as a catch-all for the infusoria, which in itself simply means any microscopic aquatic animal or plant. Most, with names like *Campylodiscus*, *Eunotia*, and *Pinnularia*, are diatoms, those water-dwelling single-celled algae that make themselves silica skeletons, which look rather like microscopic hatboxes – though the kind of hatbox, all intricate patterning, that only the most exclusive of Parisian milliners would dare use. There was *Gallionella*, an iron-oxidizing bacterium, too. There were phytoliths, little silica particles secreted in the tissues of grasses, that Ehrenberg (though few after him) made something of a study of: in the Lyon dust among these he identified six species of *Lithodontium* and sixteen of *Lithostylidium*. There were a few species he classified within the polythalamia, that we would now call foraminifera, single-celled amoeba-like protozoans that live in the sea and secrete a tiny, many-chambered limy shell in which to live.

These tiny skeletons of plants and animals made up twelve per cent of the little packet of dust he had been sent. Where had they come from? Here, Ehrenberg is, at some length, enigmatic. One supposes with hindsight that some (the diatoms, for instance) were blown from dried-up ponds, while the foraminifers are probably fossils, whipped up by the wind from some ancient rocky landscape. The dust itself? To Ehrenberg not typically African, but similar, he suggested, to dust that had fallen on Malta, Genoa, and the Cape Verde islands. Some elements, he thought, looked to be from South America.

Enigmatic, perhaps – but it was certainly the beginning of a new science, of aerobiology (Krumbein 1995). Ehrenberg could not have known that, but he knew the subject was important. A few years before, he had analysed curious "paper meteorites" that were generally considered to have fallen from the heavens. No, he said, they are just leathery-textured, dried-up microbial mats from some distant shoreline, up to hundreds of kilometres away, that had been carried high and far by the winds. He thought disease-causing microbes – and life-giving nutrients, too – could be dispersed by the wind, and tried to work out the amount of dust that, over millennia, may accumulate on each square metre of the Earth's surface. He cited historical figures as far back as Cicero, Plutarch and Homer who had wondered at this phenomenon – and began *Passatstaub und Blutregen* by quoting Darwin, and his account of dust falling on to the *Beagle* in mid-ocean.

Today, the consideration of dust – alive or dead – is part of the business of working out how the Earth works. Aerobiology, now, is looking to realms even tinier than those ventured into by Ehrenberg – though, in that, there was his quirkiness, too, in reputedly never using magnifications greater than x300.[2] It is microbes and viruses, spores and pollen that are now the day-to-day fare of most aerobiological studies – and not just as sporadic accidental passengers caught up in a gale. Microbes would have been borne on the winds ever since the dawn of life perhaps four billion years ago, and this surely would have been a key factor in the way these organisms spread across the planet. There is talk now among aerobiologists of an "atmosphere biome" – a specific global ecosystem far above our heads where the tiniest life-forms are present in enormous numbers – up to one hundred million in each cubic metre of air – and which metabolize, and maybe multiply, too (Morris *et al.* 2011).

These organisms carry out work up in the sky. They influence the shape of the clouds – sometimes in an extraordinarily specific way. Take *Pseudomonas syringae*, for example. It is a type of gram-negative bacterium – that is, one that has thin cell walls – and is not the most common microbe in the air. But, its airborne forms have the remarkable ability to cause ice to nucleate around it – and these act as seeds for moisture droplets. This living grain, therefore, is a cloud-maker. Even more interestingly, not all ground-based forms of *Pseudomonas syringae* seem to show this ice-nucleation property, suggesting that the wind-borne type is as adapted to the air as is an albatross or a swift, and that it is firmly at home in its "atmosphere biome." Quite what advantage it obtains from this arrangement is unclear. But, given that clouds are the great wild card in the Earth's climate control (do they help warm the planet, or cool it?), *Pseudomonas*

[2] A rather more serious eccentricity, and one that has affected Ehrenberg's reputation in modern times, was his resistance later in life to Darwin's evolutionary theory – even while quoting Darwin in that first sentence of *Passatstaub und Blutregen* (over ten years before the publication of *Origin of Species*, one must remember), and corresponding at length with him. Microfossils, Ehrenberg said, did not evolve. Well, those were early days, and we now know that microfossils provide some of the most beautiful examples of evolution in the whole of palaeontology or – as Darwin put it (he did not use the word "evolution" himself) – of "descent with modification."

syringae, for all its microscopic size, might be a significant engineer amid our planet's command-and-control systems.

To a geologist, wind-blown dust can be tricky, evasive, anonymous stuff – often infuriatingly so – even when it is just made up of tiny mineral grains, rather than comprising bacteria transported through the atmosphere. When dust falls into the ocean or into a lake, it hides amid other fine-grained material brought in by storms or sea currents. In the resulting rock stratum one cannot generally tell what has come in by water and what has arrived from the air. Only when the amount of wind-blown dust overwhelms the other sediment sources does it show itself clearly, and then this is always – *almost* always – a phenomenon described as from the land.[3]

Loess, the stuff is called. It is made of the fine silt grains that are carried by strong winds from barren icy landscapes in glacial times, to cover the neighbouring lands. In central China, loess forms a blanket extending over half a million square kilometres, swept in by winds from the frost-shattered and glacier-ground Himalayan Mountains. It makes for excellent soil, when tended well (and Chinese farmers have been nurturing the loess soils for over a millennium). It has a darker side, though: when an earthquake strikes, loess turns into something like a choking granular liquid, drowning farm and farmer alike. It is a complex and fascinating phenomenon, this, driven by a combination of millions of collisions within the moving mass, and suspension of grains in air engulfed by the onrushing flow. It has some parallels with what happens inside the frightening volcanic phenomenon known as a pyroclastic flow – and it can be as deadly.

In such terrain, a latter-day Ehrenberg might put both utility and hazard aside to calculate how much dust has fallen on to each square meter of ground. The calculation, here, is easy. The Chinese loess is up to 100 metres thick and started forming two and a half million years ago, when the great Northern Ice Ages began. That is a millimetre every two and a half years, on average. Perhaps a little slower than Ehrenberg's original reckoning, but nevertheless, over time – over geological time – the grains build up.

They build up so well, indeed, that people these days play different games with the loess strata. They are one of the great archives of Ice Age history, sensitively recording changes in climate. In the bitterly glacial times, the loess swept in and piled up, while in the warmer interglacial episodes – like today – the dust-supply slowed, and rich soil formed on the land surface, which bore lush vegetation. The superimposed loess and soil deposits are a barcode, betraying the passage of the many passing warm and cold phases of past climates.

The finest grains can travel farther still, to the ends of the Earth. They make particularly eloquent patterns when they come to rest with the almost eternal[4] snows of Antarctica. The four kilometre-thick ice cap of this continent is the harshest place on Earth, and has only recently begun to yield its secrets to human explorers. Drill through the ice and one can recover almost one million years' worth of snow layers. They tell stories even more remarkable than those of the Chinese loess – not least, about dust.

[3] The Soom Shale, perched dramatically atop Table Mountain in South Africa, is an exception. Nearly half a billion years old, it is the remains of a dead, stagnant sea floor where individual layers of wind-blown dust can be clearly recognized. The incoming dust probably over-fertilized the waters, making the sea floor uninhabitable, which in turn set the scene to preserve the carcasses of strange, primitive, drifted-in creatures – guts, eyes, muscles, and all. It is a kind of fossilized Aladdin's cave, with dust grains at the heart of this extraordinary local alchemy. The whole story is in Gabbott *et al.* 2010.

[4] Thirty-three million years, in this case, from the tumultuous beginning of the Oligocene epoch.

The ice layers show quite clearly that the coldest times of Ice Age Earth were also – by far – the dustiest and therefore, too, the driest (Liu *et al.* 2013). In glacial phases, the amount of dust reaching the ice cap could be more than fifty times that during warm phases, vivid testimony to the freezing, arid, windblown landscapes that then spread over the world. The rises and falls in the dust content of the ice layers, every few tens of millennia, are regular, almost like clockwork. They show beautifully how finely balanced the Earth system was during the Ice Ages, as it reacted to (and indeed, amplified) slight, regular changes in the Sun's light and warmth caused by minute variations in the Earth's spin and orbit. Ehrenberg, one suspects, would have been enthralled at the delicate planetary machinery revealed thus, by his beloved dust grains.

If enthralled by the day-to-day workings of the Earth machine, Ehrenberg would have been entranced by its occasional outbursts – that could shower the Earth with the microscopic diatoms that he himself became so adept at recognizing and classifying. The force, here, came from deep within the Earth.

Taupo volcano in New Zealand does not have the renown of Vesuvius or Krakatoa. Nor does it look much like a volcano. It is now a lake, about forty kilometres across. Yet it marks the caldera, or collapsed crater, that was left after the most powerful volcanic eruption of this geological age: the Oranoui eruption which, 25,400 years ago, spread something like one thousand cubic kilometres of ash and debris over much of New Zealand's North Island. The volcano before the eruption also possessed a large crater lake – and volcano lakes are splendid breeding grounds for diatoms, because they possess both nutrients and silica in large amounts. When Taupo erupted, much of the lake was blown into the sky, along with the diatom layers that had built up on its floor. As the ash cloud moved across the island, ash and diatoms fell out, to drape landscape and sea floor alike.

The ash, looked at by the eye of a scanning electron microscope, contains the elaborately sculptured skeletal remains of diatoms, in prodigious amounts: they average some ten *million* per gram. The diatoms alone in the deposit amount to over half a cubic kilometre in volume (Van Eaton *et al.* 2013). The diatoms, therefore, in that single ash layer, are present in literally cosmic amounts. Lay them end to end (they are each about one-hundredth of a millimetre across, by the way; this is a job only for the exceedingly patient) and they would stretch for something of the order of 500 light-years, which is far enough to reach to the gigantic,[5] garnet-red dying star in our galaxy that is Mu Cephei. It is a measure of biological richness (and also of how grain numbers may translate when stretched from three dimensions into one).

Among those countless erupted diatoms, could some stay alive – survive the heat, the shock, then the freezing temperatures, desiccation, and ultra-violet irradiation of the stratosphere – then to colonize some distant island? The answer to this is a cautious "maybe." (Pike 2013) It is a question that Ehrenberg would have been very alive to, as he himself wondered whether disease-causing bacteria could be spread by the winds. He might have been amused that such mysteries could persist over generations, and remain obstinately unsolved.

Passatstaub und Blutregen was written 167 years ago. A lot has changed since then. The mass of humanity has grown five-fold, while our use of energy has grown twenty-fold. In the approximately one-sixth of one-thousandth of one million years (and a million years is the

[5] Mu Cephei's diameter is roughly equivalent to the orbit of Jupiter around the Earth's Sun.

smallest of change as regards Earth history) since that publication, the geology of our planet has changed permanently and indelibly. When Paul Crutzen proposed the term Anthropocene to highlight this shift in Earth state (Crutzen 2002), he focused on the extraordinary changes to the gases in our atmosphere. But, the very dust grains in the air have changed, too.

The change is too bewilderingly various to list, or categorize. Humans release dust from the fields that they till, from the urban landscapes that they construct, from factory chimneys, from the quarries that they carve into hillsides, from the forests, and from the fuels that they burn. Some – such as the soot (black carbon) from fossil fuels – falls on to polar ice, darkening it. The darker ice absorbs more of the sun's rays, and melts more easily. Part of the melting of global ice that is helping push up sea levels, now, by some three millimetres a year, is because of black carbon that has travelled through the air to the polar regions. The situation is bad, but is not hopeless. It is easier to control emissions of black carbon than of carbon dioxide. Perhaps the skies can be made cleaner, and a little cooler.

In all, perhaps a quarter of the dust in the air is human-produced – more in some countries than in others. It can be a difficult thing to measure, for not all human-produced dust comes with a "made by people" stamp on it. Some does, though. And it can help feed an ocean – and might even lock some of humanity's extra carbon away.

Burn coal or oil, and the hydrocarbons convert into invisible carbon dioxide gas, to release the energy to power our lives. Within those fuels, though – particularly in coal – there are mineral particles that do not burn. Rather, they melt, and produce tiny glassy spheres that ascend with the smoke. Fly ash, it is called, and it might be thought to be grain, vapour and ray all in one: it is the mineral component of smoke. Years ago, these minute spherical grains were released from every factory chimney, and made skies grey with smog. These days, they are mostly caught within the chimneys and buried underground – or used, to bulk up concrete, for instance. But, there is a great deal of this stuff generated each year – almost a billion tons. Inevitably, some is still released into the winds, to travel far and wide – as far as the oceans.

In those oceans, there is life, and that life depends upon the plankton that grows in the surface layers, and that plankton in turn needs feeding. Of all the nutrients present in seawater, the one often in shortest supply is iron – and this therefore limits the amount of life that those oceans can support. Much of the fertilization of the oceans is by the very dust that caught Ehrenberg's attention – and Darwin's too – for the colour of the blood rains is due to iron oxides in the dust, whether from the deserts of North Africa (the Sahel is a notable generator of such grains, today) or of Asia or Australia.

For the plankton of the ocean, though, the blood-red colour represents a chemical deception: much of that iron might as well not be there. Those iron oxides in the dust are well-nigh insoluble, and are therefore unavailable to living organisms. Only about one per cent can be absorbed by the plankton, to help their growth. The iron in loess-type dust from glacial regions is a little better, with some two per cent of it available to help the living ocean. Fly ash, though, is so different that it could be dust from another planet: the iron within it is almost all in a highly soluble form, as a sulphate salt: more than seventy per cent can be released to the iron-hungry organisms. These particular human-made dust particles, therefore, are a fertilizer rich enough to modify the carbon cycle within an ocean (Schroth *et al.* 2009). If they help grow carbon that

can then sink to the sea floor, to be buried in the ocean floor muds, they might help protect humanity from the worst consequences of its excesses. This would be more by happy accident than by design, true, but then every little piece of serendipity is welcome, as the waters rise around us.

How might the dust grains of the world change, as the world itself changes into whatever we happen to make of it, in our uncertain future? Predictions are always dangerous, but perhaps the black carbon of combustion can be curbed, just as the fly ash mostly has been. This would make sense, for it would protect human lungs as well as global shorelines. Then, those extraordinary ice cores tell us that warmer worlds are wetter, less dusty worlds. Well, this tendency has to compete with the human tendency to trail plumes of dust from farms and building sites. The balance, here, may be a delicate one.

In Homer's *Iliad*, Zeus, the god of sky and thunder, sent blood rains as a warning of slaughter in battle. We live on a more crowded world, but perhaps a gentler and less warlike one. Even as the dust soars high above us, we may study it as a measure of the world's behaviour, as Ehrenberg did, rather than invoke it in strife.

Jan Zalasiewicz
University of Leicester

Originally published in Katrin Klingan *et al*., *Textures of the Anthropocene: Grain Vapor Ray* (MIT Press, 2015).

Reprinted with permission from Haus der Kulturen der Welt.

REFERENCES

CRUTZEN, P. J. 2002. Geology of Mankind. *Nature* **415**, 23.

GABBOTT, S. E., ZALASIEWICZ, J., ALDRIDGE, R. J. and THERON, J. N. 2010. Eolian input into the Late Ordovician post-glacial Soom Shale, South Africa. *Geology* **38**, 1103–1106.

KRUMBEIN, W. E. 1995. Gone with the wind – a second blow against spontaneous generation: In memoriam, Christian Gottfried Ehrenberg (1795–1876). *Aerobiologia* **11**, 205–211.

LIU, Y., SHI, G. and XIE, Y. 2013. Impact of dust aerosol on glacial–interglacial climate. *Advances in Atmospheric Sciences* **30**, 1725–1731.

MORRIS, C. E., SANDS, D. C., BARDIN, M., JAENICKE, R., VOGEL, B., LEYRONAS, C., ARIYA, P. A. and PSENNER, R. 2011. Microbiology and atmospheric processes: research challenges concerning the impact of airborne micro-organisms on the atmosphere and climate. *Biogeosciences* **8**, 17–25.

NAUMANN, F. 2007. Alexander von Humboldt in Russia: The 1829 Expedition. *Geological Society, London, Special Publications* **287**, 161–175.

PIKE, J. 2013. Of volcanoes and diatoms. *Geology* **41**, 1199–1200.

SCHROTH, A. W., CRUSIUS, J., SHOLKOVITZ, E. R. and BOSTICK, B. C. 2009. Iron solubility driven by speciation in dust sources to the ocean. *Nature Geoscience* **2**, 337–340.

VAN EATON, A. R., HARPER, M. A. and WILSON, C. J. N. 2013. High-flying diatoms: Widespread dispersal of micro-organisms in an explosive volcanic eruption. *Geology* **41**, 1187–1190.

Making your publications count

The total number of articles published each year continues to grow rapidly. At the same time, academic researchers face increasing pressure from funders and institutions to justify their position by making their published output count. Unfortunately, each year large numbers of published papers remain uncited and largely unread simply because their potential readers are unaware of their existence. According to a 2013 survey by Kudos, a web-based service created to help researchers increase the impact of their published articles (more on this later), a large majority of researchers across a wide range of academic disciplines felt not only that more could be done to raise the profile of their work, but also that this was the responsibility of the authors themselves <**http://tinyurl.com/kudos-interview**>. As well as working to make the Wiley Online Library (which hosts all *Palaeontology* and *Papers in Palaeontology* papers published by the PalAss since 1999) more visible, Wiley has created an online resource of tools and advice for authors to help them promote their own work. These are freely available at <**http://exchanges.wiley.com/authors/promo**>.

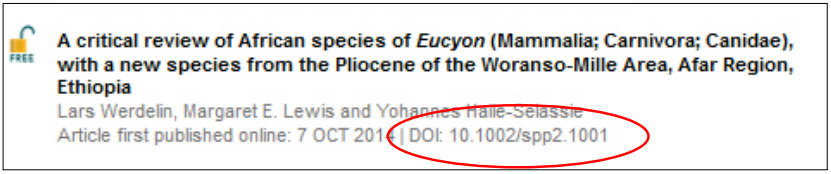
Search engine optimization (SEO)

Every day, the leading search engines such as Google crawl literally billions of websites using complex algorithms to guess which websites users are looking for. Search engine optimization (SEO) is the process of tailoring a website or page to ensure that it is indexed correctly by search engines, so that it will appear high on a user's search results list. Even before an article is published, authors are strongly encouraged to consider how the title, abstract and keywords that they choose might be made more attractive to these 'spiders' or 'robots'. At one time we were advised that keywords had a specific purpose, and certainly should not include words from the title of the paper. Things have changed. Search algorithms are continuously improved and, as a result, the current advice is that keywords should be repeated often, even in the title, so that the key aspects of the work are made obvious to the indexers.

Another factor that search engines consider is the number of in-bound links to a page. It is therefore important that when your paper is published, you add a link to your personal website, that of your group and any other relevant community. However, not all in-bound links are considered equal; institutional websites are particularly favoured, but be careful about adding too many reciprocal links, as Google is less keen on these.

Whatever your views on Wikipedia, it is one of the first places that many people look to for information. Are there any pages on relevant topics where you could add content and a link to your article?

When you link to your article, always use the DOI (digital object identifier) as this creates a permanent link, even if the page on which the paper is stored changes, or an online publication is updated to a final issue format. All DOIs can be resolved using the form: http://dx.doi.org/xxxx. The DOI should be prominently displayed on the first page of the paper, or on the journal webpage, for example:



In this case, the relevant link would be: <**http://dx.doi.org/10.1002/spp2.1001**>.

Social media

When you submit a paper to *Palaeontology* or *Papers in Palaeontology* you are asked to summarise the content of your article in 100 words or less in plain language aimed at the general reader. This is made available to Wiley for marketing purposes, but we also use it to tweet about every paper as soon as it is published. Authors are encouraged to do the same to spread the word. Kudos recommends that authors should tweet about their article two or three times in the week following publication, and then monitor and respond to any discussion. Following authors whose work you cite may encourage them to do the same for you.

For those who like to keep up with statistics, all Wiley publications now come with an Altmetric score displayed next to the online abstract, and a link to any papers that cite this article:

Altmetric collects data and links to the paper from social media sites, blogs, newspapers and magazines.

Using the press

Does your institution have a press or comms team? If so, send them details of your paper including the lay summary that you wrote on submission. An impact statement, detailing who might benefit from your findings and how, would also be useful. If you feel that your article is

particularly newsworthy, Wiley will also organise a press release; please raise the issue with me (by e-mail to <**editor@palass.org**>) when your paper is accepted, or use Wiley's online form at <**http://tinyurl.com/Wiley-form**>.

Kudos

Earlier, I briefly mentioned Kudos, which was created to provide tools for researchers, their institutions and publishers, to measure and increase the impact of their papers: <**http://tinyurl.com/kudos-interview**>. This service is currently freely available to researchers, who can register at <**https://www.growkudos.com/**>, and encompasses much of what has been discussed here. It begins with simple advice, such as anecdotal evidence that articles with shorter titles are read more, so authors should avoid very long titles containing highly technical terms where possible.

In 2013, 150,000 papers from three major publishers (AIP Publishing, the Royal Society of Chemistry, and Taylor and Francis) were loaded into a test site and randomly assigned to either a control or a test group. Kudos monitored usage data (citations and Altmetric scores) for the control group. Authors in the test group received an e-mail inviting them to beta test the Kudos tools. The response was rapid and impressive. In the first 24 hours, 1,000 authors signed up, and eventually 5,500 were involved. At the end of the pilot, Kudos reported a 19% higher rate of daily downloads of articles in the test group over those in the control group; see <**http://tinyurl.com/Kudos-pilot**>.

To conclude

Whether we like it or not, the face of publishing is changing – although this is nothing new. There are now so many journals out there that we have to shout about our content to make sure it is found and used. PalAss and Wiley will both continue to do our best to produce high-quality publications and to promote your work, but we also need your help.

Sally Thomas
Publications Officer
<editor@palass.org>

>>***Future*** Meetings of Other Bodies

"Planktic gastropods: biology, ecology and palaeontology" in association with the Malacological Society of London
The Natural History Museum, London *1 April 2015*

To register your interest in presenting a talk, please contact Deborah Wall-Palmer (e-mail <**deborah.wall-palmer@plymouth.ac.uk**>).

7th International Brachiopod Congress: The Brachiopod World
Nanjing, China *22 – 25 May 2015*

The theme of the Congress will be "The Brachiopod World". Scientists around the world who are interested in fossil and living brachiopods and related topics are invited to attend. The Congress venue will be the Nanjing International Conference Hotel in the vicinity of Nanjing City proper, at the foot of the beautiful Purple Mountain, where more than 200 heritage and scenic tourist sites are located together with more than 620 species of vascular plants.

The Congress will include keynote speeches, scientific sessions, posters, pre- and post-conference field excursions. Within the four-day indoor meeting, all of our distinguished colleagues will have opportunity to refresh, update, and exchange their knowledge on Brachiopoda and related areas. As always, the Congress will bring internationally known scientists together to share experiences and ideas on the latest developments of brachiopod study.

For further information, please see the conference website: <**http://www.7ibc.org/**>.

Palaeozoic Echinoderm Conference
Zaragoza, Spain *14 – 21 June 2015*

This Conference will celebrate the career of Dr Andrew Smith, a world-renowned specialist in echinoderms who retired in late 2012.

The Conference will focus on Palaeozoic echinoderm communities; presentations will review the current state of knowledge for a range of groups, highlighting recent advances and identifying topics of uncertainty and possible future research paths. There will be short workshops on Spanish fossil material and new analytical techniques, and a field trip will take place close to Zaragoza (Iberian Chains) and in the north-western part of Spain, between the cities of León and Oviedo (Cantabrian Mountains).

For further information, please see the conference website:
<**http://progressinechinodermpalaeobiology.blogspot.com.es/**>.

12th International Symposium of Antarctic Earth Sciences (ISAES)
Goa, India *13 – 17 July 2015*

The International Symposium of Antarctic Earth Sciences (ISAES) in Goa, India, has several sessions relevant to palaeontologists. In particular, session 20 "Break up of Gondwana and Vertebrate evolution" and session 21 "Key drivers of Antarctic biodiversity through the Cenozoic: the influence of climate, oceanography and tectonics".

For further information please see the conference programme: <**www.isaes2015goa.in/program.php**>.

STRATI2015: 2nd International Congress on Stratigraphy
Graz, Austria *19 – 23 July 2015*

The Congress is open to all topics in stratigraphy. The technical programme will range from the Archean to the Holocene, cover all techniques and applications of stratigraphy, and discuss discoveries that the stratigraphical record reveals about the Earth system. In addition, it will serve as the primary venue for International Union of Geological Sciences (IUGS) business, for International Congress on Stratigraphy (ICS) sub-commissions, and for the award of ICS stratigraphy prizes.

There will be a range of pre- and post-conference field-trips and a variety of social activities will be offered. Funds will be available to support travel expenses for students. Application information will be posted on the Congress website.

Please see the website for more details where registration is now open: <**http://strati2015.uni-graz.at**>.

5th Polar Marine Diatom Workshop
Salamanca, Spain *19 – 24 July 2015*

The Polar Marine Diatom Taxonomy and Ecology Workshops represent a community-led initiative to provide international polar diatom researchers with an opportunity to interact and discuss topical issues and new results that bear on recent and future research activities in the polar regions. Workshops have a strong focus on the Neogene to Recent time period and on taxonomic issues toward standardization of terminology and identifications. Workshops are interactive with dedicated microscope-based taxonomy sessions.

Workshops allow students and early career researchers to interact with, and receive training and advice from, leaders in the field and, as such, researchers at all stages of their careers are encouraged to attend.

Please check the website for updates (<**www.polarmarinediatomworkshop.org**>) or e-mail María Angeles Bárcena for more information (<**mbarcena@usal.es**>).

Systematics Association Biennial Meeting
University of Oxford, UK *26 – 28 August 2015*

This three-day meeting will take place in The University Museum of Natural History and the Department of Zoology, with accommodation available in historic Christ Church College.

There is an exciting programme including both plenaries and thematic symposia, as well as contributed sessions. Scheduled symposia include:

- The value of long-term monitoring plots for plant systematics and ecology in the tropics
- Comparative approaches to the origin of biodiversity
- Accelerating the pace of taxonomy
- Rooted in deep time: Palaeontological contributions to systematics

Abstract submissions for contributed talks and posters are open until 1st July 2015.

Please check the Systematics Association website at <**http://systass.org/biennial2015/**> for updates.

Flugsaurier 2015, The International Meeting of Pterosaurology
University of Portsmouth, UK *26 – 28 August 2015*

In 2015, Flugsaurier, the International Meeting of Pterosaurology, will be held in the United Kingdom for the very first time. Flugsaurier 2015 will be held at the University of Portsmouth in conjunction with the Symposium of Vertebrate Palaeontology and Comparative Anatomy which will be held afterwards in Southampton.

Please see the meeting website for more information: <**http://flugsaurier2015.com/home.html**>.

Anyone who would like to be included on the mailing list should contact Dr Dave Martill (e-mail <**david.martill@port.ac.uk**>).

The Annual Symposium of Vertebrate Palaeontology and Comparative Anatomy
National Oceanography Centre, Southampton *31 August – 3 September 2015*

The meeting will be preceded by Flugsaurier 2015 (to be held in Portsmouth). Pre-conference field-trips are planned, in conjunction with Flugsaurier, to visit the famous Jurassic coast in Dorset on 29–30 August. A post-conference field-trip on 4th September will follow the formal SVPCA sessions.

Please check the website for updates, at <**http://svpca.org/years/2015_southampton/index.php**>.

Climate impacts, ecosystems and evolution – from deep time to the future
Durham University, UK *3 – 6 September 2015*

This multidisciplinary conference will be both inclusive and substantive, involving biologists, geologists, geographers and palaeontologists, addressing research questions over different timescales – decadal, multi-decadal, millennial or tens of millennia to millions of years in deep time.

The Conference will provide a unique platform to present a range of research cultures and topics linked to the common challenges of understanding the impact of climate change on ecosystems throughout geological time.

The Conference is held in association with the Climate Impacts Research Centre and will be hosted at Van Mildert College, Durham University.

To register your interest, please visit <**www.dur.ac.uk/circ**>.

Advanced Course in Jurassic–Cretaceous–Cenozoic Organic-Walled Dinoflagellate Cysts
Heidelberg, Germany *13 – 19 September 2015*

The course will focus on morphology, stratigraphy and palaeoecology. An excursion will take you to the UNESCO World Heritage site at Lake Messel quarry, an Eocene lake deposit. Following the course there will be a special workshop in which the latest developments on Arctic and Nordic dinocyst biostratigraphy will be presented.

Please see the website for further information: <**www.lpp-foundation.nl**>.

RALI 2015: an international conference on the Rise of Animal Life: Cambrian and Ordovician biodiversification events
Marrakesh, Morocco *5 – 9 October 2015*

More than 500 million years ago the emergence of animals marked a turning point in the evolution of life on Earth, giving rise to present-day biodiversity and ecosystems. This international conference will focus on this crucial event, especially its timing, possible processes and causes, with special emphasis on the relationships between the Cambrian Explosion and the subsequent Great Ordovician Biodiversification Event.

The Conference will be held in the captivating city of Marrakesh, offering an ideal setting for this scientific gathering. A special symposium dedicated to aspects of promoting geological heritage will be held in conjunction with the Conference and will highlight associated educational, cultural and socio-economic issues. A post-conference field-trip offers participants the opportunity to visit fossil localities near Zagora, where the Lower Ordovician Fezouata Biota was discovered.

Conference booking is now open at <**http://www.fstg-marrakech.ac.ma/rali2015/**>.

7th International Conference on Fossil Insects, Arthropods and Amber
National Museum of Scotland, Edinburgh *26 April – 1 May 2016*

This is the first time that this Conference will be held in the UK. It will consist of three days of talks on fossil non-marine arthropods (especially insects) and the scientific study of amber, plus two optional one-day field-trips.

To be added to the mailing list for the 1st circular, please e-mail Dr Andrew Ross (<**a.ross@nms.ac.uk**>).

14th International Palynological Congress and the 10th International Organization of Palaeobotanists Congress (IPC XIV/ IOPC X 2016)
Salvador, Brazil *late September – early October 2016*

Local organizers are planning the Congress to occur after the Olympics in Brazil. Further details to come.

DINO11
EPOC Laboratory, Bordeaux University, Bordeaux, France *2017*

Further details to come.

Please help us to help you! Send announcements of forthcoming meetings to <**newsletter@palass.org**>.

Meeting REPORTS

58th Annual Meeting of the Palaeontological Association
University of Leeds, UK *16 – 19 December 2014*

The 58th PalAss Annual Meeting took place at the University of Leeds, 21 years after the University had last hosted the meeting, so it was a very timely reunion. This year's meeting was notable both for the variety of topics covered and the high standard of the contributions. With 70 talks and 100 posters, there was plenty to interest experienced researchers and to inspire budding palaeontologists alike. Events kicked off with a symposium entitled "The photosynthesis revolution: how plants and photosynthetic micro-organisms have bioengineered the planet". Attendees were introduced to major themes running throughout palaeontology, such as the limits of the fossil record, the use of modern analogues to understand extinct organisms, and the way in which geochemical evidence can aid palaeontological research.

Topics covered ranged from cyanobacteria and the Great Oxidation Event, phytoplankton in the fossil record, and the spread of vegetation on land, to the ecophysiology of early land plants and the rise of angiosperms. "Photosynthesis, of course, is what makes the world go round", were **Nick Butterfield**'s opening words when he addressed the audience during his talk on photosynthesis in Proterozoic oceans. He went on to explore the idea of one-off evolutionary singularities such as the evolution of oxygenic photosynthesis. He spoke of the fossil record of cyanobacteria, noting that "the oxidation of water is as close as you get to magic in the natural sciences: cyanobacteria are the only guys that did it". Shortly afterwards, **David Beerling** gave a fascinating talk on trees and forests and their role as geoengineers of past and future global climates; in particular, he explored different ways of artificially accelerating the sequestration of fossil fuel CO_2 emissions, such as enhanced weathering through the distribution of pulverized silicate rocks over tropical land. Simulations show that this could help mitigate climate change as well as protect coral reefs from ocean acidification.

The Annual Address, given by **Alan Haywood**, was entitled "Understanding ancient Earth climates and environments using models and data". It emphasized the importance of integrating data in models and also served as a very clear introduction to models as a whole, challenging common misconceptions and also introducing some new modelling approaches. This took us up to the icebreaker reception, which was in the impressive and iconic Parkinson Building at the entrance to the University. We enjoyed a fantastic buffet and drinks while getting to catch up with old friends and colleagues.

The second day of palaeontological enterprise and the start of the Conference proper, consisting of both oral and poster sessions, kicked off with the theme of mass extinctions. Topics ranged from the role of microbial anaerobic respiration in the end-Permian mass extinction to new data on the K–Pg (Cretaceous–Palaeogene) mass extinction using fauna from Antarctica. In the same session, **Nick Longrich** introduced us to the fossil record of an intriguing group of animals known as worm lizards, in the context of the K–Pg mass extinction.

Icebreaker reception in the iconic Parkinson Building. Photo courtesy of Anthea Lacchia.

Next followed a series of talks on fossil wood, pinecones and fungi, as well as spores and pollen. **Alexandra Lee**'s talk, which focused on models for habitat preferences of early angiosperms, compared evidence for an understory habitat versus exposed habitat and concluded that they occupied a wider range of environments than previously thought. Talks on vertebrate evolution, the dietary evolution of whales, the palaeoecology of brachiopods, turtle diversity and the Cambrian diversity explosion, were just a few of the wide-ranging topics in the next sessions, prior to the AGM and Annual Dinner.

Poster session. Photo courtesy of Anthea Lacchia.

Palaeo Ale from Leeds Brewery at the poster session. Photo courtesy of Tom Fletcher.

The Leeds City Museum provided a very picturesque setting for the dinner and prize-giving ceremony. During the AGM, **David Harper** was welcomed as the new president of the Association, having taken over from **Mike Benton**. The President's Medal was awarded to **Philip Donoghue** for his outstanding contribution in the field of palaeontology, while the Mary Anning Award, which recognizes the contribution made by someone not employed in palaeontology, went to **Christoph Bartels**, who is responsible for the modern investigation of the Hunsrück Slate biota. **Maria McNamara** was the recipient of the Hodson Award for her many achievements at an early career stage, including her pioneering use of innovative techniques in the field of taphonomy. **Richard Fortey** was the recipient of the Lapworth Medal, which honoured his large body of research and major contribution to the field of palaeontology. As well as being famous in scientific circles, Fortey is well-known for his popular science books such as *Trilobite!*, and for his work on TV and other media, which not only popularizes fossils but continues to inspire generations of palaeontologists, some of whom were in attendance during the ceremony and took the opportunity to meet and congratulate him.

The annual dinner at Leeds City Museum. Photos courtesy of Anthea Lacchia.

The third and final day of talks saw the attendees split into two parallel sessions. **Andy Gale** gave an account of the phylogeny of barnacles and **Richard Twitchett** spoke about the origin and evolution of foraging behaviour. **Paul Wignall** presented evidence concerning the little-known Middle Permian mass extinction and **Emily Mitchell** showed how the use of spatial analysis suggests a stolon-like reproductive mode in *Fractofusus*, an Ediacaran macroscopic fossil. **Dieter Korn** presented a refined ammonoid biostratigraphic scheme for the end-Permian sections in Iran, also showing correlations with Chinese successions. Other topics included early ray-fin evolution in fish, dinosaur body size, the evolution of biomineralization, and crustaceans.

The meeting ended with a prize-giving ceremony that saw **David Button** win the prize for best talk for his presentation on character evolution in the Sauropodomorpha. Three other talks were highly commended: **Alexandra Lee**'s on early angiosperms, **Robert Goodhall**'s on dietary evolution in Archaeocete whales, and **Tom Merrick-Fletcher**'s on the evolution of speed. From among the many posters, two winners were chosen: **Jennifer Hoyal Cuthill**'s on fractal models used to better understand Ediacaran fauna, and **Edine Pape**'s stable isotope investigation of chemosymbionts through geological time. Two other posters were highly commended: **Javier Ortega-Hernández**'s on the homology of cephalic sclerites in Burgess Shale euarthropods, and **Thomas Hearing**'s on the exceptional preservation of a Burgess Shale-type arthropod from the Middle Ordovician of South Wales.

The meeting was not quite over yet: those attending the field-trip gathered the next day, on a sunny, ice-cold winter's morning, to depart for the North York Moors, where Oxfordian (Upper Jurassic) Corallian outcrops awaited! Despite the early-morning start, around fifty delegates joined our valiant leaders, **James Witts** and **Crispin Little**, on the coach bound towards Betton Farm, near Scarborough. Cris gave voice to the landscape as we drove through it, explaining the geology behind vale and dale. The Vale of Pickering is underlain by easily erodible Jurassic, whereas the Yorkshire Wolds beyond lie on Cretaceous chalks, the two separated by a sharp scarp.

Upon arrival at Betton Farm, we were greeted by Avis Turner (MBE). The charity she set up, Basics Plus, runs the farm and does tremendous work employing local people with special needs. After a brief overview of the local geology, we were set loose in the long-abandoned quarry on the farm premises, our destination for this first part of the trip. The quarry has a peculiar shape, with small hollows separated by curving ridges, creating quite a warren. A possible reason for this would soon become clear. As we set about exploring the quarry searching for fossils, the structure of the reef became apparent. Ribbon reefs are identifiable by mounds of *Thamnasteria* corals, forming the main ridges which run across the quarry. Between these, exquisite spiral gastropods and spines of *Nenoticidaris smith* were visible. To one side of the quarry, the fore-reef talus yielded coral fragments, echinoderms and abundant gastropods, these filled with drusy calcite. To the other side of the quarry, micrite yielded palm-sized, intact shells of the gastropod *Bourgetia saemanni*, echinoderms *Hemicidaris* cf. *intermedia* and *Pseudodiadema* sp., as well as a smattering of *Modiolus* sp. bivalves. Behind this, lagoonal facies were small patch reefs housing *Thamnesteria* corals and many of the suspects already identified. It seems that those quarrying this ancient lagoon dug around the more resistant patch reefs and comparatively well lithified micrite, and removed the intervening limestone. Once our exploration of the quarry was complete, we sat down to a delicious barbecue prepared by Avis and her team, warmed by a cosy bonfire and festive mulled wine. It is not every day that you get to barbecue in winter sunshine whilst sitting in a fossil lagoon!

Comfortably warmed by the wine and food, we returned to the coach for a sleepy journey to the next locality, Ravenswick Quarry. Although much of this quarry is comparatively poor in fossils, certain horizons are truly worth the visit! Branching, *in situ Rhabdophyllia phillipsi* form the framework for the upper beds exposed in the quarry, with the intervening spaces filled by numerous spines of the iconic *Paracidaris florigemma* echinoid. A short hop on the coach later, we reached our final locality for the day, Spaunton Quarry. Here, the shape of the quarry was less obvious than in the previous localities, as it ringed a large sheep-filled field (a novelty to some of the delegates who come from less agricultural homesteads). The much darker grey, inter-reef limestones had a deceivingly Carboniferous feel, comprised as they were of echinoderm fragments, but the diagnostic

The field-trip to North Yorkshire: barbecue in the tropical Jurassic in December; Rhabdophyllia phillipsi *in Ravenswick Quarry; Spaunton Quarry. Photos courtesy of Jo Hellawell.*

Paracidaris florigemma spines revealed their late Jurassic age. The hunt for rare ammonites from this locality sadly yielded but a few rather unimpressive fragments. Those who ventured to the far side of the quarry encountered more intact fossils in the patch reefs, which repeated the gastropod and coral theme which had dominated the day.

We thank the organizers, **Crispin Little** and **Fiona Gill**, for a truly wonderful meeting. See you in Cardiff!

Anthea Lacchia
Trinity College Dublin

Charlotte Kenchington
University of Cambridge

The Old Red Sandstone: is it Old, is it Red and is it all Sandstone?
Elim Church Conference Centre, Brecon, Wales *3 – 5 October 2014*

This Symposium brought together stratigraphers, sedimentologists, palaeontologists, palaeobotanists and palinologists from countries spanning the globe, including Britain, Canada, Australia and France. The Forest Fawr Geopark covers the western half of the Brecon Beacons National Park and is underlain by a large outcrop of Old Red Sandstone. As most recent studies of the Old Red Sandstone in Wales and the adjacent English borderlands have concentrated on the outcrops in south Pembrokeshire, the Geopark management proposed to hold a symposium on the Old Red Sandstone in order to encourage workers to investigate the large and little-known outcrops in and around the Geopark. The symposium was organised and run by a committee consisting primarily of members of the Geologists' Association South Wales Group, but with financial support from the Palaeontological Association and the Geologists' Association (London), and was held at the Elim Church Centre in Brecon, Powys.

The meeting consisted of three lecture sessions followed by a public open afternoon and a day of field-trips. Following a Keynote Address by Prof. **Brian Williams** on the first day, there followed two sessions, the first focusing on a review of the Old Red Sandstone and the second on Palaeontology. The first session contained papers by **Anthony Brook** on the contrasting careers of Roderick Murchison and Hugh Miller, **Tony Ramsey** on the geological, industrial and cultural heritage of the Geopark, and **Toby Driver** on Old Red Sandstone landscapes from the air.

After lunch, the palaeontological session concentrated on the fish and plants. In Alain Blieck's absence, **Carole Burrow** delivered his and David Elliot's paper on pteraspidomorphs. This was followed by **Michael Newman** on whether there was evidence from fish fossils to suggest that the Scottish Lower Devonian Old Red Sandstone was a separate realm or whether it was connected to the Anglo-Welsh Basin. Next **Susan Turner** looked at bone-beds, age control, palaeobiogeography and the diversity of fish micro-vertebrates. Our attention then moved to terrestrial habitats, with **Jennifer Morris** bringing us up to date with recent advances into our understanding of the colonisation of the Old Red Sandstone continent, followed by **Christian Baars** looking at the environmental effects of early land plant evolution on atmospheric CO_2 levels.

Following the formal part of the day, delegates moved to the Castle Hotel for a bit of rest and relaxation before the conference dinner where brains were required again when Duncan Hawley entertained us with a quiz about the Old Red Sandstone and especially dates of its appearance on maps *etc*.

The morning of the second day consisted of a session on the sedimentology and stratigraphy of the Old Red Sandstone in south Wales. **Duncan Hawley** kicked off with a review of the Old Red Sandstone in the Black Mountains and Herefordshire, and was followed by **Geraint Owen** who looked at soft-sediment deformation structures and their nature and implications. After coffee **John Davies** looked at the identification of mappable lithostratigraphical sub-divisions of the Brownstones, and the session was rounded off by **Kate Andrew** and **Elliot Carter** looking at a thousand years of building with Old Red Sandstone.

The afternoon consisted of outreach events, including two walks to examine the local Old Red Sandstone building stones, led on behalf of the Welsh Stone Forum by John Davies and Jana Horak. Other events consisted of two presentations by Kester and Elizabeth Webb on The Hidden Edge of Exmoor, displays of low-level aerial photographs and topographical drawings, posters and displays from a range of societies (both local and national), book sales, the creation of an Old Red Sandstone mural with children, and the launch of Dilys Harlow's book *The Land of the Beacons Way* that provides a geological description of this long-distance footpath.

The final day consisted of two full-day field excursions. One, led by **John Davies**, examined the lithostratigraphy of the Brownstones around Fan Fawr and Blaen Llia, while the other – led by **Duncan Hawley** – examined some of the classical faunas and ichnofaunas from Cockett Hill, Tredomen and Tremynfa quarries.

The Symposium was deemed to have been a great success and it was generally felt that a similar one should be arranged in the not-too-distant future. It is intended that a symposium volume of the papers delivered and the posters be produced in due course. The organisers would like to thank the Palaeontological Association for its generous financial support and also the organisations that

took part. These included the Geologists' Association, The Geologists' Association South Wales Group, The Open University Geological Society, the Teme Valley Geological Society, The Mid-Wales Geological Society, the British Geological Survey, Amgueddfa Cymru – National Museum Wales and the Forest Fawr Geopark.

John Davies
Fforwm Cerrig Cymru – Welsh Stone Forum

Delegates on John Davies' excursion to Fan Fawr following the Brownstones Succession up Nant Gerdiden. Photo courtesy of John Davies.

Delegates on Duncan Hawley's excursion in Trefonen Quarry, an exceptional faunal locality. Photo courtesy of John Davies.

——OBITUARY——

Martin David Brasier 1947 – 2014

Photo courtesy of Alexander Brasier and Derek Siveter

Martin Brasier was a leading palaeobiologist of his time, and Emeritus Professor of Palaeobiology in the Department of Earth Sciences, Oxford. He was best known internationally for his research in the fields of the origin of life, the early history of the biosphere, and the Cambrian explosion event. His contributions to our discipline covered a much wider range than even those broad topics, extending, for example, from publications on living foraminiferids, to the interpretation of isotope values in Eocene gastropods, and to a facies study of the Yorkshire Jurassic. A tragic car accident which took his life has prevented what he doubtless still intended to be, in the 'retirement' phase of his career, a time of scientific inquiry and productivity.

Martin spent much of his career investigating the palaeobiology of deep geological time, though initially he was drawn to looking at living communities. He began his doctoral research in 1969, and within a year this involved him acting as ship scientist aboard HMS *Fawn*, charting and sampling modern Caribbean reefs and lagoons. This led to his thesis on the distribution and ecology of foraminifera from the waters around Barbuda. On many an occasion thereafter, he drew on his experiences of investigating such living microfossil, sea-grass and mangrove communities, when investigating associations much more ancient. His studies on modern forams also led him in the early 1980s to develop an objective approach to the study of foram architecture and evolution (the MinLOC and PI methods), resulting within a few years in a spate of publications on this and related themes.

Meanwhile, Martin had already moved down the length of the stratigraphical column to research archaeocyathids and cherts at various Cambrian localities; the early Cambrian skeletal fossil record and palaeoenvironment of central England; an important Precambrian–Cambrian section in Spain; and the nature of the early Cambrian facies transgression across western Europe. He underscored his name as a Cambrian (as well as microfossil) researcher at this still relatively early stage of his career when in 1979 he organized with Michael House, at Hull University, the Systematics Association Conference on the 'Origin of major invertebrate groups', and in the special volume of the same name he gave a detailed account of the Cambrian radiation.

Martin's interest in microfossils was highlighted by the publication (1980) of his *Microfossils* book. It became the recommended text for countless students in the UK and abroad, providing them with their introductory training in micropalaeontology (a revised second edition, co-authored with Howard Armstrong, appeared in 2005). This volume proved of particular use just a few years afterwards, when together with Hull colleague and ostracod expert John Neale, they set up a successful MSc course in micropalaeontology.

He also played a part in the early development of the then British Micropalaeontological Society (BMS), now The Micropalaeontological Society (TMS), when from the mid-1970s to the mid-1980s he served successively as Foraminifera Group Secretary, BMS Newsletter Editor, and Foraminifera Group Chair. He also co-edited, with John Neale, a book on *Microfossils from Recent and Fossil Shelf Seas* (1981), a compendium of British micropalaeontological research at that time, and which was used later as a template for BMS occasional publications.

Martin began his fascination with the natural world, and matters widely historical, from the time of his schoolboy background in Colchester. At the grammar school there, he opted for botany, zoology and chemistry before university, while in his spare time (sometimes with elder brother Clive, who himself had a career as a microbiologist with the Forestry Commission), he investigated Romano-British remains and associated stratified deposits in Essex and East Anglia. After graduating with a first from Chelsea College London (1969), his doctorate (1972) was undertaken at UCL with Tom Barnard as supervisor.

There followed in quick succession positions as Micropalaeontologist at the Institute of Geological Sciences (now British Geological Survey), and a temporary lectureship at Reading where Martin stood in for and briefly came under the influence of Roland Goldring. In 1974 he joined the Hull University Geology department that Michael House was beginning to build up, achieving a Readership there in 1986. Martin was in his element in the field, for example when he was interpreting all manner of rock-faces on student excursions. Week-long visits to examine the Palaeozoic geology of Pembrokeshire, or the Jurassic palaeoecology of the Yorkshire coast (the finale always being a driftwood barbecue on the beach), were hugely enjoyed by all.

Martin remained in Hull until Margaret Thatcher's re-organisation of UK Earth Science departments saw his rising palaeobiological reputation recognised, and a move followed (1988) to the Department of Earth Sciences at Oxford. He was instrumental in setting up the palaeobiological laboratory there, an 'open-house' retreat for both the analysis of fossils and also the discussion of all matters concerning the fossil record, from the origin of life to exceptional preservation, or extinction events to high-resolution chemostratigraphical and imaging techniques. Martin was Tutorial Fellow in Earth Sciences (Palaeobiology) at St Edmund Hall Oxford for 24 years, over which time he guided hundreds of undergraduates, postgraduates and postdoctoral associates in their studies. He gained a Readership (for the second time) and became Professor (2003) of Palaeobiology at Oxford, and on his retirement (2014) became Emeritus Fellow of St Edmund Hall and Emeritus Professor of Earth Sciences.

During Martin's early years at Oxford he became more heavily involved in the International Geological Correlation Programme (IGCP) with respect to the Cambrian and late Neoproterozoic time periods. His expertise in this area saw many positions on international bodies come his way over the next decade or so. These included Voting Membership then Chairmanship of the International Stratigraphic Subcommision (ISS) on Cambrian stratigraphy; Secretary of the Working Group on the Precambrian–Cambrian boundary; Chairman and elector for the Precambrian–Cambrian boundary; Leader of IGCP Project 303 on Precambrian–Cambrian event stratigraphy; and most recently Voting Member of the ISS on Ediacaran stratigraphy. He was also a Visiting Professor at Memorial University, Newfoundland, and a sometime NASA Exobiology/Evolutionary Biology group member and a National Science Foundation (NSF, Washington) panel member.

During the last two decades Martin put his major research effort into the investigation of Proterozoic (especially Ediacaran) and Archaean life and environments. The suitability of pumice as a substrate for the origins of life, the Earth's earliest non-marine eukaryotes, metazoan evolution and Snowball Earth, and evolutionary relationships within the Ediacara biota, together with many other related topics, all came under his (and his co-workers') scrutiny during this time. Through his classical geological training, Martin promoted a critical geological as well as palaeobiological assessment of Earth's most ancient life, and in the process assembled around him in Oxford an associated and enthusiastic group of postgraduate and postdoctoral Precambrian researchers. In examining possible remains of early Achaean life, he strongly advocated mapping features and fabrics at micro and macro scales, the involvement of field observations, and the assiduous interpretation of petrographic thin sections. This approach led him (2002) to counter the idea that the 3,460 Ma Apex Chert in Australia contained the planet's oldest known organic remains.

Martin had a great sense of fun, which those who were associated with him or who saw him away from any formal academic platform will know. He was also talented in various areas that were removed from academic life. As a skilled piano player, he would need little excuse to improvise tunes, jazz-style, if there was an instrument to hand. On one occasion he played with band members of Stephan Grapelli's Hot Club of France, and several Christmas parties in the Oxford University Museum also come to mind. His son Alexander has recalled that there was a period when Martin seemed scarcely to go out without returning with a piano.

He built up a collection of early microscopes, including one used by the micropalaeontologist Joseph Cushman. This was not only because he had a keen interest in such things but, as he was always ready to indicate, producing good science needn't necessarily require having access to large sums of money: much could be achieved with a modest (these days) investment in a good microscope and imaging system. He had a collection of antiquarian books (for example by Hooke, and Darwin), and his interest in Romano-British archaeology led to a fine collection of coins and seals ("my pension pot" he used to say – unconvincingly so, as he would never sell them).

Martin published at least 160 papers (two out of the first ten were in the journal *Nature*). In recent years he also wrote two books – *Darwin's Lost World* (2009) and *Secret Chambers* (2012) – aimed at drawing the curious layman into the process of the discovery and nature of early life. He was delighted, in the late stage of his career, to be able to reach out to this wider audience, just as much

as if he had had a good paper accepted. His contribution to the Geological Sciences was recognized by the Geological Society of London in 2014, when it awarded him the Lyell Medal, and his scientific legacy will continue through the many young researchers he trained and inspired. Martin's great enthusiasm for his subject even spilled over into close family connections. There were early, joint publications with his wife Cecilia, who had also trained as a geologist and curator, and more lately with Alexander, now a lecturer in soft-rock geology in the School of Geosciences, Aberdeen. Martin is survived by Cecilia, sons Matthew and Alexander, daughter Zoe and two grandchildren. He will be greatly missed by all those who benefited from his guidance, expertise and warm friendship.

Derek Siveter
Oxford University Museum of Natural History

Acknowledgements. I thank the following, who in various ways provided assistance to me in connection with the compilation of this obituary: Jonathan Antcliffe, Alexander and Clive Brasier, Owen Green, Alex Liu, Latha Menon and David Wacey.

Martin at Mistaken Point, 2007. Photo courtesy of Alexander Liu.

Sylvester-Bradley REPORTS

The palaeontology and sedimentology of the Downton Bone Bed

Luke Hauser
School of Earth and Environmental Sciences, University of Portsmouth

Background

The Downton Bone Bed is a Silurian deposit dated to the Mid Ludfordian (late Ludlow), which occurs 1.5 m above the Ludlow Bone Bed. Despite its close proximity to this internationally famous bone bed, the Downton Bone Bed has received little attention over the last 175 years and is mentioned only briefly in the literature (Elles and Slater 1906; Turner 1973; Antia 1979; Dineley and Metcalf 1999). My PhD project involves the first systematic study of the Downton Bone Bed.

Fieldwork

The Downton Bone Bed is exposed in the disused Weir Quarry located near the Shropshire–Herefordshire border in the West Midlands of England. The funding received from the Palaeontological Association enabled three days of fieldwork to be undertaken at the site earlier this year. The aims of the fieldwork were to establish as far as possible the lateral extent of the bone bed at Weir Quarry (Figure 1) and to collect more samples for processing, especially for vertebrate remains.

Figure 1. A typical section at the disused Weir Quarry in Shropshire.

Preliminary results

So far only a small amount of the bone bed collected has been processed, but already the material that was recovered is showing promise as two genera of thelodont have been found, *Paralogania ludlowiensis* (Figure 2a) and *Thelodus parvidens*, as well another species of *Paralogania, P. tarranti*. Only one genus of acanthodian (*Poracanthodes porosus*) has been extracted as yet. Also recovered are a number of plant fossils such as *Cooksonia* sp. (Figure 2b). On the bedding surfaces many invertebrates have been found, such as the bivalve *Modiolopsis complanata* and the gastropod *Turbocheilus helicites*. Other bedding surfaces are covered by the moulds of ostracodes which remain to be studied, although two taxa have already been identified: *Londinia fissurata* and *Leperditia* sp. It appears that the environment in which the Downton Bone Bed formed was at times punctuated by storm events, as the deposition of the sediment seems to fluctuate between quiet conditions and high energy events. The horizons which appear to have been deposited rapidly are also where most of the vertebrate fossils are preserved. The aims moving forward are to complete the analysis of the vertebrates and to begin the investigation into the remaining groups, *i.e.* ostracodes and palynomorphs, as it is hoped that Downton will contain the same terrestrial taxa as seen in the Ludlow Bone Bed. By cataloguing the taxa present in the Downton Bone Bed it will fill in a gap in the British fossil record for the upper Silurian as well as enabling a high-resolution palaeoenvironmental analysis.

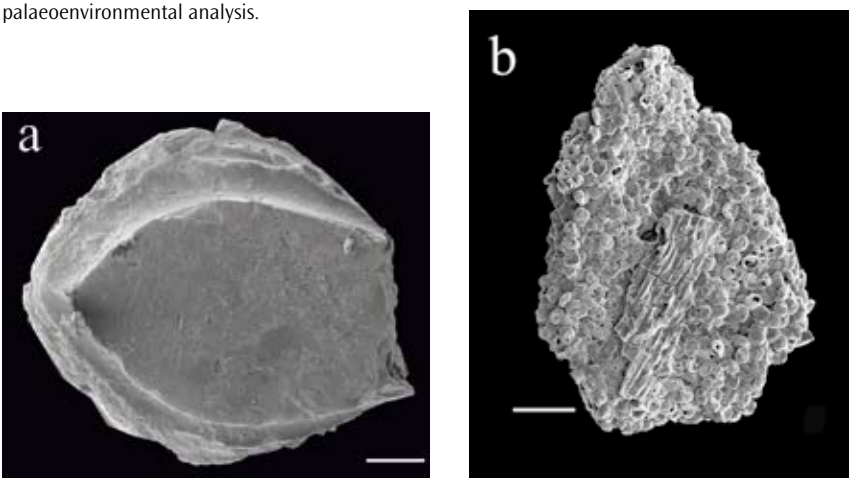


Figure 2. Two of the specimens recovered so far for this study from the Weir Quarry locality in Shropshire. a) Trunk scale of Paralogania ludlowiensis *and b) sporangium of* Cooksonia *sp., both from the Downton Bone Bed samples. Scale bars are 100µm.*

REFERENCES

ANTIA, D. D. J. 1979. Bone-beds: a review of their classification, occurrence, genesis, diagenesis, geochemistry, palaeoecology, weathering and microbiotas. *Mercian Geologist*, 7, 93–174.

DINELEY, D. and METCALF, S. 1999. *Fossil fishes of Great Britain*. Geological Conservation Review Series, No. **16**, Joint Nature Conservation Committee, Peterborough, 675 pp.

ELLES, G. L. and SLATER, I. L. 1906. The highest Silurian rocks of the Ludlow district. *Quarterly Journal of the Geological Society*, **62**, 195–222.

TURNER, S. 1973. Siluro-Devonian thelodonts from the Welsh Borderland. *Quarterly Journal of the Geological Society*, **129**, 557–584.

Taphonomy of dragonflies and damselflies (Insecta: Odonata) from the Crato Formation (Lower Cretaceous) of Brazil

Nathan Barling
School of Earth and Environmental Sciences, University of Portsmouth

Introduction

The Early Cretaceous Crato Formation is a world-renowned Konservat-Lagerstätte. It crops out along the flanks of the extensive Araripe Plateau in the northeastern states of Ceará and Piauí, Brazil. It yields an astonishingly diverse palaeobiota and is particularly well known for its fossil insects. This status is in part due to the age and location of the formation, as it represents a rare glimpse into a terrestrial Gondwanan ecosystem, during an important time in the co-evolution of insects and angiosperms (Hochuli *et al*. 2006). At least 20 orders of insects are known from the formation, and well over 350 fossil species have been described. Many of the insect fossils are remarkably well preserved (Barling *et al*. 2015), however, the vast majority of studies have focused on systematic palaeontology and the description of new taxa. The Crato Formation presents a unique opportunity to study many aspects of Cretaceous Gondwanan palaeoentomology and, in order to fully understand these insects, an understanding of their taphonomy is essential.

Dragonflies and damselflies (Odonata: Anisoptera, Zygoptera) are spectacular and ecologically important insects (Grimaldi and Engel 2005). They are habitat specialists with limited distribution ranges (Kalkman *et al*. 2008), although they are known to inhabit a variety of environments ranging from bogs to lush tropical forests, semi-arid scrublands, waterfalls, and even thrive in the arid centre of the Arabian Peninsula (Waterston and Pittaway 1991; Kalkman *et al*. 2008). The majority of odonates require a clean freshwater source for reproduction and, as such, are important environmental indicators for healthy freshwater ecosystems. There are approximately 6,000 modern species of Odonata and 700 fossil species described (Grimaldi and Engel 2005). Within the Crato Formation over 22 families with approximately 52 species have been recognised.

Aims

This study aims to provide an insight into the taphonomy of odonates and the taphonomic parameters controlling their preservation. The Odonata provide an excellent candidate for this study as their morphological diversity is relatively low, they tend to preserve dorso-ventrally, they are well-studied in the formation, and a large collection is available for study in the Staatliches Museum für Naturkunde, Stuttgart (SNMS). Thanks to a Palaeontological Association Sylvester-Bradley Award, I was able to travel to Stuttgart and study the collection there for a week.

Methods

The SMNS collection contains approximately 192 Crato odonate specimens, 16 of which were unavailable for study. I studied the remaining 176 specimens, 115 of which were imagines. Only imago specimens were included in the completeness coding, as their morphology, and subsequent taphonomy, differs drastically from that of the larvae. Additionally, larvae are particularly difficult to correlate with their adult counterparts and variations between ontogenetic stages make definitive

species placement difficult. Figure 1 provides examples of Crato Formation odonates with varying levels of completeness.

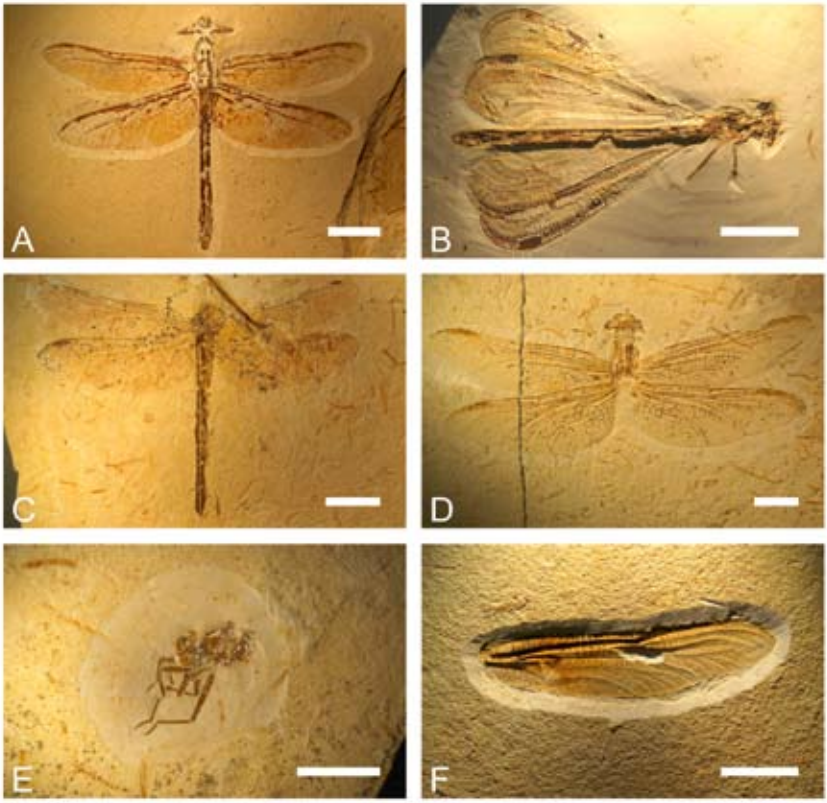


Figure 1. Representative Odonata from the Crato Formation displaying varying states of completeness and relief. Varying angles of light were used to highlight relief where present. A, complete undetermined taxa SMNS 64361; B, nearly complete Eucharistigma atrophium *with high relief SMNS 66387; C, partially complete* Gomphaeschnaoides obliquus *with head and limbs missing SMNS 63069; D, partially complete* Cordulagomphus hanneloreae *with abdomen and limbs missing SMNS 66591; E, incomplete Anisoptera fragment with wings and abdomen missing SMNS 66854; F, isolated* Araripeliupanshania *wing with high relief SMNS 66616. Brightness, contrast and intensity have been adjusted. Scale bars are 1cm.*

To document the completeness of each specimen, the fossils were divided into 'sections' (head/thorax/abdomen/wings/limbs, see Figure 2). The completeness of each 'section' was tabulated, along with other taphonomic data including the presence of internal organs/tissues, preserving/infilling minerals, damage caused by compaction, and other artefacts. The completeness data was simplified (<10% = Absent, 10–75% = Partial, >75% = Present). Disarticulation regularly occurred along the boundaries of 'sections' and, as such, this simplification meant that loss of data was avoided. The simplified data could then be rank ordered (Absent = 1, Partial = 2, Present = 3) for statistical analysis. Finally, every paired combination of 'sections' could be subject to Spearman's

Rank correlation coefficient. To complete this, the ranks were arranged in numerical order and the sum of their numerical positions averaged. The difference between the averages of the 'sections' being compared (d) was entered into the Excel-compatible Spearman's Rank correlation coefficient equation ($p = 1 - 6 \Sigma d^2 / n (n^2 - 1)$), where n represents the number of specimens ($n = 115$). A value (p) between –1 and +1 was produced that represents the relationship between the two sections, where –1 is a perfect negative correlation, +1 is a perfect positive correlation, and 0 represents no correlation.

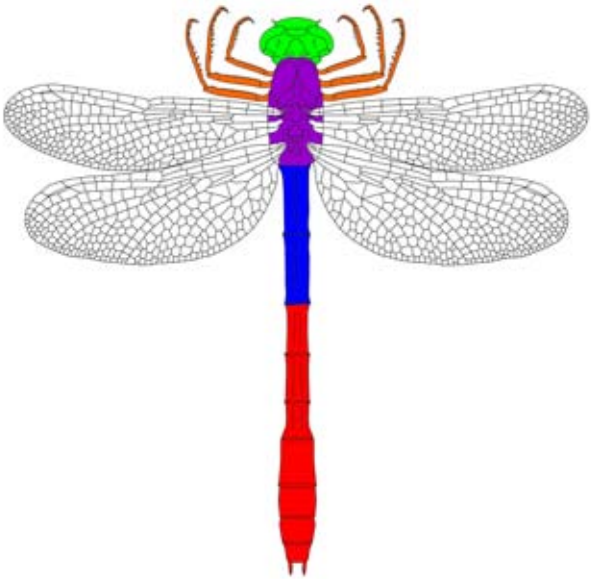


Figure 2. Simplified line drawing of a representative Odonata specimen, highlighting each 'section' in different colours. Note that the abdomen is divided into anterior and posterior, as many specimens were found with only the posterior portion of the abdomen absent. Venation is that of Procordulagomphus xavieri *(Nel and Escuillé 1995), however, the rest is a composite of well-preserved and modern specimens.*

Preliminary Results and Discussion

Preliminary results show that all correlations are positive but vary in strength. This indicates that these 'sections' share a taphonomic commonality. When one 'section' is lost, the other 'sections' are more likely to be lost with it and *vice versa*. This is to be expected with adjacent 'sections' (*e.g.* losing a thorax will likely cause you to lose the head); however, if we consider the relationships of non-adjacent 'sections' (*e.g.* abdomen and wings, or limbs and head) we know that the loss of one section should not directly result in the other section being lost. In this sense we can use the Spearman's Rank relationships to construct hypotheses grounded in modern odonate ecology

to suggest why their relationships vary in strength. These hypotheses could include anatomical requirements for hunting or reproduction, predator–prey relationships, aspects of insect taphonomy in an aquatic medium, and scavenging. Interactions such as these are known in modern Odonata, and their Cretaceous equivalents may be visible in the Crato Formation. For example, modern odonates are preyed upon by birds during flight which can result in the abdomen being removed (Russell *et al*. 1998; Yuan *et al*. 2006). The relationships that abdomina share with other body parts may be weakened by their 'targeted' removal, or strengthened if another 'section' is also removed in the hunting/feeding process (*e.g.* if the hind wings or part of the thorax are bitten away with the abdomen).

With these data we hope to achieve a better understanding of the overall taphonomy of odonates in the fossil record, potentially identify ecological factors affecting the preservation of these insects, and create a rigid dataset for Crato Formation Odonata completeness that can be used in later studies.

REFERENCES

BARLING, N., MARTILL, D. M., HEADS, S. W. and GALLIEN, F. 2015. High fidelity preservation of fossil insects from the Crato Formation (Lower Cretaceous) of Brazil. *Cretaceous Research*, **52**, 605–622.

GRIMALDI, D. and ENGEL, M. S. 2005. *Evolution of the Insects*. Cambridge University Press, Cambridge, 755 pp.

HOCHULI, PA. A., HEIMHOFER, U. and WEISSERT, H. 2006. Timing of early angiosperm radiation: recalibrating the classical succession. *Journal of the Geological Society*, **163**, 587–594.

KALKMAN, V. J., CLAUSNITZER, V., DIJKSTRA, K.-D. B., ORR, A. G., PAULSON, D. R. and VAN TOL, J. 2008. Global diversity of dragonflies (Odonata) in freshwater. *Hydrobiologia*, **363**, 595–351.

NEL, A. and ESCUILLÉ, F. 1995. A new dragonfly from the Lower Cretaceous of Brazil. *Palaeontology*, **37**, 923–930.

RUSSELL, R. W., MAY, M. L., SOLTESZ, K. L. and FITZPATRICK, J. W. 1998. Massive swarm migrations of dragonflies (Odonata) in eastern North America. *American Midland Naturalist*, **140**, 325–342.

WATERSTON, A. R. and PITTAWAY, A. R. 1991. The Odonata or dragonflies of Oman and neighbouring territories. *Journal of Oman Studies*, **10**, 131–168.

YUAN, H.-W., WANG, M.-K., CHANG, W.-L., WANG, L.-P., CHEN, Y.-M. and CHIOUS, C.-R. 2006. Soil composition affects the nesting behaviour of blue-tailed bee-eaters (*Merops philippius*) on Kinmen Island. *Ecological Research*, **21**, 510–512.

Callomon REPORT

Chemosymbiosis in methane seep fossils from Japan

Edine Pape
School of Earth and Environment, University of Leeds

Introduction

To reconstruct the ecosystems of the past, the palaeoecology of ancient animals needs to be investigated and our research focuses on fossil invertebrates. Like all biomineralizing organisms, bivalves and brachiopods use organic templates to guide the crystallisation of calcium carbonate minerals during shell formation. This shell-bound organic matter (SBOM) records the isotopic composition of the animal's diet and has the potential to be preserved in the fossil record. In particular, SBOM from chemosymbiotic modern animals (living in symbiosis with chemosynthetic bacteria) shows distinctive stable isotopic values from their sources, *e.g.* hydrogen sulphide ($\delta^{34}S$) and methane ($\delta^{13}C$), as well as a trophic level ($\delta^{15}N$) (O'Donnell *et al.* 2003; Mae *et al.* 2007; Dreier *et al.* 2012). These chemical sources are found at hydrothermal vents and cold seeps, and are used by the bacteria there to obtain energy for carbon fixation, being either sulphur-oxidizing (thiotrophy), methane-oxidizing (methanotrophy), or present in combination (dual symbiosis).

Identifying chemosymbiosis in the fossil record has thus far been extremely difficult, and our project aims, for the first time, to explore the origin and evolutionary history of this unique nutritional strategy. For the last 50 million years seeps have been dominated by bivalves with modern chemosymbiotic relatives. However, at older seeps extinct bivalve groups and rhynchonelliform brachiopods were the dominant members (Campbell 2006), and testing their nutritional strategy is a major aim of the research.

The Callomon Award from the Palaeontological Association was used to enhance the suite of fossil material available for this research, by sampling fossil seep localities in Japan dating from 0.5–15 million years ago. These sites are well known for their excellent fossil preservation and, in addition to helping assess the occurrence of chemosymbiosis in this time period, are very valuable for interpreting results from more ancient localities via their isotopic and molecular preservation. They enable us to test and validate the method developed for extraction and analysis of modern SBOM for use with ancient material.

Fieldwork in Japan

During the fieldwork conducted in April 2014 we were able to collect samples from four fossil seep localities in Japan: the Miocene Izura seep (16.3/16.4 Ma, Uedo *et al.* 2005), the Middle Pleistocene Kakinokidai seep (Shibasaki and Majima 1997), the Late Pliocene Nakatsu seep (4.8–3.8 Ma,

Futakami *et al.* 2001) and the unpublished Kounandai seep from the Early Pleistocene, at around 2 million years old. The seeps are characterised by carbonates with extremely depleted $\delta^{13}C$ values, showing that they were derived from methane. The fossils excavated from these seeps are often articulated and at many localities preserved in life position.

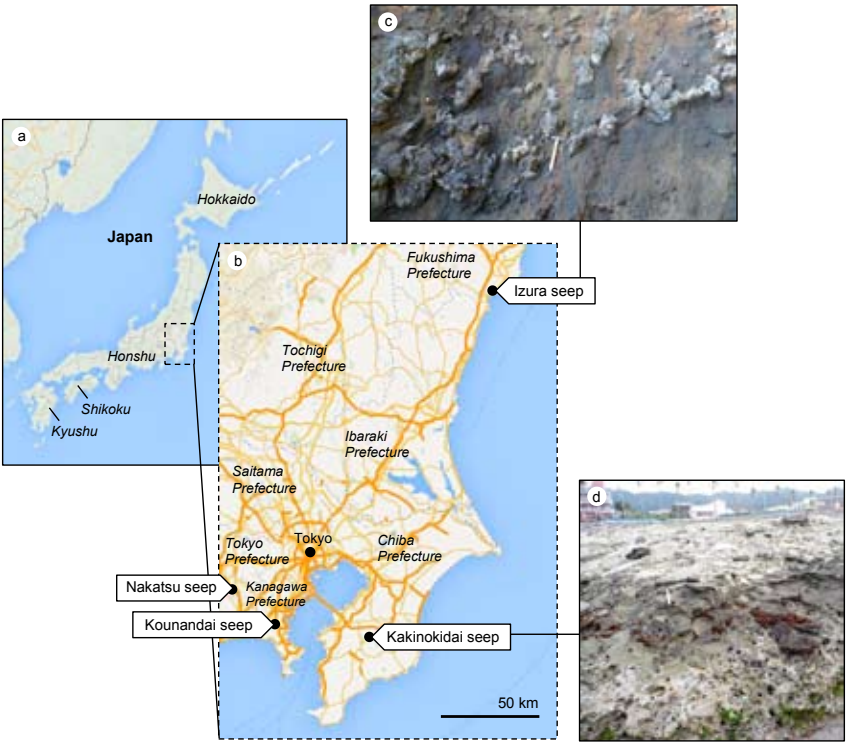


Figure 1. Fossil seep localities visited in Japan in April 2014. a) Map of Japan showing the study area at the eastern part of Honshua Island, enlarged in b. b) The four ancient seep localities targeted for sampling. c) An outcrop at Izura seep (Fukushima Prefecture) showing the seep carbonates, around which Lucinoma acutentilineatum *and* Mizuhopecten kobiyami *(heterotrophic oyster) were collected. d) An outcrop at Kakinokidai seep (Chiba Prefecture) showing seep carbonates, around which* Calyptogena *sp. were collected.*

The excavations at the seep localities allowed for the collection of suspected chemosymbiotic species, thought to be thiotrophic. Species from multiple modern chemosymbiotic families were obtained, including: Lucinidae (*Lucinoma acutentilineatum* at the Izura seep, *Lucinoma aokii* at the Kakinokidai seep, and *Lucinoma* sp. at the Kounandai seep), Vesicomyidae (*Calyptogena* sp., at the Izura seep and the Nakatsu seep) and Solemyidae (*Acharax tokungai* at the Kakinokidai seep), as well as comparable heterotrophic mollusc specimens from the Izura seep and Kakinokidai seep. Additional fossil specimens were provided by Prof. Majima of the Yokohama National University. This material includes *Lucinoma*, *Acharax*, *Conchele* (Thyasiridae), hetertrophic species and *Terebratulida* (Brachiopoda) from various seep localities of a similar recent age range. Of particular importance are the relatively rare Solemyidae and Thyasiridae that could be added to our suite of

material. Because we have obtained multiple species of various families and nutritional strategies at the same locality, this gives us the opportunity to directly compare stable isotopic signals of different nutritional strategies, and it will help us gain insight into how similar environmental factors influenced different species.

By sampling multiple localities we hope to create a time-series for several genera, and assess the influence of changing environmental parameters. Currently, the SBOM from the various specimens is being obtained and will be analysed for carbon, nitrogen and sulphur stable isotopic values. Together with samples from the Paleozoic, Mesozoic and Paleogene, this will allow investigation of the presence of chemosymbiosis through geological time, and its relation to changing seawater chemistry.

Figure 2. Suspected chemosymbiotic bivalves collected at Japanese fossil seep localities. a-b) Calyptogena *specimens (Vesicomyidae, infaunal) that are a rare species at the Izura seep, and the sole species present at the Nakatsu seep. c-d)* Lucinoma *specimens (Lucinidae, infaunal), the dominant component of the seep faunas at both localities. Scale bars are 2cm.*

REFERENCES

CAMPBELL, K. A. 2006. Hydrocarbon seep and hydrothermal vent palaeoenvironments and palaeontology: past developments and future research directions. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **232**, 362–407.

DREIER, A., STANNEK, L., BLUMENBERG, M., TAVIANI, M., SIGOVINI, M., WREDE, C., VOLKER, T. and HOPPERT, M. 2012. The fingerprint of chemosymbiosis: origin and preservation of isotopic biosignatures in the non-seep bivalve *Loripes lacteus* compared with *Venerupis aurea*. *FEMS Microbiology Ecology*, **81**, 480–493.

FUTAKAMI, M., ITO, M. and MATSUKAWA, M. 2001. Conglomerates with vesicomyid Bivalvia (*Calyptogena*) of the Shiramazu Formation of the Chikura Group in Shirahama, Chiba – An example of mud diapirs, *The Journal of the Geological Society of Japan*, **107**, 611–619 (in Japanese with English abstract).

MAE, A., YAMANAKA, T. and SHIMOYAMA, S. 2007. Stable isotope evidence for identification of chemosynthesis-based fossil bivalves associated with cold-seepages. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **245**, 411–420.

O'DONNELL, T. H., MACKO, S. A., JANEL, C., DAVID-HARTTEN, K. L. and WEHMILLER, J. F. 2003. Analysis of $\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$ in organic matter from the biominerals of modern and fossil *Mercenaria* spp.. *Organic Geochemistry*, **34**, 165–183.

SHIBASAKI, T. and MAJIMA, R. 1997. A fossil chemosynthetic community from outer shelf environment of the Middle Pleistocene Kakinokidai Formation, Kazusa Group in Boso Peninsula, Chiba Prefecture, central Japan. *Journal of the Geological Society of Japan*, **103**, 1065–1080 (in Japanese with English abstract).

UEDA, Y., JENKINS, R. G., ANDO, H. and YOKOYAMA, H. 2005. Methane-induced calcareous concretions and chemosynthetic community on outershelf of the Joban forearc basin: an example from the Miocene Kokozura Formation, Takaku Group, north of Ibaraki Prefecture, central Japan. *Fossils*, **78**, 47–58 (in Japanese with English abstract).

Undergraduate Bursary REPORTS

The Toarcian Oceanic Anoxic Event: a temporary exposure in Lincolnshire

Alex Hudson
Ocean and Earth Science, National Oceanography Centre Southampton

Sediments from the Toarcian (Early Jurassic, ~183 million years ago) archive one of the most profound environmental perturbations of the Mesozoic era, the Toarcian Oceanic Anoxic Event (T-OAE; Jenkyns 1988). This event was marked by widespread bottom-water anoxia, biotic extinctions, and a negative carbon isotope excursion of some 5–7‰ (Hesselbo 2000; Palfy and Smith 2000). In the early Jurassic, outgassing from the Karoo–Ferrar volcanism is thought to have caused warming and disruption to ocean water dynamics leading to the dissociation of methane hydrates from the seafloor (Palfy and Smith 2000). Astronomical forcing may also have driven variations of the extent of anoxia (Kemp *et al.* 2005). Ultimately the T-OAE resulted in global deposition of organic-rich black shales in shallow marine environments that contain up to 18% total organic carbon (TOC; Jenkyns 2010). Most studies of this event have focused on sections from European epicontinental seaways, but the event has now been identified from a variety of oceanographic settings worldwide (Gröcke *et al.* 2011; Al-Suwaidi *et al.* 2011); however, our understanding of the forces driving anoxia and the internal distribution of organic matter within T-OAE sediments is still incomplete.

Study of the T-OAE is particularly pertinent as a parallel to the ecological and biogeochemical changes occurring in today's warming oceans. In addition, organic-rich mudrocks are of particular interest to the shale-gas exploration sector, and understanding their development could aid in future hydrocarbon exploration.

The temporary exposure of a new T-OAE succession in northern England provided an opportunity to conduct a pilot study seeking to understand more about the environmental perturbations and the drivers of anoxia. This temporary exposure at Winterton (Lincolnshire) is of particular interest as the sequence lies between the stratigraphically complete deep water succession of the Cleveland Basin (Yorkshire) and the less complete shallow water succession known from the East Midlands Shelf. Fieldwork at Winterton (Lincolnshire) involved collecting samples from the 24 m of exposed succession, spanning an 11 m-thick dark grey/black paper shale known as the Whitby Mudstone Formation; additional samples were taken from the underlying Marlstone and Charnmouth Mudstone formations for comparison. Sedimentological logging, total organic carbon (TOC) and palynofacies analyses of the samples will be set against a carbon isotope record in order to identify the T-OAE event within the section.

The base of the Whitby Mudstone Formation contains around 2 % TOC directly above the Marlstone Formation, but organic content reaches a maximum of 15% TOC, with high levels of ~10% TOC

sustained for 4 m, in the middle of the succession (Figure 1). The highest TOC values coincide with the darkest mudstones and where a lithological change occurs from a more blocky mudstone to bituminous paper shales. This change likely indicates the establishment of the lowest oxygen conditions through the Whitby Mudstone Formation. It is unclear whether the termination of the T-OAE is recorded in the succession, as TOC is still high (at 9%) in samples taken from the stratigraphically youngest sediments exposed in the section.

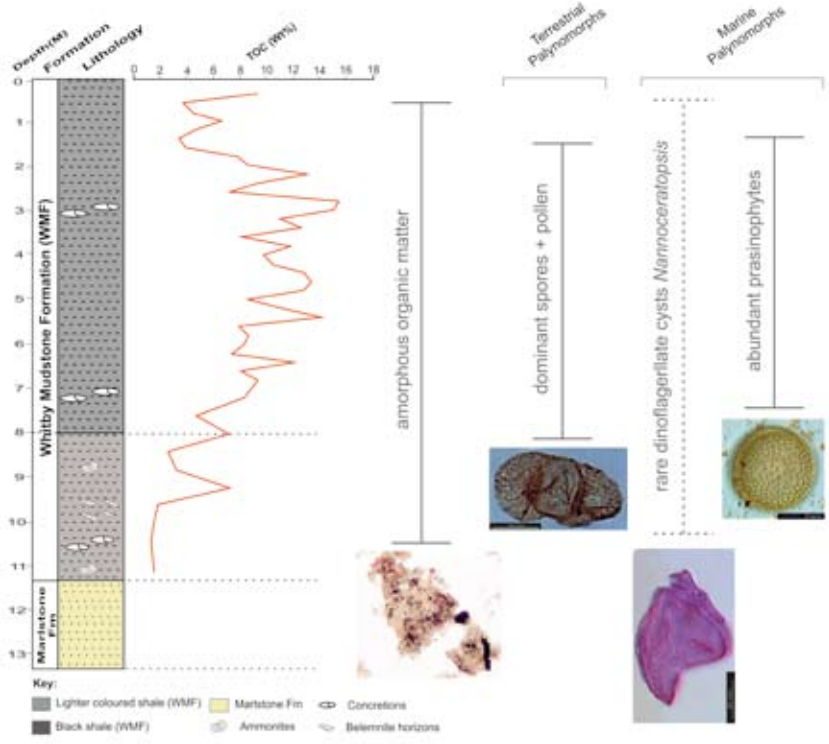


Figure 1. Total organic carbon (TOC) values and palynofacies analysis results from the Whitby Mudstone Formation.

All palynofacies samples examined are dominated by amorphous organic matter (Figure 1). Samples from the levels with highest TOC values show increased abundance of particulate organic debris, dominated by terrestrial phytoclasts, such as abundant elongate wood fragments and plant cuticle, along with bisaccate and polysaccate gymnosperm pollen and various trilete pteridophyte spores. These initial results indicate that the sediments were deposited in a proximal shelf setting, and that the T-OAE event was characterised by increased surface runoff delivering elevated levels of terrestrial material in the form of organics and probably nutrients. The marine palynomorphs are dominated by sphaeromorph and tasmanitid prasinophytes, with less common *Nannoceratopsis* dinoflagellate cysts also present. The dominance of prasinophytes is likely to indicate a stratified, low salinity surface-water lens, developed as a result of the high terrestrial runoff.

Our findings suggest that the development of anoxia was driven by high primary productivity, which was maintained by increased nutrients delivered by enhanced terrestrial runoff. The extremely high TOC values and lithological changes to black laminated shales suggest the position of the event within the Whitby Mudstone, although the end of the event may not be present in the succession. The still-awaited stable isotope ($\delta^{13}C_{org}$) results will enable more precise definition of the T-OAE event at Winterton.

REFERENCES

AL-SUWAIDI, M., *et al.* 2011. First record of the Early Toarcian Oceanic Anoxic Event from the Southern Hemisphere, Neuquen Basin, Argentina. *Journal of the Geological Society*, **167**, 1–4.

GRÖCKE, D. R., HORI, R. S., TRABUCHO-ALEXANDRE, J., KEMP, D. B. and SCHWARK, L. 2011. An open ocean record of the Toarcian oceanic anoxic event. *Solid Earth*, **2**, 245–257.

HESSELBO, S.P., *et al.* 2000. Massive dissociation of gas hydrate during a Jurassic oceanic anoxic event. *Nature*, **406**, 392–395.

JENKYNS, H.C. 1988. The early Toarcian (Jurassic) anoxic event; stratigraphic, sedimentary and Geochemical Evidence. *American Journal of Science*, **288**, 101–151.

JENKYNS, H.C. 2010. Geochemistry of oceanic anoxic events. *Geochemistry, Geophysics, Geosystems*, **11**, 1–30.

KEMP, D.B., COE, A.L., COHEN, A.S. and SCHWARK, L. 2005. Astronomical pacing of methane release in the Early Jurassic period. *Nature*, **437**, 396–399.

PALFY, J. and SMITH, P. 2000. Synchrony between Early Jurassic extinction, oceanic anoxic event, and the Karoo-Ferrar flood basalt volcanism. *Geology*, **28**, 747–750.

Small carbonaceous fossils (SCFs): A new measure for the early Silurian palaeodiveristy of New York State (USA)

Laurenz Schröer

Research Unit Palaeontology, Department of Geology, Ghent University

Using low manipulation hydrofluoric acid (HF) dissolution methods on mudstones can reveal exceptional assemblages of organic-walled microfossils. During my research project I focused on this category of relatively common but largely overlooked fossils, recently coined "small carbonaceous fossils (SCFs)" by Butterfield and Harvey (2012). It is an artificial group consisting of fragments of a wide range of invertebrates. Some are abundant in the regular record and, interestingly, these non-biomineralized parts can be very well-preserved without Lagerstätten conditions (Harvey and Butterfield 2008). As such, SCFs can help to provide information about true first and last appearances of fossil taxa that are otherwise rarely preserved. This project aimed to help further evaluate the potential of SCFs as a biostratigraphic tool. SCFs are usually larger and more delicate than standard palynomorphs, and their extraction requires a dedicated protocol,

different from standard palynological analyses. Nevertheless, SCFs, or rather parts of these fossils, can sometimes be found in residues of standard analyses. Our material comes from the Medina Group of New York (USA), where the potential for SCFs was highlighted based on earlier standard palynological analyses.

We collected samples from the West Jackson Road section in Lockport (New York State) in 2011. In total there are six samples, one (sample JV11-239) is from a very thin shale layer of the Whirlpool Formation, which otherwise consists of sandstone. The other five samples (JV11-234 to JV11-238) are from the overlying shales of the Power Glen Formation, a mixed sandstone–siltstone–shale unit. These formations are considered to be of Rhuddanian age (Early Silurian) by Miller and Eames (1982). Despite the encouraging results in the test samples mentioned above, applying a low-manipulation HF-extraction procedure to our Medina Group samples yielded only a low abundance of SCFs. In addition, these low yields consist of specimens that are very hard to classify. Figure 1a shows a mandible of unknown affinity, and Figure 1b illustrates the very fine and delicate nature of a specimen that could possibly be a gill of a crustacean. In addition, the SCFs included relatively well-preserved organic cuticle with little spines.

Fortunately, the yield and variety of the standard palynomorphs was much larger, and interesting finds of previously unidentified taxa guided our research towards these groups. Scolecodont maxillae and carrier elements are the dominant palynomorphs found in all our samples from the Power Glen Formation, belonging to the families Paulinitidae, Polychaetaspidae, Atraktoprionidae, Mochtyellidae and Tetraprionidae. Scolecodonts are totally absent in the sample of the Whirlpool Formation. In the Whirlpool Formation, the most abundant palynomorphs are algae/acritarchs and clusters of potential cryptospores. Some of the algae are rather difficult to assign to an existing group; their peculiar one-spined vesicles are reminiscent of the genus *Geron*, but in constrast to *Geron,* they are a lot larger, averaging lengths of around 200µm.

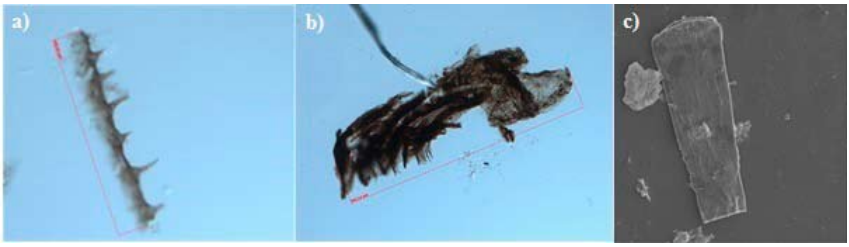


Figure 1. A selection of specimens from this study. a) A SCF from sample JV11-237, length 249 µm, b) A SCF from sample JV11-235, length 342 µm, c) Hercochitina *sp. from sample JV11-239, length 375 µm. All samples were collected from the West Jackson Road section in Lockport (New York State).*

Almost every sample yielded a few well-preserved chitinozoans. These finds are very interesting, not only because their appearance is an indicator for true marine conditions (as there was some doubt about when such conditions appeared in the section) but also because they represent the first truly age-diagnostic chitinozoans in these strata. In contrast to earlier publications (*e.g.*, Miller and Eames 1982), we observed typically, and exclusively, Upper Ordovician genera such as *Hercochitina* (Figure 1c) in sample JV11-239 and potentially in samples JV11-234 and JV11-236. There are two possible interpretations: first, the Whirlpool Formation is of Late Ordovician rather than of Silurian age and the age assignment needs to be revised; or, secondly, the organic material was reworked,

potentially during the major lowstands of the Hirnantian glaciation. The very delicate spines of some of the chitinozoans are very well preserved, which suggests it is unlikely that the material has been reworked. Additional research comparing our new finds with previously documented fossil data will be needed to confirm our interpretations, and to evaluate if these formations might have been formed before or during the Hirnantian glaciation, adding to a better understanding of this event.

REFERENCES

BUTTERFIELD, N. J. and HARVEY, T. H. P. 2012. Small carbonaceous fossils (SCFs): a new measure of early Paleozoic paleobiology. *Geology*, **40**, 71–74.

HARVEY, T. H. P. and BUTTERFIELD, N. J. 2008. Sophisticated particle-feeding in a large Early Cambrian crustacean. *Nature*, **452**, 868–871.

MILLER, M. A. and EAMES, L. E. 1982. Palynomorphs from the Silurian Medina Group (Lower Llandovery) of the Niagara Gorge, Lewiston, New York, U.S.A. *Palynology*, **6**, 221–254.

The Late Devonian mass extinction phase – new discoveries from the British marine fossil record

Ian Smith
School of Geography, Earth and Environmental Sciences, Plymouth University

My project developed around the rich Late Devonian fossil faunas recovered from a temporary section near Bovey Tracey in south Devon in 2014. These faunas, dominated by ammonite-like clymenid ammonoids as well as other groups including phacopid trilobites, are virtually unique in the UK, and are only comparable to the famous faunas of the now-infilled South Petherwin limestone quarries of east Cornwall figured by John Phillips, the nephew of William Smith, in 1841 (and much later reviewed by E. B. Selwood in *Palaeontology* in 1960). Devon and Cornwall are, of course, the type area of the original Devonian system of Sedgwick and Murchison in 1839, and the early descriptions by Phillips contributed to the first characterisation of the system globally.

The temporary excavations which yielded the new faunas were first recognised by two local amateur geologists, Malcolm Billinge and Dave Walker, who immediately contacted local geological networks and, very soon, one of my supervisors, Kevin Page, replied. I first visited the site myself with Kevin – an ammonoid specialist -– and my co-supervisor, Helen Hughes – a trilobite specialist – in early summer 2014, and the quality and abundance of the fossil faunas quickly became apparent. Conspicuous were the abundant large ammonoids preserved within nodules, as well as frequent trilobite cephala, crinoid ossicles, and rare small solitary corals and bivalves.

Approximately 8-9 m of dominantly purplish-red Rora Slate Formation was exposed in 2014 (Figure 1), before being covered over as site works progressed. The many bands of calcareous nodules of various sizes are a classic Devonian pelagic facies, well known across Europe and in Morocco. At the base of the section, however, was a greenish-grey unit which appeared to be a tuff. This level is potentially quite important, as it may yield zircons and hence an absolute age with which to calibrate biostratigraphical dates derived from the fossils.

Figure 1. Part of the temporary section near Bovey Tracey. The new section features mudrocks of the Rora Slate Formation with bands of calcareous nodules. The exposure here is about 2m high but extends for another 5–6 m to the south.

After making detailed field observations, the key samples collected were processed in the Brunel Laboratory facilities at Plymouth University and prepared using air abrasive and pneumatic pen equipment (see Figure 2). A common problem, however, is that many nodules are decalcified and the fossils in these have a tendency to crumble away into a rusty dust: consolidation with a Paraloid acrylic polymer, dissolved in acetone, was therefore essential.

Samples from several of the nodule bands were broken into 1 cm^3 pieces for conodont processing, as these fossils are generally abundant in deeper water Devonian limestones and are essential for biostratigraphical correlations. Samples of the tuff band at the base of the outcrop were also crushed, in order to scan them for zircons using Plymouth University's INQUA mineral identification system. Representative ammonoids and trilobites were photographed with the help of the chemistry department, who rigged up an ammonium chloride coating system in a fume cupboard. Stacked digital images of specimens could then be compiled using imaging software, in order to create fully in-focus images by effectively creating the correct depth of field.

As well as this specimen preparation, research into other Devonian localities in the region was carried out and the results used to begin to build a stratigraphically-organised spreadsheet to document faunal records from the Late Devonian of southwest England. As it develops, it is hoped that this database will allow, for the first time, a comprehensive assessment of a key phase in the story of life on Earth in the UK – the Late Devonian mass extinction – including the regional expression of the two major extinction episodes at this time, the Kellwasser and Hangenberg 'events'.

Figure 2. A typical clymenid ammonoid specimen undergoing preparation (diameter is approximately 10cm).

Consultation with Dr Dieter Korn (Berlin) regarding the ammonoid genera recovered from the exposure suggests that most of the fauna belongs to the *Clymenia laevigata* Zone of the *Clymenia* Stufe which is Late Fammennian. As well as the clymenids *Clymenia*, *Franconiclymenia* and *Gonioclymenia,* goniatites similar to *Sporadoceras* and imitoceratids were also recovered (although further investigation is needed to confirm these preliminary identifications). The trilobites also need further study, but appear to include both blind *Dianops* and *Phacops* with eyes.

My project culminated with a presentation of the preliminary results to the annual meeting of the Ussher Society – southwest England's geological association – in January 2015, entitled "A new section in Late Devonian cephalopod-rich pelagic sediments in south Devon". We now plan to write this up for publication in the Society's journal, *Geoscience in South West England* – but once my final exams are over!

I would like to express my gratitude to the Palaeontological Association for the opportunity to carry out this study and to my project supervisors for their support and instruction.

REFERENCES

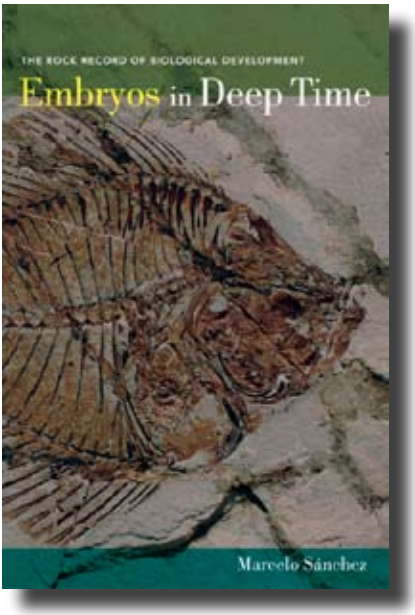
PHILLIPS, J. 1841. *Figures and descriptions of the Palaeozoic fossils of Cornwall, Devon, and West Somerset; observed in the course of the ordnance geological survey of that district*. Longman, Brown, Green, and Longmans, London, 231 pp.

SELWOOD, E. B. 1960. Ammonoids and trilobites from the Upper Devonian and lowest Carboniferous of the Launceston area of Cornwall. *Palaeontology*, **3**, 153–185.

Book Reviews

Embryos in Deep Time: The Rock Record of Biological Development

Marcelo Sánchez. 2012. University of California Press, Berkeley. 265 pp. £28.95 (hardback). ISBN: 9780520271937.



In this study of embryology in the fossil record, the author writes from an extensive personal knowledge of this subject, discussing his own research as well as others in this field. His brief prologue ends with an apt statement: "*Ultimately, each book presents a personal take on a matter, and this is no exception.*" *Embryos in Deep Time*, Sánchez's 'personal take', is highly recommended: an in-depth summary of what the fossil record reveals about biological development, a synthesis of current research in the disciplines of comparative anatomy, ecology and developmental genetics, embryology and palaeontology.

The book is well edited, although some sentence constructions and word choices make it clear that the author's first language is not English. This does not detract from the readability and adds to an engaging style. After the first few chapters, you are drawn into a world of long extinct creatures and long sentences do not matter any more. Concise notes provide a great deal of further information for each chapter. One of the book's strengths is the use of different kinds of extinct and extant examples, from a wide range of geological epochs and geographical localities. It does not just concentrate on one group or continent, and it asks an important question: can a study of fossil embryos demonstrate evolutionary changes in reproduction?

The first two chapters discuss fossils in general, ontogeny and phylogeny, extinction events, and what the fossil record tells us about evolution and in particular, how the emergence of molecular biology has created new opportunities for investigation when combined with the more established disciplines of palaeontology and comparative anatomy. The narrative subsequently moves to the dark arts of evo-devo, phenotypic plasticity and modularity, what these important concepts mean, and how the science of palaeontology addresses them.

In chapter three Sánchez deals with vertebrate ontogenies in the fossil record, viviparity in fossil fish and marine reptiles. He also considers reasons for retention of oviparity and, given the extensive evolutionary history of birds, the absence of avian viviparity among over 9,000 extant species and all known fossil species. An account of ichthyosaurs containing embryos from the Holzmaden deposits of Germany ensues but it is the discussion of the 47.5-million-year-old early whale, *Maiacetus inuus,*

that is particularly interesting, although it was not mentioned in the chapter notes or in the list of references. This enigmatic fossil was of an adult with a smaller individual inside its body cavity; the interpretation as a pregnant female about to give birth was later questioned by cetacean experts, who said the smaller individual was prey – as Sánchez says: an embryo or a last meal?

I was gratified to read in chapter four that "the most important piece of equipment for most palaeontologists, besides the hammer, is the microscope". *Embryos in Deep Time* continues by looking at how palaeohistology can provide major insights into growth patterns and bone construction. As an example, the author uses the monster turtle *Stupendemys geographicus*, from the late Miocene of Venezuela (Scheyer and Sánchez-Villagra 2007). This chapter extensively details how an examination of the microstructure of fossil teeth and bone can reveal insights into maturation time, longevity and changes in growth phase that may have affected certain groups at various stages of their evolution. It includes a discussion of dinosaur growth patterns, the origin of birds, as well as bone development and locomotion in extinct species. The author discusses his own work on the skeleto-chronology of the marine and terrestrial species of Galapagos iguana, and ends with an elegant treatment of the nature of teeth.

In the next chapter we are introduced to the pre-microscope concept of the homunculi – where human eggs contained fully formed, albeit tiny human individuals, the term 'animalcules' being used for the same principle in other species. It was a long time before people realized that early ontogeny of complex organisms involved repeated cell division that would subsequently develop into a recognisable organism. Sánchez then moves on to discuss growth, growth series and taxonomy of a number of fossil groups, providing a useful introduction to growth and diversification patterns discussed in the following chapter.

Chapter six places development of organisms in a broader context. It covers catastrophic events and mass extinction events such as the asteroid impact on the Yucatán Peninsula and volcanic events of the Deccan Traps. Ocean acidification is addressed, and the author examines patterns of larval evolution in the oceans, climate change and mammalian developmental evolution; how changes in ocean chemistry affected development of past marine organisms and how it may affect marine ecosystems in the near future.

Developmental genetics and phylogeny appear in chapter seven, with examples of how developmental evolution can be inferred from extinct adult phenotypes and the *Hox* gene. The author introduces the Middle Triassic "lizard-fish" *Saurichthys*, detailing how morphological patterns observed in developmental genetic studies of extant fish also appear to be similar to those in fossil species.

Following on from the previous chapter the book deals with missing links, discussing Goldschmidt's 'hopeful monster' in detail, with examples of eye migration in flatfish from the Eocene of Italy. Sánchez discusses Goldschmidt's theories of the lack of intermediate forms in evolution and epigenetic systems emerging from both environmental and genetic factors, explaining why the Italian flatfish argue against the hopeful monster hypothesis.

He does, however, state that Goldschmidt's ideas are relevant, moving on to an elegant discussion of a counter-example: bat wings. Comparative anatomy and reference to the fossil record is combined with cutting edge molecular biology, and this chapter ends with a discussion of turtle shells and

whale legs. As such, the memorably named sonic hedgehog gene makes a brief appearance – an important molecule mediating the development of an area of the hind limb bud in other land vertebrates which is absent in dolphin embryos.

The penultimate section of this book discusses mammalian and human development, beginning with mammalian evolution, stem mammals and mammalian common ancestors in the Jurassic. An interesting part deals with the dichotomy among extant mammals between the monotremes and the marsupial and placental mammals, a deep separation of the two evolutionary lines extending back to the Jurassic. The hominid fossil record ends this chapter and could perhaps have been more detailed and expanded on, given we know so much about human embryology.

The final chapter is engagingly entitled "*On trilobites, shells and bugs*". It makes a refreshing diversion after spending most of the book with vertebrates. The author makes this point, noting that it was never his intention to provide a full treatment of invertebrate developmental palaeontology as this would occupy a separate volume. Sánchez discusses the role of the *Hox* gene in segmentation and regionalization in trilobites, once again combining molecular biology and genetics with classical palaeontology. The chapter also discusses plasticity in segmental development in geologically younger forms, evolution of trilobite body plans and the ability to enroll; anti-predator strategies forming a major selective factor in the evolution of enrollment.

Aesthetically the layout is good, although in places the formatting shifts from justified to left alignment and back again which appears a little irregular. This does not, however, detract from overall readability. Lack of citation means text is less cluttered and the reader has to stop to look up information, though this could be considered to make the book more accessible to a wider audience. The high-quality illustrations are well chosen; a mixture of line drawing, schematic diagrams, palaeontological reconstructions and photographs, sometimes haunting in the case of the fruit bat embryo (Figure 40, pg 150). One minor illustrative point is that Figure 1 (geological eras mentioned in the text) could have been larger as there is too much white space on the page.

In summary, *Embryos in Deep Time* is written in an engaging style so as to be accessible to non-specialists, while still maintaining its appeal for palaeontologists and evolutionary biologists, whether graduate students or established researchers. It offers good value for money, discussing >500 million years of evolution of life on Earth in just over 200 pages. More technologically-minded readers may like to know that the book is available on Kindle for £23.95. As the print book is only five pounds more expensive this is not much of a saving, though for some may be enough.

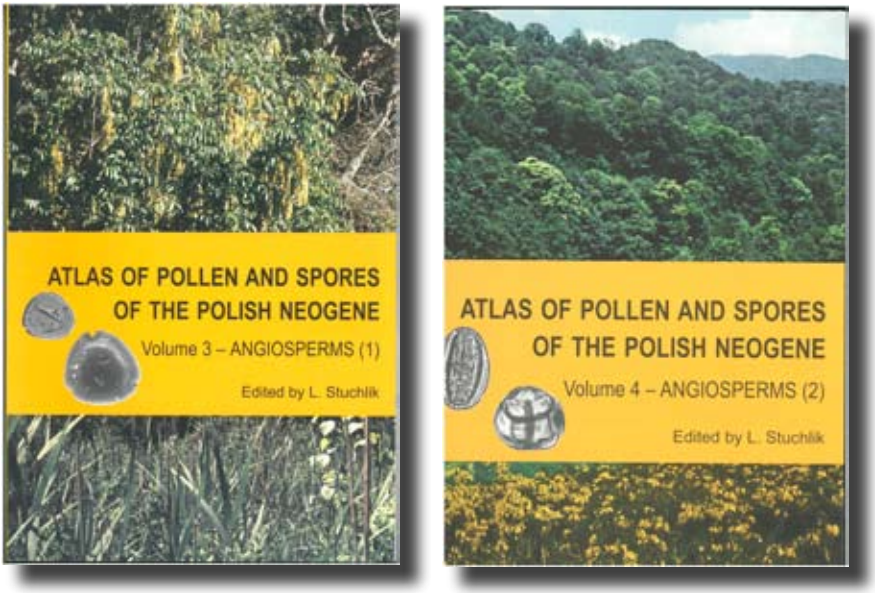
R. S. Pyne
Ceredigion, UK

REFERENCE

SCHEYER, T. M. and SÁNCHEZ-VILLAGRA, M. R. 2007. Carapace bone histology in the giant pleurodiran turtle *Stupendemys geographicus*: phylogeny and function. *Acta Palaeontologica Polonica*, **52**, 137–154.

Atlas of Pollen and Spores of the Polish Neogene:
Volume 3 – Angiosperms (1) and Volume 4 – Angiosperms (2)

L. Stuchlik (ed.). W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków. Vol. 3, 2009. 233 pp. €55 incl. postage. ISBN 978-83-89648-74-7. Vol. 4, 2014. 466 pp. €59 incl. postage. ISBN 978-83-62975-23-5.



In *Newsletter* **53** (2003) I reviewed the first two of a projected four large-format (A4) volumes on the pollen and spores of the Polish Neogene. The first of these covered spores and the second gymnosperm pollen. They were published in 2001 and 2002, respectively. Publication of the third and fourth volumes on angiosperm pollen was expected within the following three years. However, as indicated above, the third did not materialize until 2009 and the fourth only recently. Of the overall cohort of nine authors, four, including the editor, contributed to all parts of the 'atlas': of the others, three were involved in all but one and two in just the last part.

In common with the first two, systematic descriptions comprise the bulk of volumes 3 and 4. Much of what I said about the approach adopted by the authors to the earlier volumes also applies to those on angiosperm pollen. Each begins with a short introduction, observations on the terminology used and a map showing locations of all of the sections mentioned in the text. In common with volume 2, also included is a figure showing the stratigraphic coverage of the sections plotted against chronostratigraphic, lithostratigraphic and generalized lithological columns. Both volumes contain many plates (67 in vol. 3, 133 in vol. 4), mostly of photographs taken under a transmitted light microscope, but some of the species are also illustrated by scanning electron micrographs. Previously published subgenera have been elevated to generic rank where merited. With few exceptions, each diagnosis or description is preceded by a synonymy comprising all Polish records and some non-Polish entries if they refer to important taxonomic changes. The species

are described in a standard format and grouped according to their known or presumed botanical relationships, based on morphological resemblances to pollen of extant taxa. All are classified as Palaeotropical for tropical and subtropical components and Arctotertiary for warm- and cool-temperate elements. Geographical occurrences of corresponding extant taxa accompany each description. Stratigraphic distributions based on records from the general palynological literature and their recorded occurrences in Poland are noted for the species in the third volume but not in the fourth.

As before, I regret the omission of an abstract that includes a list of all new taxa, revised combinations of genera and species, and the genera and species for which emended circumscriptions are provided. The introductions are useful but incomplete in these respects. Fortunately the final volume includes an appendix that lists the names of all of the species described and illustrated and their location (volume, page, and plate and figure references). The fact that this list is alphabetical according to genus and their included species is most helpful for locating a particular taxon, the affinity of which might not be known to the user. Altogether the four volumes contain descriptions of 600 spore and pollen species assigned to 195 genera. Ten of the genera and 68 of the species are new and there are 84 new combinations.

Much painstaking work has gone into producing this 'atlas'. It is obviously of interest primarily to palynologists. Although especially valuable to specialists on Neogene palynology it will also be a useful reference for those who work on older, especially Paleogene and Cretaceous, successions.

David Batten
Aberystwyth University

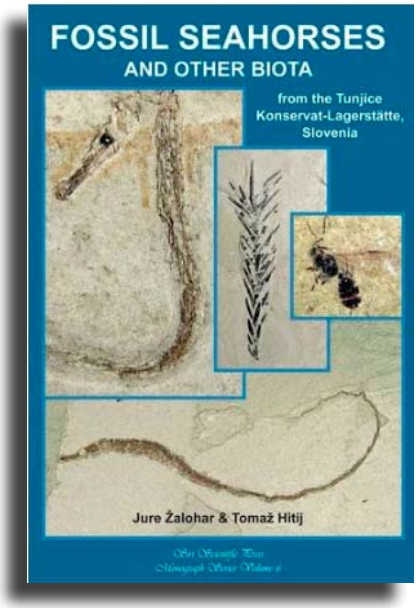
Fossil Seahorses & Other Biota from the Tunjice Konservat-Lagerstätte, Slovenia (Monograph Series volume 6)

Jure Zalohar and Tomaz Hitij. 2014. Siri Scientific Press. 176 pp. £69.99 (hardback). ISBN: 978-0-9574530-4-3. Available direct from the publisher at **<www.siriscientificpress.co.uk>.**

Seahorses are iconic members of seagrass communities worldwide. Part of their charm resides in their horse-like heads and upright posture, with their tails curled around seagrass stems waiting for their prey. Extant seahorses are currently under threat through habitat destruction and degradation, use in Asiatic medicines, and the aquarium trade. They are the only fish group to have been awarded some measure of protection under the Convention on International Trade in Endangered Species (CITES).

Fossil seahorses are rare, the authors providing the second and older record from the Miocene. The authors have previously provided a taxonomic account of the seahorses (Žalohar *et al.* 2009) and associated pygmy pipehorses (Žalohar and Hitij 2012). This has enabled a more precise estimate of their origin, possibly linked to Oligocene expansion of seagrass habitats (Teske and Beheregaray 2009).

This well-illustrated book is arranged in a number of titled chapters, each of which has an integral reference list. The first of these (*Seahorses as a form of life; foreword*) concerns the aesthetics of



seahorses particularly related to their similarity to the mathematical structures of Mandelbrot. This possibly could have been omitted. The next (*Historical explorations of the Tunjice Hills*) provides a brief history of exploration of the area, firstly in the search for coal in the 18th century and more recently for the rich fossil material from the Oligocene and Miocene.

The next chapter (*The ancient sea of the Central Paratethys*) concerns the geological setting of the Tunjice area in terms of the Oligocene–Miocene palaeogeography of the Mediterranean and the stratigraphy of the Tunjice Hills and neighbouring areas. Figure 3.15 is instructive in indicating three fossil horizons, the Gornji Grad beds (coral reef), marine clays with well-preserved fish (both Oligocene) and later in the succession the focus of this book, the Coprolitic Horizon (Lower Samartian, Middle Miocene).

The following chapters are arranged in stratigraphic order from the Oligocene through to the Miocene. *A journey through the geological past of the Tunjice Hills* provides an account of the flooding of the area over Triassic carbonates with the formation of the Gornji Grad beds (Early Oligocene). These contain a rich fauna dominated by corals and are followed in the area by deeper marine clays containing plants, insects which, as well as fish, are illustrated. The plants suggest a subtropical climate during the Oligocene. Although not noted as such, these beds actually represent another Lagerstätte. The next chapter (*The Pannonian Basin forms*) completes the Oligocene with the formation of terrestrial deposits containing coals and mammal fossils.

Miocene life thrives begins a series of chapters on the Miocene. The Early Miocene records a series of brackish water fossiliferous sediments including molluscs, crustaceans and plant remains, particularly in nodules. There then follows deeper water sediments which are relatively poor in fossils. The Early Miocene finishes with sediments containing terrestrial vertebrates, sharks and sirenians. The Middle Miocene enters a new cycle, leading into more marine conditions with highly fossiliferous sediments (*Evidence of the open ocean*). The later part of the Middle Miocene continues with fossiliferous marine sediments containing leaves (*Shallow Sarmatian sea*). Within this sequence is the Coprolitic Horizon (*The Coprolitic Horizon – an unexpected discovery*), the focus of this book, with Figure 9.3 providing a detailed stratigraphic column.

This chapter introduces the three following chapters which provide details of the fossils in ~70 pages. The Coprolitic Horizon is named as such because of the presence of terrestrial coprolites, and consists of clays and laminated diatomaceous siltstones. These, and well-preserved fish and insects, suggest anoxic conditions at times. *Fossils of the Coprolitic Horizon* provides details of the fossils in this Lagerstätte. The fossils consist of two elements, those swept into the basin and those living in the basin. There are a variety of plant remains including leaves, flowers, cones and seeds;

also insects including dragonflies, beetles, bees and ants have been transported into the basin. Seagrass and algae from near shore are also present, with seagrass suggesting the proximity of possibly extensive seagrass meadows. Fossils of forms living in more oxic periods include molluscs and polychaete worms. Well-preserved fish may have been living in oxic waters and before death and burial in more anoxic sediments. The most common fish are various syngnathids, including seahorses. This chapter is well illustrated, mostly with colour photographs.

The next chapter (*Fossil seahorses*) provides further details on seahorses with additional illustrations, and of interest is the relative abundance of juvenile forms. The authors suggest that seahorse fossils could be found elsewhere with appropriate preservation; these seahorses are thought to have been swept into the basin from nearby seagrass meadows. *Origin of seahorses – finding the 'missing link'* provides an account of how seahorses and pygmy pipefish may have migrated from their supposed origin in the Indo-Pacific which has implications for a renewed seaway from this area into Paratethys. Since the fossil forms are similar to living ones this suggests an earlier evolution in the Oligocene.

The last chapter (*The palaeontological collection*) provides a brief account of the museum collection and the difficulties of preserving material. At the end of the book there is a taxonomic index.

This book brings these unique seahorse-bearing sediments to a wider audience than would be reached by academic papers alone. For those interested, several Lagerstätten are noted. The variety of well-preserved plants and insects not recorded in one volume elsewhere may also be of interest to some. The large amount of illustrations is likely to please most palaeontologists. This account adds to the taxonomic accounts previously published by the authors. The main strengths of this book are the illustrations which will have an appeal to all and the stratigraphic organization of the text; two figures of the stratigraphy are useful to refer back to when reading the text. A summary of Miocene stratigraphy in the Paratethys is useful, particularly for the uninitiated. Apart from the first chapter, which could have been removed, there are no particular weaknesses. The text is quite readable with a profusion of interesting and useful illustrations, and the book is nicely presented. The price, however, militates against private purchase, except by the well-heeled. Library purchase, particularly where there is a palaeobiological focus, is to be encouraged.

George F. Forsey
Northampton

REFERENCES

TESKE, P. R. and BEHEREGARAY, L. B. 2009. Evolution of seahorses' upright posture was linked to Oligocene expansion of seagrass habitats. *Biology Letters*, **5**, 521–523.

ŽALOHAR, J., HITIJ, T. and KRIZNAR, M. 2009. Two new species of seahorses (Syngnathidae, *Hippocampus*) from the Middle Miocene (Sarmatian) Coprolitic Horizon in Tunjice Hills, Slovenia: the oldest fossil record of seahorses. *Annales de Paléontologie*, **95**, 71–96.

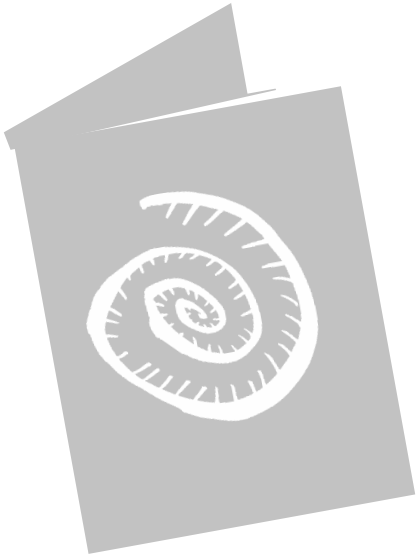
ŽALOHAR, J. and HITIJ, T. 2012. The first known fossil record of pygmy pipehorses (Teleostei: Syngnathidae: Hippocampinae) from the Miocene Coprolitic Horizon, Tunjice Hills, Slovenia. *Annales de Paléontologie*, **98**, 131–151.

Books available to review

The following books are available to review. Please contact the Book Review Editor, Tom Challands (e-mail <**bookreview@palass.org**>), if you are interested in reviewing any of these.

- *Lower Jurassic foraminifera from the Llanbedr (Mochras Farm) Borehole, North Wales, UK*, by P. Copestake and B. Johnson.
- *Trilobites of the World: An Atlas of 1000 Photographs*, by P. Lawrance and S. Stammers.
- *Late Ordovician Ostracods of the Girvan District, southwest Scotland*, by M. Mohibullah, M. Williams and J. A. Zalasiewicz.
- *Anatomy, Phylogeny and Palaeobiology of Early Archosaurs and their Kin*, by S. J. Nesbitt, J. B. Desojo and R. B. Irmis (eds).
- *Fossil Insects: An Introduction to Palaeoentomology*, by D. Penney and J. E. Jepson, with artwork by R. Bizley.
- *Issues in Palaeobiology: a Global View Interviews and Essays*, edited by M. R. Sanchez-Villagra and N. MacLeod.
- *Mammoths and the Environment*, by V. V. Ukraintseva.

Dr Tom Challands
PalAss Book Review Editor,
School of GeoSciences,
The University of Edinburgh,
Grant Institute,
The King's Buildings,
James Hutton Road,
Edinburgh
EH9 3FE
UK



Careering off course!

Inspirational palaeontologists

Sally Thomas is a Freelance scientific editor and Publications Officer of the Palaeontological Association. Her palaeontological career began with a BA in Natural Sciences from Cambridge, specialising in geology, followed by a PhD with Jenny Clack in the University Museum of Zoology, Cambridge, investigating the lateral line system of early tetrapods. Following a graduate training programme at Cambridge University Press, progressing to commissioning editor, Sally had a short stint project managing new GCE qualifications for the exam board OCR, before going on maternity leave. Making the bold decision not to return to formal employment, she instead approached former colleagues for copy editing work in the journals side of the business, building a relationship with the society that owned the journal and eventually taking over management of their submission and editorial process. Sally recently became one of only two employees of the Palaeontological Association, managing both of the Association's journals.

If you were a scientific paper, what would the title be?
Autographic dyslexia: a study of the inability to spot the errors in one's own work.

Describe yourself in three words?
Organised, busy, persistent.

When you were a child, what did you want to be when you grew up?
An astronaut.

How did you first get interested in palaeontology?
From a young age I was generally interested in the world around me, but I was finally bitten in my first year at university when I took geology as an 'extra'.

When did you decide to follow the career path you are on now?
I have never really decided on a career path, but have taken opportunities as they have arisen.

What are the main responsibilities of your job?
To manage the submission and production of all papers submitted to *Palaeontology* and *Papers in Palaeontology*. This includes helping authors and editors to negotiate the minefield that is the ScholarOne database, checking all papers for potential technical issues that might crop up in production, and trying to steer authors towards journal style before it is too late, a little copy editing and a lot of proof reading.

In an average week, how many hours do you work?
36, although I don't have a regular work pattern.

How many people do you work with on a daily basis?
On most days I don't actually see or speak to anyone (at work), but probably correspond by e-mail with around ten different people:

authors, editors and the staff at Wiley. Of these, there are two or three with whom I communicate on most days.

What gives you the most satisfaction in your job?
Getting research published in a useful and professional format, and correcting errors before most people have a chance to spot them!

What are the worst things about your job?
Firefighting. Because I deal with a large number of small individual projects, and have no control of when new ones start, it is difficult to spread the load evenly and things tend to come in waves. Solitude can be an issue – I tend to find that when I do meet someone at the end of the day, I can't stop talking!

What has been the best career advice you have received?
A long time ago I was told that if someone asked if I could do something, and it sounded interesting, I should say 'yes' and worry about the detail later. It's possible to learn how to do many things if you have the incentive, and I've found that it has taken me down paths I would not otherwise have explored. So far, I haven't come unstuck!

What skills does it take to be successful in your job?
Having a very keen eye for detail, being organised, and being able to juggle a large number of small projects at once.

Do you have any tips for students who would like to take a similar career path?
Having a diverse background is a good idea, partly because it opens up opportunities, and partly because I find it useful to know a little bit about a lot of things; it helps you to stand out from the crowd in a competitive job market and it's always handy to have a potential Plan B. Papers submitted to our journals cover a very wide range of subjects, and a little background knowledge goes a long way. I've had a lot of luck getting to where I am now, but some of it I've helped along – two of my current jobs only came along because I asked for them.

Are there any major obstacles to being successful in a career like yours?
I work from home and that doesn't suit everyone. Most major publishers don't tend to employ people to do the job I do because it's too expensive; their work is contracted out to general typesetting companies in India and they rely on authors or academic editors to do much of the work I do. It's not easy to plan a career path.

What's the best thing about your job?
Flexibility. On one hand, the typesetter in India tends to release proofs at 4pm on a Friday afternoon, and I like to get through them before the author does, but I can also pop into my children's primary school to help out with the orchestra every week as well as being there for assembly. It's a question of balance – I try and respond quickly to authors in all time zones, and who tend to work through the weekend, but I can compensate mid-week.

What is your favourite fossil and why?
Ichthyostega which formed the starting point for my PhD. In particular, MGUH fn 1398c, currently on loan to the University Museum of Zoology in Cambridge, as I spent many happy hours staring at it down a microscope and gradually revealing the ornamented surface of the lower jaw one grain of metamorphosed sand at a time with a dental pick.

For jobs in publishing the following websites may be useful, as well as individual publishers' websites:

<**http://jobs.theguardian.com/jobs/**>
<**http://www.nature.com/naturejobs/science/**>
<**http://jobs.newscientist.com/en-gb/**>

Palaeontology

VOLUME 58 • PART 1

CONTENTS

Palaeontology

VOLUME 58 • PART 2

CONTENTS

Papers in Palaeontology

Volume 1 | Part 1 | FEBRUARY 2015

Overseas Representatives

Argentina: Dr M.O. Manceñido, Division Paleozoologia invertebrados, Facultad de Ciencias Naturales y Museo, Paseo del Bosque, 1900 La Plata.

Canada: Prof R.K. Pickerill, Dept of Geology, University of New Brunswick, Fredericton, New Brunswick, Canada E3B 5A3.

China: Dr Chang Mee-mann, Institute of Vertebrate Palaeontology and Palaeoanthropology, Academia Sinica, P.O. Box 643, Beijing.

Dr Rong Jia-Yu, Nanjing Institute of Geology and Palaeontology, Chi-Ming-Ssu, Nanjing.

France: Dr J. Vannier, Centre des Sciences de la Terre, Université Claude Bernard Lyon 1, 43 Blvd du 11 Novembre 1918, 69622 Villeurbanne, France.

Germany: Professor F.T. Fürsich, GeoZentrum Nordbayern, Fachgruppe Paläoumwelt, Universität Erlangen-Nürnberg, Loewenichstrasse 28, D- 91054 Erlangen, Germany.

Iberia: Professor F. Alvarez, Departmento de Geologia, Universidad de Oviedo, C/Jésus Arias de Velasco, s/n. 33005 Oviedo, Spain.

New Zealand: Dr R.A. Cooper, New Zealand Geological Survey, P.O. 30368, Lower Hutt.

Scandinavia: Dr R. Bromley, Geological Institute, Oster Voldgade 10, 1350 Copenhagen K, Denmark.

USA: Professor Paul Selden, The Paleontological Institute, University of Kansas, Lawrence, Kansas, 66045.

Professor N.M. Savage, Department of Geology, University of Oregon, Eugene, Oregon 97403.

Professor M.A. Wilson, Department of Geology, College of Wooster, Wooster, Ohio 44961.

TAXONOMIC/NOMENCLATURAL DISCLAIMER

This publication is not deemed to be valid for taxonomic/nomenclatural purposes [see Article 8.2 of the International Code of Zoological Nomenclature (4th Edition, 1999)].

Newsletter copy

Information – whether copy as such or Newsletter messages, review material, news, emergencies and advertising suggestions – can be sent to Dr Jo Hellawell, e-mail <**newsletter@palass.org**>). The *Newsletter* is prepared by Nick Stroud, and printed by Y Lolfa, Talybont, Ceredigion.

Deadline for copy for Issue No. 89 is 8th June 2015.

Palaeontological Association on the Internet

The Palaeontological Association has its own pages on the World Wide Web, including information about the Association, and copies of the *Newsletter*. Internet Officer Alan R. T. Spencer can be reached by e-mail at <**webmaster@palass.org**>. The locator is <**http://www.palass.org/**>.

Advertising in the Newsletter

Advertising space in the *Newsletter* will be made available at the rates given below to any organisation or individual provided the content is appropriate to the aims of the Palaeontological Association. Association Members receive a 30% discount on the rates listed. All copy will be subjected to editorial control. Although every effort will be made to ensure the *bona fide* nature of advertisements in the *Newsletter*, the Palaeontological Association cannot accept any responsibility for their content.

£75 for half a page £130 for a full page

These rates are for simple text advertisements printed in the same type face and size as the standard Newsletter text. Other type faces, line drawings *etc.* can be printed.

Rates for distribution of separate fliers with the Newsletter:

1,100 copies for worldwide distribution	£250
850 copies for worldwide distribution exclusive of North America	£200
600 copies for U.K. circulation only	£150

— — — **Newsletter design by Emma Davies, 31 Stafford Street, Edinburgh EH3 7BJ** — — —