The Palaeontology Newsletter

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Reminder: The deadline for copy for Issue no. 92 is 6th June 2016.

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Editorial

The PalAss *Newsletter* has been a cardinal feature of the Association's publishing remit for nearly thirty years, and over its lifetime it has evolved in response to trends in palaeontology, science and society. Today the *Newsletter* features a mixture of long-established content relating to meetings, grant reports, methodologies and book reviews, and more recent additions such as media coverage of palaeontology, virtual visits to collections and biographies of notable palaeontologists (current and historical). I am honoured to take up the role of Newsletter Editor for 2016 and am hugely grateful to the outgoing Editor, Jo Hellawell, for invaluable help during the transition period. I hope that under my stewardship, the *Newsletter* continues to deliver thought-provoking material of interest to all of the Association's members.

One aspect of palaeontology – and the scientific realm more broadly – that has been highlighted recently is the role of women. Gender bias in scientific disciplines is not new and has its roots in a tangled web of societal and historical causes. In order to highlight the need for gender parity in scientific careers, the United Nations declared the 11th of February as the International Day of Women and Girls in Science. Some STEM (science, technology, engineering and maths) disciplines struggle to achieve gender parity at undergraduate and junior postgraduate level. For other disciplines, *e.g.* palaeontology, gender inequity is most striking at higher career ranks, with a marked drop-off in women at lecturer and professorial levels. As a discipline we need to explore creative measures to improve retention rates of good female palaeontologists. In a recent study, Plotnick *et al*. (2014, *GSA Today*) suggested making childcare available at meetings. Other beneficial measures could include improved leave policies at third-level institutions with particular supports for the transition back to work to allow female researchers to kick-start their research following maternity leave. These suggestions are merely scratching the surface at potential solutions to a complex problem. More thorough consideration of the issue coupled with implementation of new support measures will hopefully result in a shift towards more equal gender representation in palaeontology in years to come.

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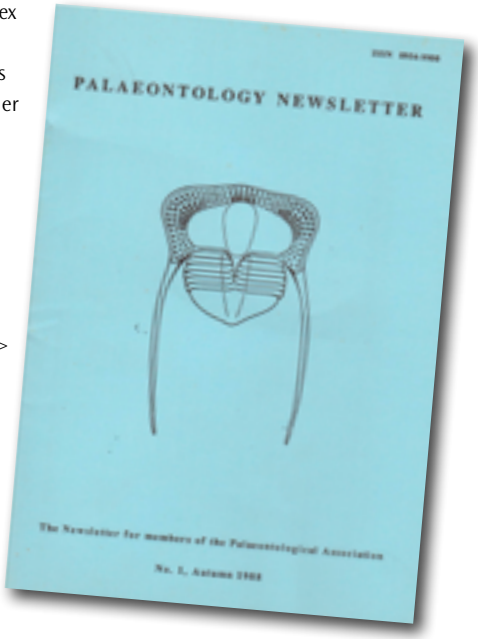


Association Business

Annual Meeting 2016

Notification of the 2016 Annual Meeting, AGM and Annual Address

The 2016 Annual Meeting of the Palaeontological Association will be held at Université Claude Bernard Lyon 1, Lyons, France, on 14–17 December, organized by Dr Gilles Cuny and colleagues.

At the AGM in December 2016, the following vacancies will occur on Council:

- Vice President
- Secretary
- Newsletter Editor
- Publicity Officer
- Outreach Officer
- Education Officer
- Internet Officer
- Ordinary Members (3 vacancies)

Nominations are now invited for these posts. 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 by e-mailing <**secretary@palass.org**>.

The closing date for nominations is **5th October 2016**. 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**>.

Council vacancies: 'job descriptions':

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 subcommittees, particularly those tasked with making recommendations for the awards of grants.

Secretary (five-year term)

The Secretary is one of the senior members of Council and has a wide range of duties and responsibilities – never a dull moment! In addition to dealing with enquiries and other communications from members and non-members, preparing agendas and keeping the minutes of all the Association's meetings, the Secretary also has a major role in keeping written records up to date, such as the rubric for the various grants and awards, and drafting the annual Trustees Report. As senior Council member, the Secretary usually sits on most of the grant-awarding committees – a demanding but ultimately very satisfying aspect of the position – and also acts as the Executive Officer's line manager. Whenever Council agrees to forge ahead with a major new initiative, the Secretary has a responsibility for drafting any new documentation that may be required, such as job descriptions and adverts. These duties require the Secretary to work closely with the President and the Executive Officer, in particular, but also with the Internet Officer and Newsletter Editor.

Newsletter Editor (three-year term)

Editing the *Newsletter* is an intense role three times a year with relatively little in between apart from collating some content and attending Council meetings. The main responsibilities are approaching people and commissioning content, ensuring that permission for all reproduced images and content has been sourced, editing all content in the *Palaeontology* style, and reminding contributors of deadlines as necessary.

Publicity Officer (three-year term)
Outreach Officer (three-year term)
Education Officer (three-year term)

Publicity Officer, Outreach Officer and Education Officer comprise the Outreach committee. These posts have responsibility for all of the Palaeontological Association outreach activities. Currently they include organizing the Association's presence at Lyme Regis Fossil Festival and the Yorkshire Fossil Festival, co-coordinating the Engagement Grants, answering relevant enquiries, and initiating other activities that promote and develop palaeontological outreach and education for the Association. The members of the outreach committee work closely together and their roles often overlap, but typical responsibilities associated with each post include:

Publicity Officer: managing the Association's social media presence, *e.g.* disseminating palaeontological news via Facebook and Twitter;

Education Officer: leading the Association's educational activities, *e.g.* delivering dedicated activities at schools' days associated with fossil festivals; communication with ESTA;

Outreach Officer: devising and implementing new outreach activities for the Association.

Internet Officer (three-year term)

The Internet Officer is one of the more time-consuming roles with year round responsibilities. The main tasks are running the PalAss web-servers and external mailing lists, updating the PalAss website content (*e.g.* the publications back archives), maintaining the website code-base (HTML, CSS, JavaScript, PHP) and online payment systems, ensuring the website meets UK/EU law and current standards for accessibility, and liaising with PalAss-hosted external websites (*e.g.* PalaeoElectronica). The busiest times of the year are in the lead up to the Annual Meeting (registration and abstract submissions) and December/January with membership renewals.

Ordinary Members (three vacancies, all three-year terms)

Ordinary members do not have a formal portfolio. They attend Council meetings and contribute to discussion, decision-makingand future planning. They often participate in important subcommittees, such as those tasked with reviewing and making decisions upon grant applications.

Awards and Prizes

The Palaeontological Association recognizes 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 summarizes the candidate's career, further supported by a brief statement from the nominators. A list of ten principal publications should accompany the nomination. Letters of support by others may also be submitted. Council reserves 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 by e-mail 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 summarizes the candidate's career, 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 by e-mail 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 reasons, this should be highlighted.

The academic case, statements of support and publication list should be attached in MS Word or PDF format, ideally as a single document if possible. Nominations should be sent by e-mail 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 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 recognized 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, ideally as a single document, and should include the full contact details of the candidate. Nominations should be sent by e-mail to <**secretary@palass.org**> by **31st March**.

The Award comprises a cash prize of £1,000 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 by e-mail 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 by e-mail 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 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. Individuals may nominate themselves for consideration when submitting abstracts for the meeting. The prize consists of a cash award of £200, and is announced immediately after the oral sessions 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 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. Individuals may nominate themselves for consideration when submitting abstracts for the meeting. The prize consists of a cash award of £200, and is announced immediately after the oral sessions 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**>). Those 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 organizers 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 organizer(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. Enquiries may be made to the Secretary (<**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 organizer(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 request is for a loan or a grant)
- Other sources of funding applied for
- Specific use to which 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 the keynote speaker agrees to submit their paper as a review article for possible publication in *Palaeontology*.

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

Outreach and Engagement Grants

Awards are made to encourage educational outreach, public engagement, and related initiatives with 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; e-mail <**outreach@palass.org**>.

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

Awards and Prizes AGM 2015

Lapworth Medal: Prof. Jennifer A. Clack FRS

Matt Friedman, Per Ahlberg and Michael Coates write: Jenny Clack is one of those rare researchers who have more or less single-handedly been responsible for rejuvenating a whole field; in her case the palaeontology of the fish–tetrapod transition. When she began her scientific career in 1978, research on the earliest (Devonian, about 365 Ma) tetrapods and their fish ancestors was in a near-moribund state. Jenny began working on slightly later Carboniferous tetrapods under the supervision of Alec Panchen, an innovative researcher whose group at the University of Newcastle was the liveliest centre for lower vertebrate palaeontology in the UK at the time. A few years later, through a combination of acumen and good fortune, Jenny got wind of a rich new locality for the fragmentary Devonian tetrapod *Acanthostega* in Greenland. She organized an expedition, which brought back an astonishing collection of fossils that revolutionized our understanding of the earliest tetrapods. Since then she has gone from strength to strength, expanding her research to other Devonian tetrapods such as *Ichthyostega* and tackling the mystery of 'Romer's Gap', a fossil-poor interval at the beginning of the Carboniferous that probably coincides with the origin of the major extant tetrapod groups. She is currently leading a major research and collecting initiative that is amassing the first-ever extensive material of tetrapod fossils from this critical time interval.

The thriving state of early tetrapod research today, with a vigorous community of scientists producing a steady stream of high-profile publications, is almost entirely of Jenny's making; where she has led, we others have followed. Her outstanding research output, with a long series of papers in *Nature* and *Science,* is a major factor behind this; but just as important has been her encouragement of young researchers, her openness with data and specimens, and her refusal to use sharp elbows to get her way. She has set a tone of collegiality and fairness that has made the field a pleasure to work in and has also greatly aided its development by encouraging communication and exchanges of ideas.

Photo courtesy of Dave Marshall

Jenny's work now spans a much broader range of vertebrate groups, from early amphibians and amniotes to Palaeozoic bony fishes and sharks. Hearing systems in tetrapods and fishes represent a long-term interest, which has led to unconventional publication destinations, such as the *Journal of Neurobiology*, and collaborative projects on topics such as acoustic communication in mudskippers. Such research breadth underscores an important feature of Jenny's success: the readiness and ability to nurture active and free-ranging networks of colleagues.

Brilliant science is often collaborative; however, it sometimes requires the drive of one person to foster long-term projects by means of which significant progress is achieved. The latest manifestation of Jenny's energy is a newly initiated international, multidisciplinary collaboration to explore the evolutionary radiation of modern tetrapods in the post-Devonian world. And then there are her students, several of whom have achieved considerable success and prominence in their own right, have spread to Australia and Sweden, and have introduced many of the best new students into the broad field of palaeobiological research.

Honours awarded thus far include Foreign Honorary Membership of the American Academy of Arts and Sciences and the Daniel Giraud Elliot medal of the National Academy of Sciences, and an honorary doctorate from the University of Chicago. In 2009 she was elected a Fellow of the Royal Society. Thus, a broad and appreciative audience has clearly recognized Jenny's scientific and scholarly achievements already.

In summary, Jenny has produced an impressive record of ground-breaking publications in top-tier journals, written a landmark text in her field (*Gaining Ground*, which has been published in two English editions and a Japanese translation), secured more-or-less continuous research funding over the past two decades, and been recognized with a series of accolades ranging from honorary doctorates to fellowship in the Royal Society. Beyond these individual achievements and awards, however, it is the collective impact of Jenny's career that sends her sailing well above the bar set by the Association for this recognition. The Palaeontological Association website is admirably brief on criteria for the Lapworth Medal: "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". I hope you agree that Jenny Clack, an inspirational beacon of motorbiking women in science, qualifies.

President's Medal: Prof. Graham Budd

Photo courtesy of Dave Marshall

Nick Butterfield and Richard Fortey write: Graham is an international leader in early arthropod palaeobiology, the Cambrian explosion, and evolutionary theory. He is also one of very few palaeontologists who have mastered the field of evolutionary/developmental biology, with data from his lab providing a unique complement to his deep understanding of the fossil record. There is a decidedly upwards (and outwards) trajectory to Graham's research, and every indication that it will continue for the foreseeable future.

Graham's early research focused on exceptionally preserved – and, at first blush, profoundly problematic – arthropods from the early Cambrian Sirius Passet biota of North Greenland. From this came a series of exceptionally fine descriptive and analytical papers, including a comprehensive account of *Kerygmachela*, a fossil that now figures centrally in any discussion of early arthropod evolution (Budd 1999, *Transactions of the Royal Society of Edinburgh*). The real contribution of this work, however, was recognizing that the peculiar character combinations exhibited by these fossils derived from their stem-group status below the last common ancestor of all living arthropods. This led in turn to an inspired re-analysis of the whole mess of problematic Burgess Shale-type arthropods, yielding a fundamentally new appreciation of how the modern phylum evolved from their stem-group lobopodian ancestors (Budd 1996, *Lethaia*; 2002, *Nature*) – a beautiful demonstration of palaeontology cracking a seemingly uncrackable question in evolutionary biology.

With this key insight, Graham went on to champion the importance of stem-group representatives more generally, and applied it to the big issues in early animal evolution. Budd and Jensen (2000, *Biological Reviews*) is widely recognized as setting the standard for how to think phylogenetically, and critically, about the origin of phyla, the fossil record and the Cambrian explosion. Graham has taken a similarly incisive, intellectual approach to the question of why arthropods are segmented (Budd 2001, *Evolution & Development*), and the origin of major morphological characters (Budd 2006, *Biological Reviews*). It was a natural progression for him to move into the developmental biology of crown-group forms (onychophorans, tardigrades and priapulids), allowing him to dig more deeply – and with notable success – into the genetic basis of evolutionary issues prompted by the fossil record.

With his remarkable capacity to tackle new concepts, Graham has also made authoritative contributions to debates over the taphonomy and interpretation of early 'embryo' fossils, the role of oxygen in early animal evolution, and molecular clocks. Most recently he has added palaeoecology to this repertoire, offering a novel hypothesis on the evolutionary feedback effects of large size through the Ediacaran–Cambrian radiation (Budd and Jensen, submitted, *Biological Reviews*). More broadly still, Budd and Jensen are in the final stages of what looks to be a comprehensive and provocative book project on the Cambrian Explosion.

In addition to his multifaceted research, Graham has enthusiastically contributed to the communication and promotion of palaeontology to more general audiences, and by taking on a broad range of editorial tasks. He is a longstanding member of the Palaeontological Association and has contributed generously to its administration and publications over the years. As one of our most accomplished and capable palaeobiologists we recommend him for the 2015 Palaeontological Association President's Medal in the strongest possible terms.

Hodson Award: Dr Roger Benson

Photo courtesy of Dave Marshall

Paul Barrett writes: Roger's PhD thesis, on *Megalosaurus* and early theropod evolution, was an exceptional piece of work – completed in less than three years and fully published within only two years of his viva (leading to around eight publications). He required little substantive help from either of his advisors and quickly displayed a talent not only for anatomy and systematics, but also for the application of statistical and modelling analytical techniques to an array of different evolutionary and palaeobiological problems. Since then, he has gone on to build an impressive independent career, starting with the award of a prestigious Junior Research Fellowship at Trinity College, Cambridge. During this early phase of his career, Roger made an excellent decision to diversify and work on other clades in addition to dinosaurs – a group he recognized was already overcrowded. This led him to work first on synapsids and then on to marine reptiles, quickly becoming internationally recognized for his work on all three groups: an impressive achievement for someone within a couple of years of their PhD.

Roger has gone on to publish on evolutionary rates, palaeolatitudinal distribution patterns, and a large body of work dealing with sampling and geological biases in the vertebrate fossil record, as well as continuing taxonomic and systematic studies. All of Roger's publications are marked by incredible attention to detail and the highest possible level of analytical rigour. Many of his taxonomic studies are benchmarks for future work and he has been instrumental in helping to bring a degree of quantitative statistical power to bear on areas of the subject that were previously loaded with qualitative speculation and arm-waving. He has built a strong network of national and international collaborators and his analytical skills are in constant demand from other colleagues who benefit from his expertise. Over the past eight years, Roger has published 67 papers in peer-reviewed journals (with an H-index of 21), a phenomenal output, including first author contributions in *Science*, *Nature Communications* and *Proceedings B*, as well as many substantial monographic descriptions and other papers in venues such as *Biological Reviews*, *Paleobiology* and *Geology*. He is already recognized as a world-leader in many of the areas in which he publishes and his work engages strongly with evolutionary biologists as well as palaeontologists.

In addition to lab-based work, Roger has also instigated fieldwork projects in Mongolia, South Africa and the UK, contributing to his development as an all-round palaeobiologist. Since being appointed to a lectureship at the University of Oxford, Roger has started to build a substantial research group of his own, including several PhD students as well as MSc project students.

Roger takes scientific citizenship seriously and sits on a NERC training advisory group, has co-convened several symposia (each of which has led to a co-edited journal issue), and participated as a leader in a NESCENT workshop. He also serves as an editor on the boards of *Palaeontology*, *Acta Palaeontologica Polonica*, *Zootaxa* and *Palaeontologia Africana*, as well as frequently being called upon as both a grant and manuscript reviewer.

In summary, Roger is an exceptional, highly talented young scientist who has already made significant, lasting and clearly measurable contributions to the subject, both academically and in terms of broader service to the subject, and who has the potential to go on to be a world-class leader in this area.

Mary Anning Award: Lutz Koch

Thomas Servais writes: Lutz Koch was born in 1941 in North-Rhine Westphalia. He spent all his life in and around the town of Ennepetal (south of Bochum and Dortmund), on the border of the industrial coal-mining area of the Ruhrgebiet and the lovely countryside of the Sauerland that is a part of the Rhenish Massif. Trained as a primary school teacher, he spent all his life with children and transmitted to them his passion for the natural sciences. In the 1960s Lutz began being interested in the geology and palaeontology of the region where he lived and worked. In the early 1980s he began to publish several books and scientific papers, on both the geology (Ennepetal hosts one of the biggest flowstone caves in Europe) and palaeontology (from the Devonian, Carboniferous and Cretaceous) of the area around Ennepetal. His contributions to palaeontology are mostly focused on the Palaeozoic, in particular on the Ordovician, Devonian and Carboniferous. The fossils investigated by Lutz include many groups, both animals and plants.

Photo courtesy of Lutz Koch

Among the outstanding results of his work, Lutz published several papers on fossil insects, including the description of the oldest whip scorpion (Thelyphonida) known to date, found in the Upper Carboniferous of the Ruhr area. However, the most valuable discoveries by Lutz are probably those from the Ordovician. Very poorly preserved, the oldest rocks of the sequence in the Rhineland yield up their fossil content only with much effort. Lutz Koch spent hundreds of hours of meticulous collecting in order to document that the Ordovician of the Rhenish Massif belongs to the easternmost part of the palaeocontinent Avalonia (that included most of the southern part of the British Isles during the Early Palaeozoic). Professionals with publication pressure simply do not have the time (and patience) to sit at localities for many hours in search of the elusive rarity. However, Lutz has persisted for many years at collecting the fossils from the area, and has described them with his colleagues in great detail. In addition, he helped many professional scientists with his guidance in the field.

As an 'amateur', with no direct connection to a museum or a university, Lutz has authored and co-authored around 100 publications, both in books and in regional, national and international

journals, covering Ordovician trilobites, ostracodes, Devonian plants, phyllocaridids, gastropods, *etc.*, as well as Carboniferous insects and arachnids (for a complete list of his publications, see <**http://www.l-koch.de**>).

Lutz Koch's contribution to palaeontology is extraordinary, and therefore several colleagues from France, Belgium and the UK supported the nomination for the Mary Anning Award, including the Lapworth Medalists Prof. Richard A. Fortey and Prof. Euan N. K. Clarkson. While the former writes that Lutz Koch has "done a good – dare I say professional – job," the latter imagines "that Mary Anning herself would have found Lutz Koch a kindred spirit".

Unfortunately, Lutz was unable to attend the 59th Annual Meeting in Cardiff to receive the Mary Anning Award in person at the Annual Dinner. However, at a well-attended ceremony in January 2016 at the Infozentrum GeoPark Ruhrgebiet in Ennepetal, the Mary Anning Award was officially presented to Lutz, with laudations of the burgomaster of the city of Ennepetal, and several official representatives from the Geological Survey of North-Rhine Westphalia, the Palaeontological Institute of the University of Cologne, and the regional Industrie-Museum.

The award ceremony in Ennepetal. From left to right: Stefan Voigt (president, Arbeitskreis Kluterthöhle), Imke Heymann (burgomaster of Ennepetal), Lutz Koch, Dr Volker Wrede (Geological Survey NRW, Krefeld), Dr Thomas Servais (CNRS, Lille), Prof. Hans-Georg Herbig (Paleontological Institute, University of Cologne), Prof. Reinhard Döpp (Industrie-Museum Ennepetal). Photo courtesy of Dr Cordula Tomachewski.

Small Grant Awards AGM 2015

The small grants awarded by the Association for funding in 2016 include the Sylvester-Bradley, Callomon, Whittington and Stan Wood awards. Council agreed that the following applicants should receive Sylvester-Bradley awards: Claire Bullar (£1,500), David Marshall (£634), and Stephen Pates (£1,500). The Callomon Award was awarded to Neil Adams (£1,500), the Whittington Award to Dr Martin Smith (£1,500), and Stan Wood awards to Caitlin Colleary (£1,497) and Marco Marzola (£1,360). Details of the proposed research are given below.

Early Pleistocene palaeontology of Westbury Cave, Somerset

Neil F. Adams
Royal Holloway, University of London, UK

The majority of Early Pleistocene fossil-bearing sites in Britain are found in the Crag Basin in East Anglia. Despite covering large intervals of the Early Pleistocene, the shallow marine to estuarine Crag Group contains many unconformities, most notably between the British Pastonian and Cromerian Stages. Comparison with more complete deposits in the Netherlands suggests this hiatus may represent over one million years of missing time. A critical taxon in European biostratigraphy in this time interval is the widespread arvicolid *Allophaiomys*, which is absent from East Anglian sites (supporting the existence of a large time gap in the Crag Basin), but importantly has been recorded from Westbury Cave, Somerset. A lack of systematic sampling of the Early Pleistocene sediments from Westbury Cave prompted new excavations in 2014, which have revealed important new records of the rodent families Arvicolidae and Hystricidae, as well as new large mammal fossils (bovids, cervids, and hyaenids). Biostratigraphical correlations suggest the assemblage dates to between 1.8 and 1.1 Ma, partly filling the substantial gap in the Crag Basin. This project aims to conduct further excavations at Westbury Cave to extend the stratigraphy of the Early Pleistocene deposits, to take additional samples of the fossiliferous horizons to uncover the full extent of the fauna, and to take samples for coupled ESR-U-series dating to constrain independently the age of this unique site in Britain.

Braincase anatomy, phylogeny and the success of Neoceratopsia

Claire Bullar
University of Bristol, UK

The Ceratopsia has been studied since the late 1800s, with the diversity and phylogeny of the group becoming evident during Marsh and Cope's infamous Bone Wars. Since then, the diversity and understanding of phylogeny has been heavily studied and condensed. Through continual new discoveries and rapidly improving cladistic techniques, palaeontologists are getting ever closer to reaching a definitive consensus of ceratopsian phylogeny. Recent phylogenetic studies have divided Ceratopsia into several monophyletic and paraphyletic groups, but there are no comprehensive

detailed phylogenetic studies that encompass the whole of Ceratopsia. This visit will permit the addition of the derived Late Cretaceous ceratopsians that radiated so dramatically on the continent of Laramidia. The study of braincases and palaeoneurology has recently been transformed by the use of CT-scanning and 3D reconstruction. The ceratopsian braincase has been poorly described due to a high level of fusion and obscurity of cranial sutures, with Hatcher's (1907) descriptions being the most reliable study to date. This grant will allow me to travel to three North American institutions and collect photographs and phylogenetic data that will ultimately result in a grand ceratopsian phylogeny. I will also use this time to investigate which specimens would provide the most complete 3D braincase reconstructions through high-resolution CT scanning. These scans will be segmented and published as accessible 3D PDFs.

Biomolecule preservation through time: mapping bone degradation in fossil proboscideans from different depositional environments

Caitlin Colleary
Virginia Tech, USA

The chemical traces of life persist long after decay. However, the molecular degradation of bone is not well understood. I will analyse modern, experimentally matured and fossil bone to map the breakdown of organic compounds over time and determine if degradation is predictable. Proboscideans (elephants, mammoths and mastodons) are closely related and have a diverse fossil record from a number of different depositional environments, including natural asphalt, sinkholes and permafrost. Pyrolysis experiments, which approximate diagenetic conditions with temperature and pressure variables, will be conducted on modern elephant bone. The modern bone, experimentally matured bone, and fossils will be compared using time-of-flight secondary ion mass spectrometry (ToF-SIMS), a surface sampling technique which preserves information on the spatial distribution of molecules, allowing for the mapping of organic compounds. These analyses will lead to a better understanding of the fossilization of organic molecules and will demonstrate if there is characteristic variation based on depositional setting. Understanding how organic molecules degrade and fossilize will inform studies regarding the phylogenetic relationships of animals and the evolutionary history of bone.

Insights into chelicerate evolution through comparative cuticular analysis

David Marshall
University of Bristol, UK

Terrestrialization, the process of moving to live on land from water, is a complex ecological transition. Novel evolutionary adaptations must first be acquired to overcome factors such as salinity, desiccation and feeding. Unfortunately, our understanding of terrestrialization throughout geological history is hampered by the bias of the fossil record; the preferential preservation of hard body parts over soft means that the majority of information is lost in the fossilization process.

Bones and teeth can tell us about biomechanics and diet, but we normally have little else to draw upon. A group of animals that holds great potential to inform us about terrestrialization is the chelicerates. These, like all arthropods, possess a tough exoskeleton through which all of their ecological interactions must be conducted. Analyses of these cuticles has provided us with insights into their biomechanics, but they have thus far been overlooked as sources of palaeoecological information. To date, there exist no comprehensive comparisons of their sensory arrays or even the composition and construction of the cuticles themselves. Where the chelicerates differ from most fossil arthropods is that their cuticles are unmineralized, meaning that they are recoverable from rocks using acid maceration. Crucially, modern and fossil representatives from both terrestrial and aquatic realms exist, making them ideal candidates for study. Furthermore, the phylogenetic relationships of the chelicerate orders are in need of revision. This grant is to enable a comprehensive comparative study of modern chelicerate cuticles. This will provide the context for the understanding of fossil cuticles, helping to ascertain the terrestrialization process in chelicerates.

The Late Triassic amphibian and reptilian fauna of the Jameson Land Basin (East Greenland) and its comparison with coeval European faunas

Marco Marzola
University of Copenhagen, Denmark

During the Late Triassic (~215 Ma), Greenland lay further to the south than today, at around 40–45°N, the modern latitude of Galicia and northern Portugal. Thanks to its palaeogeography and palaeoenvironments, the Fleming Fjord Formation of the Jameson Land Basin (East Greenland) offers one of the richest Late Triassic vertebrate faunas of its kind in the world, including fishes, amphibians, early mammals and a plethora of reptiles such as turtles, phytosaurs, aetosaurs, pterosaurs and dinosaurs. Many of these taxa are known from very well-preserved and nearly complete material collected during various expeditions in the 1990s and one in 2012. Despite its outstanding preservation and completeness, most of the vertebrate material has yet to undergo detailed anatomical and osteological comparison and description, as well as phylogenetic analyses. Some of these unstudied remains may represent new species, and their detailed study will help fill gaps in the anatomical and osteological descriptions, as well as in the phylogeny, of many taxa. This project focuses specifically on the comparison of the Greenland temnospondyl, aetosaur, turtle, and prosauropod dinosaur material with other Late Triassic taxa from Europe.

Diversity and ecology of the anomalocaridids of the Great Basin, USA

Stephen Pates
University of Oxford, UK

I will be using the Small Grant provided by the Palaeontological Association to visit three museums, namely the Smithsonian, Yale Peabody Museum and the University of Kansas Natural History Museum. I will be examining and redescribing anomalocaridid specimens from the Great Basin

Region in North America. The Great Basin Region contains a number of Mid-Cambrian Lagerstätten, providing a diverse assemblage of fossil arthropods, brachiopods, echinoderms, sponges and hyolithids. Amongst these body fossils, mouth parts and appendages of the Cambrian's most famous apex predators, anomalocaridids, provide an opportunity to study and understand what kinds of prey they could have attacked, whether they are capable of causing so-called trilobite 'bite marks' and whether they may have been competing for similar prey, or if they had their own ecological niches. The Great Basin anomalocaridids have been described in disparate papers, many of them over 25 years old. New studies in the last few years have improved our knowledge of anomalocaridid anatomy, and new techniques, such as the use of polarized lighting, allow more detail to be seen from these fossils. A recent study of anomalocaridids from the Canadian Burgess Shale showed an apparent decrease in their diversity over time. As there are Great Basin sites both younger and older than those of the Burgess Shale, this gives us a unique chance to extend the knowledge of anomalocaridid diversity in North America through time.

Vetulicolian affinities reconsidered through the lens of ecdysozoan anterior organization

Martin R. Smith
Durham University, UK

The Cambrian period boasts a great diversity of enigmatic non-biomineralized metazoans that have traditionally been regarded as 'weird wonders'. New data from exceptionally preserved fossils, combined with advances in the application of cladistic-based methodologies, have begun to constrain the higher affinities of many of these problematica – although some of these forms nevertheless remain difficult to interpret due to their unusual morphologies. This is particularly true of the vetulicolians – a group of early to middle Cambrian metazoans known from several konservat-lagerstätten. These distinctive animals consist of a barrel-shaped carapace followed by a clearly segmented paddle-like tail. Recent accounts tend to position vetulicolians within deuterostomes, but the radially-arranged sclerotized plates that surround the vetulicolian mouth opening could be taken to suggest a broad affinity with Ecdysozoa (moulting animals). This project will use Burgess Shale material to re-evaluate the morphology and evolutionary significance of vetulicolians. Vetulicolian relationships will be critically tested through a developmentally-informed phylogenetic analysis that integrates recent data on the homology of the anterior region in the major metazoan lineages. Altogether, this analysis aims to resolve the long-standing controversy of vetulicolian affinities within Bilateria, revealing the full evolutionary significance of this esoteric group.

Palaeontological Association Undergraduate Prize Scheme

We have made some changes to the way in which this scheme operates because our previous practice of writing to individual British and Irish departments in May has not been 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 is continuing and, as of last year, has been extended to undergraduate students in other countries, but we no longer send out invitations to individual departments. Instead 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.

Jo Hellawell
Executive Officer

ASSOCIATION MEETINGS

60th Annual Meeting of the Palaeontological Association
Université Claude Bernard Lyon 1, France *14 – 17 December 2016*

The Annual Meeting of the Palaeontological Association will be held at the University Claude Bernard Lyon 1, organized by Gilles Cuny, Bertrand Lefebvre, Vincent Perrier and Jean Vannier, with the help of the "Cellule Congrès" of the University.

Symposium
The meeting will begin with a Symposium in the afternoon of Wednesday 14th December at the Rockefeller Conference Centre of the University Claude Bernard Lyon 1, followed by an evening reception at the Villeurbanne City Hall.

The topic for the Annual Symposium this year is 'Assessing palaeoenvironments and palaeobiology through geochemistry'.

Conference and Annual Address
The conference will be held at the Rockefeller Conference Centre and will begin on Thursday 15th December with a full day of talks and posters. The Annual Address will be given by Prof. Manolo Gouy (University Claude Bernard Lyon 1) on the topic "Molecular thermometers: reconstructing the evolutional history of the adaptation to environmental temperature along the tree of life". In the evening there will be a nocturnal visit to the new museum "Musée des Confluences" followed by the Annual Dinner on the banks of the river Rhône.

Friday 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 time for questions.

The Association AGM will take place after lunch, and a wine and local products tasting session will be organized at the end of the day.

Field trip
A field trip to the city of Autun, approximately 190 km North of Lyon, is planned for Saturday 17th December. We will visit the Natural History Museum in Autun as well as the type localities for the Autunian in the area, which have yielded among many other things the temnospondyl *Onchiodon (Actinodon) frossardi*. Access to the collections of the Museum could be arranged rather than to go in the field for those interested.

Getting to Lyon

By Train
The centre of Lyon is connected to all major French cities by the high-speed TGV trains via the three stations of Perrache, Part Dieu and Lyon-Saint Exupéry. Lyon Part-Dieu railway station is just two hours from Roissy CDG airport by TGV and there is also a direct connection from London St Pancras to Lyon Part-Dieu, but only on Saturdays during December. For the rest of the week, you'll need to change trains either in Lille or in Paris. It is easier to do so in Lille, as in Paris you'll need to change stations (from Gare du Nord to Gare de Lyon). For information see <**http://www.eurostar.com/**>.

By Coach

Lyon is served by a few regular coach services from towns and cities across France; these are often cheaper than trains. For information see Starshipper Bus (<**www.starshipper.com/en/starshipper-bus_p191**>) and Flixbus (**www.flixbus.com**).

By Car

There is limited parking around the University, and almost none on campus, so driving to the meeting venue is not the best option. Lyon is two hours away from the Alps. Distances from other cities by road:

Paris–Lyon: 465 km (A6);

Marseille–Lyon: 315 km (A7);

Geneva–Lyon: 149 km (A40);

Montpellier–Lyon: 303 km (A7-A9).

By Plane

Lyon-Saint Exupéry International Airport offers more than 115 direct connections, including regular flights to 68 international destinations, daily flights to 29 destinations in France, and low-cost airline companies connected to several European destinations. There are direct connections to Lyon for participants arriving at Paris CDG Airport by plane or by train.

An express tramway, Rhônexpress, links the Lyon-Saint Exupéry airport to the central Lyon Part-Dieu railway station in 25 minutes, with departures every 15 minutes, guaranteeing safe swift access to the heart of the city. Note that it is cheaper to buy the tickets in advance on the Internet or at the station rather than inside the trams. Website: <**www.rhonexpress.fr/**>.

Public Transportation in Lyon

The network of metros, trams and buses of the T.C.L. (Transports en Commun Lyonnais – Lyon Public Transportation) enables rapid and easy transport from one place to another in the city and its suburbs through four metro lines, five tram system lines, two cabin transport lines and more than 130 urban bus lines.

The Rockefeller Conference Centre is served by metro D, two tram lines (T2 and T5), and six bus lines (C8, C13, C16, C22, C26 and 24), station “Grange Blanche”. Website: <**www.tcl.fr**>.

Registration and booking

Registration, booking and abstract submission will commence in June 2016. Abstract submission will close in September (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 €50, with the final deadline for registration in November 2016. Registration 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 (<**www.palass.org**>) from June 2016.

Accommodation

Accommodation is available within walking distance of the University and should be booked separately. Lyon has an accommodation capacity of more than 17,000 rooms in hotels and apartment hotels, which can be booked through the usual online resources (see for example <**www.booking.com/lyon-hotels**>).

Greater Lyon offers a choice between the charm and elegance of châteaux hotels and the dependable comfort of major international chains (Accor-Sofitel, Mercure-, Best Western, Boscolo, Crowne Plaza, Hilton International, Holiday Inn, Louvre Hotels, Relais & Châteaux, Radisson BLU, Warwick).

The conference organizers will book a block of rooms and studios (up to four persons) at the Appart'hôtel Odalys Bioparc, just behind the Rockefeller Conference Centre. Prices will range from approximatively €22 in a shared studio to €89 per person per night. To make your reservation e-mail <**bioparc@odalys-vacances.com**>, using the code 'UCBL1'. Please mention the name of the Meeting. The deadline for reservations is 13th November 2016. After this date, reservations will still be possible with the code 'UCBL1' depending on availability.

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 Lyon 2016 meeting, grants of up to £100 (or the euro equivalent) will be available to student presenters who are travelling from outside France. 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 Jo Hellawell (e-mail <**jo.hellawell@palass.org**>) once the organizers have confirmed that their presentation is accepted, and before 1st December 2016. Entitle the e-mail "Travel Grant Request". No awards can be made to those who have not followed this procedure.

Collections

Attendees who would like to take this opportunity to visit the palaeontological collection of the University Claude Bernard Lyon 1, the largest French university collection, or the palaeontological collection at the Musée des Confluences Centre de Conservation et d'études des Collections need to contact Emmanuel Robert (e-mail <**emmanuel.robert@univ-lyon1.fr**>) for the former and Didier Berthet (e-mail <**didier.berthet@museedesconfluences.fr**>) for the latter, well in advance of the Annual Meeting, to arrange their visit.

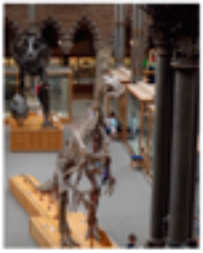
Lyon

Lyon (<**http://www.onlylyon.com/en/visit-lyon.html**>), Capital of Gaul, is an ancient Roman city and a UNESCO world heritage site. It is also a world capital of gastronomy with, among many others, Paul Bocuse restaurants. It is situated in the middle of famous vineyards (Beaujolais – Côtes du Rhône). The "festival of lights" will take place a few days before the Conference.

Logo and slogan

The Little Prince (Le Petit Prince) is the most famous of the novels by French writer, poet and pioneering aviator Antoine de Saint-Exupéry. This poetic tale is named after its main character, a young boy represented in our logo. The Little Prince is the fourth most-translated book in the world and was voted the best book of the 20th century in France. Translated into more than 250 languages, it has become one of the best-selling books ever published. Because Saint-Exupéry was born in Lyon (29th June 1900) and gave his name to the Lyon Airport, we thought it relevant to use the Little Prince as the ambassador for the Annual Meeting in Lyon. The Little Prince logo is used with kind permission of the Succession Antoine de Saint-Exupéry. "Draw me a sheep" is a famous catch phrase of the Little Prince and inspired our slogan "Draw me a trilobite", inviting colleagues to present their work in Lyon.

We look forward to seeing you in Lyon in December!



Progressive Palaeontology

Oxford 2016

Held in the historic Oxford University Museum of Natural History and the contemporary Department of Earth Sciences

19th - 22nd May 2016

19th May: Registration and Icebreaker reception in the Museum
20th May: Talks and poster session, followed by the conference dinner at Exeter College
21st-22nd May: Museum tour (21st) or field trip (both days)

> Competitive travel grants available for overseas attendees
>Free registration

Join us in Oxford for Prog Pal 2016!

Meet with fellow early stage palaeontologists in our 'Cathedral of Science', the University Museum of Natural History. Join us for drinks and nibbles during the Icebreaker, followed by a day of stimulating talks and posters. Have coffee looking out over the Oxford skyline from the Earth Sciences department. To conclude the day, relax and enjoy the conference dinner and auction.

Hunt for three-dimensionally preserved vertebrate and invertebrate fossils on our two day field trip to the Isle of Sheppey. Alternatively, take a behind the scenes tour of the musuem collections.

Follow us on social media for further information:

Progressive Palaeontology 2016 **@ProgPal2016**

Email: progpal2016@palass.org

news

Paper prizes

The Palaeontological Association has initiated two new annual prizes awarded to the best papers published in *Palaeontology* and *Papers in Palaeontology*. These are to recognize and reward excellence in our field of science and also to encourage the submission of high-quality papers to our journals.

The prize is open to all authors irrespective of age and nationality; membership of the Association is not a requirement. Frontiers reviews, rapid communications and regular research articles are all eligible. The corresponding author of the winning paper is offered gold open access, paid for by the Association, for one nominated paper submitted by her/him (or one of her/his nominated co-authors) to *Palaeontology* or *Papers in Palaeontology* within the following 18 months (subject to our standard peer-review process).

So how does it work? At the end of the year, when we know all of the papers that are going to be published in the annual volume, I ask the science editors (who have had the task of steering these papers through the review process) to nominate any papers that they feel stand out as particularly noteworthy. What we are looking for are papers that have scientific breadth and impact, high quality of writing and illustration, and novelty. For *Papers in Palaeontology* it is novelty, breadth and importance of the fauna or flora that we are seeking, while for *Palaeontology* we are looking for those papers that have a wide impact and will shape future research directions in palaeontology. The nominated papers are then circulated around the Editorial Board and voted on.

The competition for 2015 was strong but the two papers that won are exemplary.

For *Palaeontology* the best paper prize went to:

- Holland, S. M. and Patzkowsky, M. E. 2015. The stratigraphy of mass extinction. *Palaeontology*, **58** (**5**), 903–924.

Background processes of rock deposition cause stratigraphic condensation that can bias the results of the most detailed stratigraphic studies of mass extinctions. In this paper, the authors dissect the effects of these biases using simulations, propose tests for distinguishing genuine extinction pulses from stratigraphically-determined clusters of last occurrences, and show that they might have influenced our understanding of four of the 'Big Five' Phanerozoic mass extinction events. The work has broad and lasting interest for all those palaeontologists, geologists and evolutionary scientists interested in the timing and pace of mass extinction events.

For *Papers in Palaeontology* the best paper prize went to:

- Popov, L. E., Holmer, L. E., Hughes, N. C., Ghobadi Pour, M. and Myrow, P. M. 2015. Himalayan Cambrian brachiopods. *Papers in Palaeontology*, **1** (**4**), 345–399.

This represents a substantial piece of taxonomic revision covering 18 genera from a critical time interval and from a very under-explored part of the world. The material is beautifully illustrated and the addition of a palaeobiogeographical analysis brings additional value to the paper.

The prizes were awarded at the Annual Meeting of the Palaeontological Association in Cardiff and my congratulations go to the prize winners.

Andrew B. Smith
Editor-in-Chief

Palaeontology in the news

For those of us tasked with keeping an eye on the mainstream media, how has palaeontology fared these last few months? Well, of course, the biggest story of all appeared in January, in that bastion of codswallop-peddling, the *Daily Express*: <**http://www.express.co.uk/news/science/637895/Mind-blowing-discovery-Fossils-of-prehistoric-sea-creature-found-on-Mars**>. My mere words cannot do the article justice, so I urge you simply to click on the link and enjoy its magnificence. Sorry, endure its mind-smashing dreadfulness.

Back on planet Earth, in reviewing a synchrotron study of some exceptional Palaeogene beetles, *Phys.org* informed us enlighteningly that fossils are "a rich source of information" (<**http://phys.org/news/2016-02-fossils-rich-source.html**>). Perhaps their readership have little grounding in palaeobiology, but surely a more informative headline could have been dreamt up. The organization did at least accurately determine the phylum to which beetles belong, however. In an attempt to summarize new research on brood care in the Burgess Shale taxon *Waptia*, the *Financial Times*' sub-editors announced that "Discoveries by researchers reveal the various ways early antropods protected their offspring": <**http://www.ft.com/cms/s/0/1dc62468-b3ef-11e5-8358-9a82b43f6b2f.html**>. If any antropologists out there wish to write a letter of correction to the august journal, I urge you to do so.

In late 2015, the article "A new ophthalmosaurid ichthyosaur from the Early Cretaceous of Colombia" by Erin Maxwell and colleagues was published online in *Papers in Palaeontology*: <**http://onlinelibrary.wiley.com/doi/10.1002/spp2.1030/abstract**>. The abstract mentioned that the skull of *Muiscasaurus catheti* displayed an "unusual configuration of the external narial opening", and this caught the attention of a few online media… "There was once a marine reptile

that had four nostrils," remarked *BBC.com* (<**http://www.bbc.com/earth/story/20151018-strange-nosed-ichthyosaur-discovered**>, explaining that the very strange nose belonged to a juvenile, slender-nosed fish eater from tropical waters. The article was picked up and regurgitated – a bromalite? – by *Red Orbit*, who ungraciously compared *M. catheti* to a 'weird-looking dolphin' (<**http://www.redorbit.com/news/science/1113410009/this-weird-looking-dolphin-like-marine-reptile-had-4-nostrils-101915/**>). *Science Recorder* focused instead on the diversity of marine reptiles in the Cretaceous tropics (<**http://www.sciencerecorder.com/news/2015/10/22/new-ichthyosaur-suggests-diverse-marine-reptiles-cretaceous-tropics/**>), noting that Colombia "was situated at between 5.6 and 7.5 degrees North [in the Early Cretaceous], comparable to its present latitude of 5.6 degrees North". That might not be especially informative, but the article did at least look at other ichthyosaur species that had been described from the region.

Closer to home, and on non-tropical dry land, there was plenty of interest in late January in the naming of a theropod found in the Early Jurassic rocks of south Wales. Now housed in the National Museum of Wales, the diddy dinosaur was named *Dracoraptor hanigani*, and unsurprisingly generated headlines. "Real Welsh dragon found … on beach," declared the *Daily Mirror* (<**http://www.mirror.co.uk/news/technology-science/science/real-welsh-dragon-found-200-7213719**>), with an – unreferenced – claim that it was "the closest scientists have come to identifying a real-life dragon". *CBBC Newsround* said that "at 201 million years old, [*Dracoraptor*] could be the oldest known Jurassic dinosaur from the UK" (<**http://www.bbc.co.uk/newsround/35372305**>), but the *Daily Mail* was much more assertive, claiming it to be "the oldest Jurassic dinosaur ever found" (<**http://www.dailymail.co.uk/sciencetech/article-3407080/Oldest-Jurassic-dinosaur-named-Hanigan-dragon-robber.html**>). Well, either "the first Jurassic dinosaur, or the last Triassic", but certainly definitive in some way. My favourite headline was *Reuters*' though, as they plumped for announcing that " 'Dragon thief' dinosaur thrived after primordial calamity" (<**http://in.reuters.com/article/science-dinosaur-idINKCN0UZ01D**>) and referred to *Dracoraptor* as 'modest'.

Staying in Cardiff, the 2015 Annual Meeting saw the Mary Anning Award given to Lutz Koch. Lutz was not able to be present in person, so Thomas Servais travelled to the National GeoPark Ruhrgebiet to make the award (<**https://akkhev.wordpress.com/2016/01/29/marie-anning-award-fuer-lutz-koch/**>). The German press were alerted, and though *mein Deutsch ist nicht gut*, I can at least direct you towards coverage of a 'Prestigious Award for Lutz Koch': <**http://www.derwesten.de/staedte/schwelm/hohe-auszeichnung-fuer-lutz-koch-aimp-id11519125.html**>. If there are other PalAss-related news stories in languages other than English, please do send them my way.

Liam Herringshaw
<publicity@palass.org>

Featured article

I have long been interested in the pioneers of our subject, such as the eccentric English geologist William Buckland. Together with Robert Jameson, Buckland was largely responsible for Catastrophism taking on creationist overtones in Britain. Jameson translated Georges Cuvier's work on fossil quadrupeds, and somewhat sneakily added 'Geological Illustrations' explicitly linking the most recent of Cuvier's catastrophic extinctions with the biblical flood. In the meantime Buckland was compiling geological evidence to prove the existence of 'The Flood', frequently (and incorrectly)

citing poor Cuvier's work. Eventually, Buckland gave up on the biblical flood, and became convinced that Louis Agassiz' glaciation theory provided a better explanation for the history of the Earth.

William Conybeare's 1822 cartoon of the eccentric geologist William Buckland poking his head into a hyena den. Buckland was probably looking for his next meal.

However, it is not Buckland's creationist ideas that interest me, but his hobby of zoophagy – which he believed made him a better palaeontologist. He claimed to have eaten his way through the animal kingdom and when hearing of the heart of a French King preserved in a silver casket (supposedly that of Louis XIV), he is said to have eaten that as well. Almost a century after Buckland's death, the Explorers Club were reputedly noshing on another extinct meat: woolly mammoth (*Mammuthus primigenius*) from the frozen wastelands of Alaska. Their famous 1951 dinner has become an enduring legend for the Club and began its notorious tradition of serving rare and exotic food. By the time you read this, guests at the 112th annual dinner will have celebrated 'OCEANS: Current of Life' by tucking into a selection of marine invasive species at the Waldorf Astoria. But what of the woolly mammoth that started this annual tradition?

The cooked meat tissue served at the 1951 Explorers Club Annual Dinner featured in Glass et al. *2016. Courtesy of the Peabody Museum of Natural History, Yale University, New Haven, CT.*

A new study in *PLoS One* by Jessica Glass and colleagues from Yale has shed light on a legendary dinner that has become something of a foodie mystery. The dinner's organizer, a theatre impresario by the rather grand name of Wendell Phillips Dodge, sent a sample of leftover meat from the 1951 meal to the Bruce Museum in Connecticut, where it was labelled as the extinct South American giant ground sloth (*Megatherium*), not mammoth. No surprises so far: the meat was originally billed on the menu as *Megatherium*, only for a club member and journalist at the Christian Science Monitor to twist the story. However, even if the meat was 'only' ground sloth, the remarkable find would extend the species' known range all the way from South America to the Aleutian Islands. In 2001 the sample was moved to the Yale Peabody Museum, and now despite the fact that the meat was cooked, and supposedly thousands of years old, Glass and colleagues managed to sequence a fragment of its mitochondrial

cytochrome-b gene. Their results indicate that the meat is not *Mammuthus* or *Megatherium*, but is in fact green sea-turtle (*Chelonia mydas*). Turtle soup was also on the menu that night, and not long after the dinner, Dodge half-heartedly confessed his treachery. He wrote in a club publication that he had found "a potion by means of which he could change, say, Cheylone midas Cheuba [sic] from the Indian Ocean into Giant Sloth".

So, Dodge by name, dodgy by nature. It seems the prehistoric dinner was nothing more than an elaborate publicity stunt. Nevertheless, as Glass and colleagues point out, their "study emphasizes the value of museums collecting and curating voucher specimens, particularly those used for evidence of extraordinary claims". Horse meat burger, anyone?

David Bond
University of Hull

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Marsh Award for Palaeontology

Dean Lomax is the recipient of the prestigious Marsh Award for Palaeontology for 2015, and the youngest individual to receive this honour to date. The Award was presented by Brian Marsh OBE on behalf of the Marsh Christian Trust and the Natural History Museum, London, where the presentation was held in November. The purpose of the annual Marsh Award for Palaeontology is to recognize those who have made an outstanding or cumulative contribution to palaeontology in the UK, yet whose efforts have not necessarily been widely recognized. The Award was given for the impressive number of publications that Dean has authored at such a young age, together with his tireless efforts at improving and bringing recognition to the importance of the palaeontology collection at the Doncaster Museum, and for his contribution to the public understanding of dinosaurs in the UK. This was seen most recently when Dean led the two-part ITV documentary "*Dinosaur Britain*" which aired on national television at the end of August, co-presented by Ellie Harrison of "*Countryfile*". The series was based on his successful book, "*Dinosaurs of the British Isles*", published by Siri Scientific Press in 2014.

Dean at the NHM with Brian Marsh OBE (photograph © NHM, London).

John Nudds
University of Manchester

The Virtual Natural History Museum

A crowd-funding page for the Virtual Natural History Museum (V-NHM) project has recently been launched. The V-NHM is an educational website designed to address the needs of the Earth Science Teachers' Association, as outlined in *Newsletter* 80. It will collate palaeontological multimedia, sourced from the digitized collections of museums, under specific points of the UK's Geology curricula, providing a valuable resource for teachers and students alike. The V-NHM itself will appear and function just like a computer game: the user will explore the exhibits, just as they would do in real life, but using an avatar. It will contain all the facilities of a world-class museum, including prep labs, an imaging suite and a lecture theatre. The project is 50% funded through grants from the Palaeontological Association and the Geologists' Association. Please help fund the project here: <**https://walacea.com/campaigns/the-virtual-natural-history-museum/**>; any donations or promotion would be greatly appreciated.

Dave Marshall
Palaeocast

Scarborough Museums Trust to appoint a Geologist

Scarborough Museums Trust manages "Rotunda – the William Smith Museum of Geology", an iconic building opened in 1829 and designed under Smith's guidance to illustrate his principles of correlation and dating by means of fossils. The Trust seeks to appoint a geologist to further develop its role as the centre of geological activity on the NE Yorkshire coast and moors, including reinvigorating the Dinosaur Coast project, initiating a Geopark proposal, and liaising with appropriate geological groups, companies, potential sponsors and supporters. The appointee will also care for and improve access to the geological collections of Scarborough Museums Trust and improve geological displays in the Rotunda. The post is for two years in the first instance, at a starting salary of £24,000. Flexible working arrangements will be considered. Further details may be obtained on our website at <**www.scarboroughmuseums.com**>. Applications should be sent to Ruth Lilley, Scarborough Museums Trust, Woodend, The Crescent, Scarborough YO11 2PW, or by e-mail to <**ruth.lilley@smtrust.uk.com**>. Closing date for applications is **Friday 8th April 2016**.

Ruth Lilley
Scarborough Museums Trust

Fossil Hunters

Fossil Hunters is a new exhibit at National Museums Scotland, Edinburgh, UK that runs until 14th August 2016. The exhibit focuses on the earliest invasion of land by tetrapods and, in particular, the work of a team of UK-based scientists led by Prof. Jenny Clack from the University of Cambridge. For a long time the paucity of tetrapods in the Early Carboniferous was considered a major gap in the fossil record, but now, thanks to the work of the TW:eed (Tetrapod World: early evolution and diversification) team, this gap has been plugged. The research owes much

to Stan Wood and his discoveries in the Scottish Borders, and the TW:eed team has been able to build on his wonderful legacy with further remarkable discoveries of their own. The team have investigated not only tetrapods, but all aspects of the sedimentology, fauna and palynology to gain a clear insight into the unique environment in which tetrapods truly did gain ground. The exhibit highlights the work of team members through videos, brings the ancient environment to life with dynamic restorations and, of course, features at the centre some of the fossils themselves.

Carys Bennett
University of Leicester
<www.tetrapods.org>

Image courtesy of Mark Witton.

Brymbo Fossil Forest on display

A major exhibition dedicated to telling the story of the Brymbo Fossil Forest is now on show in Wrexham, UK. The star exhibit of *Swamp Land: Brymbo 300 Million Years Ago* is a two-metre-high *Stigmaria* fossil with a root span of four metres, which has been carefully conserved and re-assembled for the exhibition. The exhibition is spread over two galleries: the first gallery contains the *Stigmaria* specimen and introduces visitors to life in the Carboniferous period; the second space allows visitors to explore the story of the swamp land in more depth, as well as setting the fossil forest in its geological and historical context. *Swamp Land: Brymbo 300 Million Years Ago* is on show at Wrexham County Borough Museum & Archives until 4th June 2016. Admission is free. For more information visit <**www.wrexham.gov.uk/english/heritage/swampland/index.htm**>.

Jonathon Gammond
Wrexham County Borough Museum & Archives
<museum@wrexham.gov.uk>

CORSTIR:
BRYMBO 300 MILIWN O FLYNYDDOEDD YN ÔL

Arddangosfa ynglŷn â Choedwig Ffosilau fyd-enwog Brymbo mewn partneriaeth ag Amgueddfa Cymru

30/01/2016 - 04/06/2016

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BRYMBO 300 MILLION YEARS AGO

An exhibition about the world-famous Brymbo Fossil Forest in partnership with Amgueddfa Cymru - National Museum Wales

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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 subsidized 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 subsidizes 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 subsidized 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 prioritized. 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

Charles Lapworth: from Arts to Sciences and Amateur to Professional

Charles Lapworth began as a modest and self-taught 'amateur', but quickly established himself as a highly respected and ground-breaking geologist. He was drawn to controversies and their resolution, and had no qualms with challenging accepted views – a breath of fresh air for the geological community during the second half of the nineteenth century.

Professor Charles Lapworth FRS (1842–1920) during a field excursion to Corndon Hill in the Welsh Borders. Reproduced with kind permission of the Lapworth Museum, University of Birmingham.

Early years

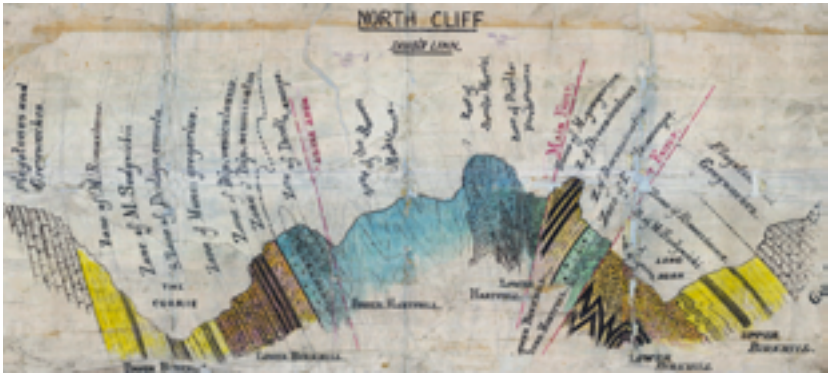
Charles Lapworth was born in 1842 at Faringdon in Berkshire, UK. From an early age he was an omnivorous reader, borrowing books from the extensive library of the parish vicar. In 1862 he began teacher training at Culham College in Oxfordshire, focusing on his early interests in art and literature. His College record noted that he was "Intelligent of appearance, of uniformly good character and seemed energetic", and his later geological work confirms these early observations. In 1864, he departed for Galashiels in the south of Scotland to take up a teaching post, before moving to Madras College in St Andrews where he taught English from 1875. Following health issues, his doctor advised him to take up open-air pursuits, and soon the landscape of the south of Scotland, combined with his enquiring mind, ignited his interest in geology and he began carrying out extensive fieldwork.

Southern Uplands and stratigraphy

Becoming familiar with the current geological interpretations of the area, Lapworth wanted to test their rigour. The rocks of the Southern Uplands had been regarded as almost barren of fossils, yet Lapworth's meticulous approach to fieldwork and collecting quickly revealed a rich graptolite fauna. The humble school master from Galashiels was being transformed, through his own efforts and teaching, into the geologist whose work would impact greatly on the geological sciences. The geologist was born and the way paved for his stratigraphic work (Elles 19__?).

Lapworth adopted a more detailed approach to geological field mapping than that used by the Geological Survey, which allowed him to record in detail the rock units and associated graptolite sequences. His large-scale mapping technique, and ability to use the graptolite fauna to zone and correlate the sequences, proved vital for his interpretation of the geological structure and history of the region. The self-taught amateur geologist's work caused some irritation with the professionals, as the Geological Survey had to re-map and re-interpret the entire area. Yet Lapworth's approach had been rigorous, scientific, and extremely 'professional'. In 1899 the Survey produced the great *Memoir on the Geology of the Southern Uplands of Scotland*, which has been described as 'a monument of the man [Lapworth] who made it possible'.

Lapworth's archive at Birmingham details his Southern Uplands work, and also demonstrates the benefits of his art and literature background. His beautifully drawn sketches, sections and teaching aids are supported by eloquent notes, letters and explanations, recording how his thoughts and theories were developing and coming to fruition.



Lapworth's hand-drawn teaching aid showing a section of the North Cliff at Dob's Linn in the Southern Uplands. Reproduced with kind permission of the Lapworth Museum, University of Birmingham.

Lapworth's grasp of Lower Palaeozoic rocks led in 1879 to his resolving of the Cambro–Silurian controversy. The division, and boundary, between Sedgwick's Cambrian System and Murchison's Silurian System had been argued for many years. Lapworth resolved the issue having identified three distinct Lower Palaeozoic faunas. He used these to divide the Lower Palaeozoic into three stratigraphic units – the Cambrian, his proposed Ordovician, and the Silurian. The resolution was simple and tactful, giving no particular favour to either of the disputing parties; ultimately a successful result, particularly for Lapworth and the Ordovician.

More controversy in NW Highlands

In 1881, a growing reputation resulted in Lapworth being appointed to the Chair of Geology and Mineralogy at the newly formed Mason College of Science in Birmingham, which in 1900 became the University of Birmingham. Lapworth immediately turned his attention to the geological structure of the Northwest Highlands, another long-running controversy involving a number of parties but particularly Murchison, Nicol, Bonney and Callaway. In the summer of 1882 Lapworth applied detailed mapping techniques in Durness before moving on to Eriboll. He dealt with the

task at a relentless pace, and believed he had resolved the NW Highlands problem by the end of that season. Lapworth realized that the superposition of metamorphosed gneiss and quartzite on top of limestone was due to complex, contractional folding and faulting – due to what we would now call thrusting. He also recognized the significance of the rocks that he termed mylonites. It is clear from both his NW Highlands and Southern Uplands work, recorded in his sketches, annotations and doodlings, that Lapworth possessed an exceptional ability to perceive geological structures in 2D and 3D, without the computer-aided modelling and visualization tools of today.

Returning to Eriboll in 1883 to gather more evidence, the excitement of solving the controversy, and the physical exhaustion due to his methods, took its toll. He had a severe illness, partly of psychological origin, and experienced disturbing nightmares. Despite this, he was able that year to publish his initial results in his paper "The secret of the Highlands".

Lapworth always expected scientific rigour in theories and interpretations, but would not dismiss other people's ideas, even if he didn't accept them. He preferred tact, respect and recognition over confrontation. His 1885 note on *The Close of the Highland Controversy* recognized all the parties involved when writing: "The old subject of dispute has disappeared, and there is no longer any reasonable excuse for dissension. We have all been partly right and partly wrong. It is time for a hearty laugh all round, a time to shake hands and be friends".

Birmingham and the Midlands

Returning to Birmingham, Lapworth's research focus changed to the Midlands and Welsh Borders. Again, his approach was to consider the accepted geological interpretations and to rigorously test their validity. Important discoveries were made, for example at Comley Quarry near Church Stretton in Shropshire, where Lapworth found the first Lower Cambrian fauna known in Britain at that time.

Around 1888, collaboration began between Lapworth and Charles Doolittle Walcott, then with the USGS, later Secretary of the Smithsonian and discoverer of the Burgess Shale fauna. Both men were working on Cambrian faunas, on the opposite sides of the Atlantic, and began regular correspondence, exchanging their ideas and also Cambrian fossil material. Their letters contain scientific dialogue, but also display a friendship through their discussions regarding family, friends, and bereavements during the Great War.

Stratigraphy *vs* Palaeontology

A document in the Lapworth Museum archive, written by Getrude Elles, implies that 'to Lapworth, palaeontology was always the complement of stratigraphy, its handmaid never to be its mistress' (apologies readers!). Lapworth himself made major contributions to both fields, he recognized the biostratigraphical significance of graptolites in the Southern Uplands, and defined the Ordovician. He also published widely and became a leading authority on graptolites. His palaeontological work culminated in the publication of *The Monograph of British Graptolites* by his two research workers, Elles and Ethel Wood, and edited by Lapworth between 1901 and 1918.

Lapworth (centre with hat and beard) leading an excursion to Comley Quarry in 1896. Reproduced with kind permission of the Lapworth Museum, University of Birmingham.

Inspiring teacher and champion

Although an inspiring and pioneering geologist whose days as an amateur were long past, he never forgot his background. Throughout his academic career he engaged with the amateur community, encouraging them to attend his evening classes on popular geology and his regular field excursions. He encouraged them to carry out their own research, often with his guidance. Lapworth also championed women in the geological sciences, particularly Ethel Wood and Gertrude Elles. He also advised Maria Ogilvie Gordon, the Scottish geologist who carried out important work on the geological structure and history of the Dolomites. Equally, his classes and excursions were attended by a significant number of women for that time.

Lapworth's students were his greatest advocates, regarding him as an inspiring teacher and speaker. They noted that his lectures and field-trips were always dramatic, brief and arresting, full of fascinating anecdotes and analogies that captivated the audience. W.W. Watts, in his 1934 account of Lapworth, noted that a student recalled a lecture on the Silurian as a revelation, "for the veil of the past was drawn aside and the sequence of geological events was disclosed in a series of pictures the vividness so intense that the audience forgot that they were merely listening to words; they saw the geological environments". Considering all the academic achievements and awards he received, and there were many, this recognition by his students would surely have delighted Lapworth.

Lapworth's detailed field mapping techniques are still practised today, and his work on the rocks of the NW Highlands furthered our understanding of the formation of mountain belts. His stratigraphic work and the Ordovician have stood the test of time. Furthermore, his classic

Dob's Linn section near Birkhill in the Southern Uplands is recognized worldwide as the location of the Global Boundary Stratotype Section and Point (GSSP) marking the boundary between the Ordovician and Silurian systems. In addition, the academic department he led for 32 years from its formation continues to flourish, and its museum (The Lapworth Museum of Geology) bears his name – all in all a considerable legacy!

Jon Clatworthy
Lapworth Museum of Geology

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Behind the Scenes at the Museum

Lapworth Museum of Geology, UK

The Lapworth Museum of Geology dates back to 1880 and the foundation of Mason College of Science, the forerunner of the University of Birmingham, and is named after Charles Lapworth, the first Professor of Geology at the College and University. In 1880, the trustees of the College purchased a collection of around 1,750 Wenlock Limestone fossils from the Dudley area, from the local civil and mining engineer, Charles Ketley. From this point the Museum flourished under Lapworth's influence and the collections grew considerably.

In 1900, Mason College became the University of Birmingham and eventually the Museum moved to its current site in the original Grade II* listed building at the heart of the University of Birmingham's Edgbaston campus. No images of the interior of the Mason College Geology Museum exist, although later student recollections describe it as dusty, full of objects, giving the appearance of untidiness, but a hive of activity. The earliest photograph we have is of the interior of the Museum after it had relocated to the Edgbaston campus (Figure 1).

Today the collections contain in excess of 250,000 specimens covering most aspects of the geological sciences, including palaeontology, mineralogy, petrology, and there are also important

collections of scientific instruments, geological models, zoology, comparative anatomy, archaeology and photography. The palaeontology collection includes material from many of the most significant geologists and collectors of the nineteenth and early twentieth centuries. There are representative collections from many Lagerstätten including the Burgess Shale, Monte Bolca, Mount Lebanon, the Green River Formation, the Solnhofen Plattenkalk and Mazon Creek.

Figure 1. The interior of the Geology Museum in the late 1920s having relocated from the city out to the Edgbaston campus. Reproduced with kind permission of the Lapworth Museum, University of Birmingham.

Some key collections

The Wenlock Limestone fauna is a key collection comprising approximately 20,000 specimens, mainly from the Dudley area. The finest individual collection was assembled between 1876 and 1897 by Sir Charles Holcroft, a very successful Black Country iron and coal master. It includes exceptional examples of the more common fossil groups (Figure 2) such as trilobites, corals, crinoids and brachiopods, but also some of the more unusual fossils within the Wenlock Limestone such as machaeridians, carpoids, cornulitids and rostroconchs. The Museum also has Holcroft's beautifully hand-written 'Fossil Register', which contains a wealth of information regarding individual specimens. Holcroft purchased specimens from the quarry foremen, who, in turn, paid their quarry men for any interesting specimens they found. It demonstrates that when quarrymen's wages were particularly low, the trading in fossils increased as the men tried to supplement their income. There are also many specimens in the main Wenlock Limestone Collection which were used in Murchison's *The Silurian System* and Salter's *A Monograph of the British Trilobites from the Cambrian, Silurian, and Devonian Formations*.

Lapworth himself became a world authority on graptolite faunas and was instrumental in showing their significance in biostratigraphy. His extensive graptolite collection was used to produce the definitive *Monograph of British Graptolites*, and contains many type and figured specimens; it is used regularly by researchers internationally. Lapworth also amassed a large

collection of Lower Palaeozoic invertebrates from Shropshire, the Welsh Borderland and the Midlands. As is the case with many of our object-based collections, there is a wealth of supplementary information including Lapworth's letters, photographs, maps, field sketches, field maps, notebooks, reports and catalogues.

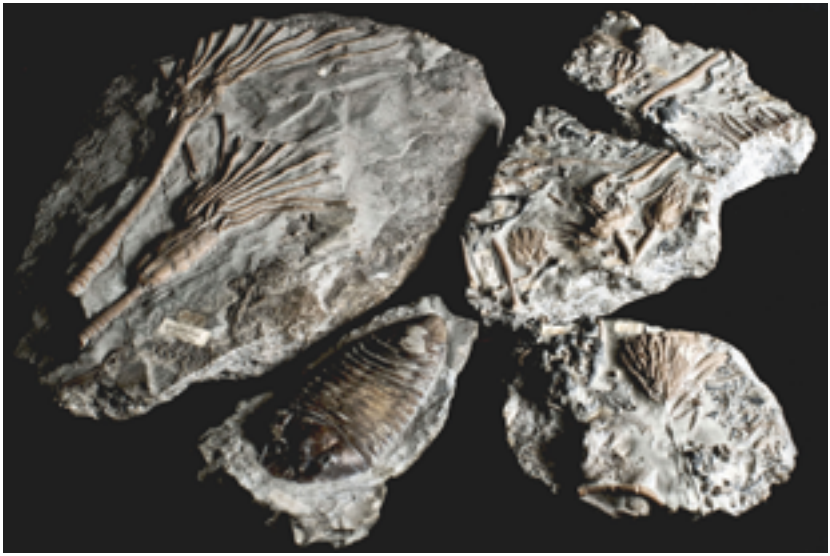

Figure 2. Wenlock trilobites and crinoids from the Holcroft Collection. Reproduced with kind permission of the Lapworth Museum, University of Birmingham.

The Carboniferous collection is centred on the flora and fauna of the South Staffordshire Coalfield. Of particular importance are the sideritic ironstone nodules from many different mines and collieries in the Black Country, particularly Coseley. These nodules, along with mudstone and coal, were often brought to the surface and spread out in fields to dry out. Local women, known in the Black Country as 'pit bonk wenches', were paid to pick out the ironstone, coal or other useful mineral material. They also put to one side fossiliferous nodules containing exceptionally well-preserved plants, and an associated fauna that includes horseshoe crabs, insects, millipedes, arachnids, crustaceans and fish.

Charles Lapworth's archive is one of most important features of the Lapworth Museum and is regarded as one of the most complete archives of any Victorian or Edwardian UK geologist. It covers 60 years of his geological work from the 1860s up to his death in 1920, and comprises around 3,500 letters, approximately a thousand field and manuscript maps, and hundreds of field sketches, notebooks, consultancy reports in connection with applied and economic geology projects, and photographs. It contains his lecture notes spanning the period 1880 to 1913, combined with teaching aids, and examples of student notebooks from the same lectures (Figure 3). The archive provides a unique record of important advances made in the geological sciences, and the development of the science during an important period in its history.

A more unusual archive is that of Professor Fred Shotton MBE (1906–1990) who was a significant Quaternary researcher, but was less well-known in his role as a military geologist. His archive

records how, during WW2, he was called upon to carry out 'Top Secret' work, initially to find water for the British Army in North Africa, and then during preparations for the D-Day landings and Allied advance across NW Europe.

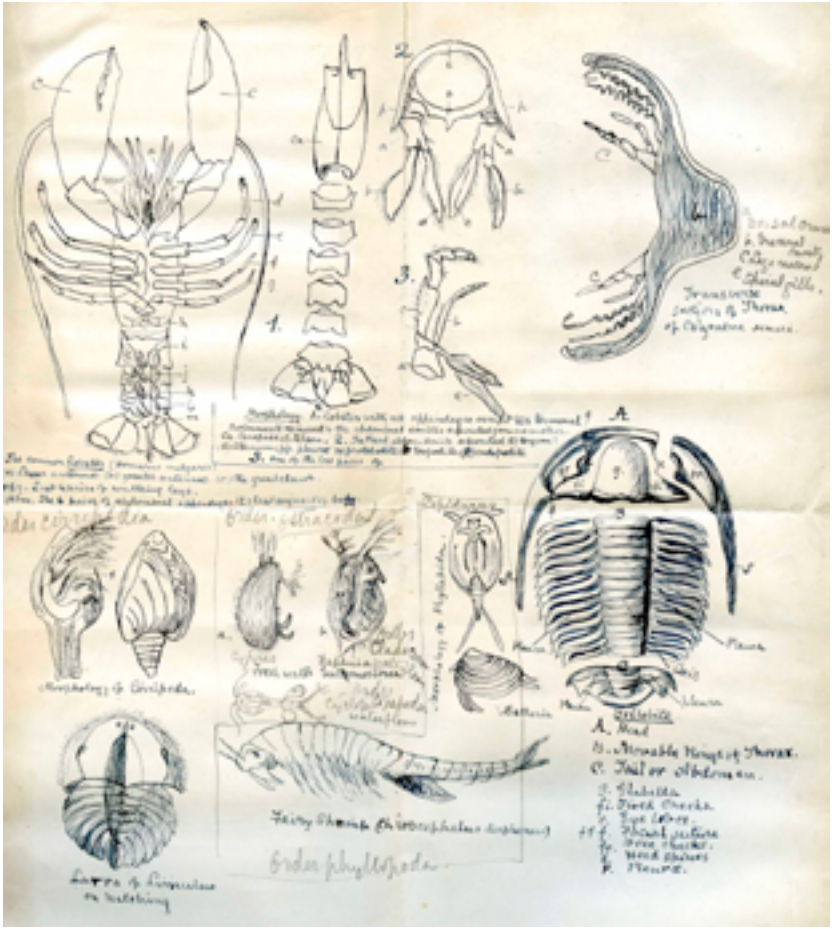

Figure 3. A student's notebook from Lapworth's 1887 palaeontology lectures at Mason College. Reproduced with kind permission of the Lapworth Museum, University of Birmingham.

Changing times

The Museum has supported teaching and research at the University of Birmingham, and its forerunner, for over 135 years. In more recent times, there have been significant increases in families, educational groups and retired people visiting the Lapworth. This growth, combined with limited exhibition space and user facilities, has led to the current £3m Museum Redevelopment Project, funded by the Heritage Lottery Fund, DCMS/Wolfson, Arts Council England, and the University's *Circles of Influence* fund-raising programme. We are developing new exhibitions around the four key themes of Evolution of Life, Active Earth, Mineral Wealth,

and Learning and Discovery. New galleries are being created and much-needed user facilities developed. The main hall of the Museum will become the Evolution of Life Gallery featuring more of our palaeontological collections, but we will also be able to display a significant amount of previously inaccessible mineralogical and petrological collections within the new Active Earth and Mineral Wealth galleries. 'Wow' features, such as a mounted dinosaur skeleton and a rock wall, are incorporated in the designs along with new innovative ways of interpreting the collections – these are exciting times for the Lapworth and its visitors!

Although closed since 2014, the Museum has continued to make the collections available to support teaching and research. The collections are used regularly to support final year undergraduate projects, with recent topics based on, for example, Eocene faunas from Sheppey, our ichthyosaur specimens, and fossil footprint material. The collections have also been studied in connection with Palaeontological Association funded initiatives, including an Undergraduate Research Bursary titled *3D photogrammetric imaging and re-analysis of a unique Late Carboniferous footprint assemblage from Shropshire*. A recent PalAss Engagement Grant will investigate *Gesture control technologies and palaeontology: exploring innovative outreach and education approaches using 3D fossil models*.

The Lapworth Museum will re-open on 10th June 2016, and will incorporate the outputs of these recent projects in the new exhibitions. The redeveloped Museum will provide a fantastic public and academic facility, with a greatly enhanced visitor experience, and we look forward to welcoming you then.

Jon Clatworthy
Lapworth Museum of Geology

Please see the website for further details: <**www.birmingham.ac.uk/lapworth**>.

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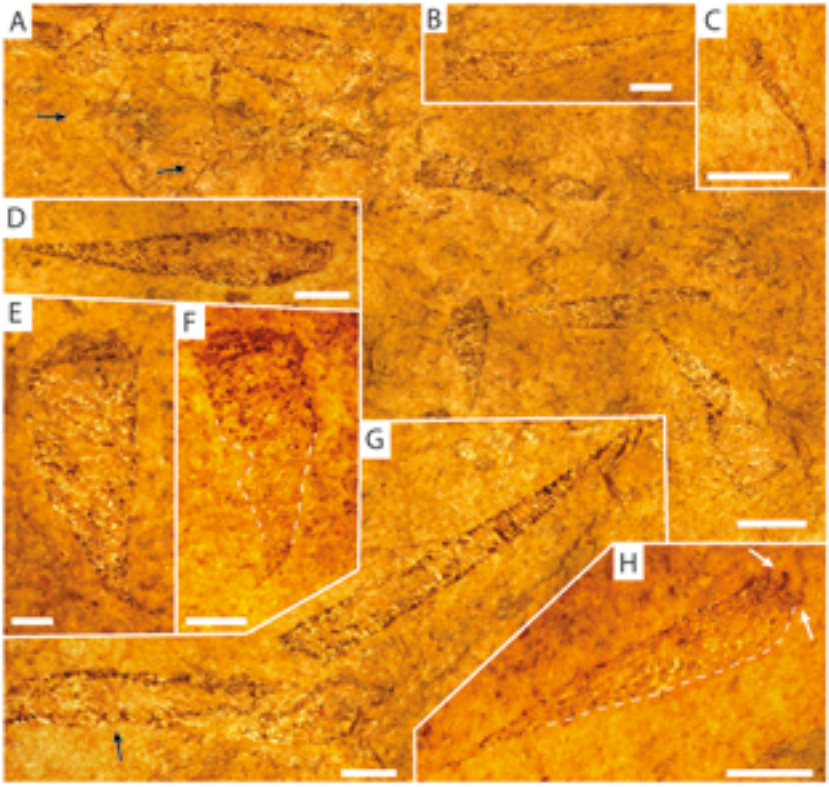
<**www.facebook.com/LapworthMuseumofGeology/**>

Mystery Fossil 23

Mike Meyer, **Bob Ganis** and **Jan Zalasiewicz** are requesting advice on an enigmatic fossil that occurs associated with Late Ordovician graptolites (black arrows in figure) in the Martinsburg Formation in Pennsylvania, USA. When first discovered, pictures were sent around to some graptolite workers and specimens were taken to the 2015 ISOS meeting and shown around. The collective result of that show-and-tell was, "They're not graptolites but we don't know what they are"… The basic characteristics of the fossil can be summarized as follows:

- They range in size from about 1 to 7+ mm (all scale bars = 1 mm);
- They are basically fusiform in shape with considerable variety;
- They have a dorsal 'head' region that tapers gradually to a trunk and narrow 'tail';
- The tail is often flexed to varying degrees;
- It is assumed that they are tectonically flattened to some degree, as are the associated graptolites; however, even taking that into account, they would appear to have a relatively flat morphology with a bilateral symmetry;



- The fossils are preserved as a quite durable cuticle;
- The composition of the cuticle (determined via BSE/SEM/EDS) differs from that of the associated graptolites, being less C-rich and more Si-rich (probably indicating a partial clay mineralogy in the body of the fossil). Highly magnified SEM images of the cuticle suggest a fibrous fabric;
- Some specimens show a cleavage imprint in the cuticle that is not expressed in the shale matrix or the graptolites. This presents an appearance of false segmentation for specimens aligned perpendicular to this selective cleavage; the animal is not segmented;
- They have no appendages or eyes, but one specimen does show short unspecified lobes (H, white arrows) protruding from the 'head'.

If you have seen this type of fossil before or think you know what it might be, we would appreciate hearing your comments. We have a candidate animal in mind, but, in the interest of avoiding suggestive prompting, we will remain mum. Please send any correspondence to Mike Meyer at <**mmeyer@carnegiescience.edu**>.

Marvellous mistakes

Some of the most striking things in life happen, surely, by mistake. Henry Becquerel, for instance, rather carelessly left some uranium salts next to a perfectly good photographic plate, and so ruined it – though in doing so hastened the development of a perfectly wonderful planetary time scale[1]. Alexander Fleming forgot to cover a petri dish containing *Staphylococcus* bacteria, with the regrettable result that it grew mouldy: regrettable for those bacteria, of course, as the antibiotic express blazed up the track, though the microbes now seem to be learning new evolutionary tricks faster than the humans can dream up responses to them, and may get their revenge all too soon.

The same naturally holds true for palaeontology. What is nice here is that it is not only the accidental serendipitous insights that are so instructive[2], but the full-blown nose-at-high-speed-into-a-brick-wall mistakes and misinterpretations. These are things to be cherished – not just for the wholesome entertainment they provide, but also in that they seem to be more than usually effective in prodding one along a road where some kind of truth[3] may ultimately lie.

Examples, of course, are all too numerous, and one could well start a regular column of this newsletter entirely devoted to this theme. One suspects that it could run for years and years and even – given the pace of adventurously speculative palaeontological research these days – that new and promising material could be produced rather faster than might be adequately described in our standard thrice-yearly format.

[1] And other things that are not so wonderful, of course – but that is going to be an underlying theme in this essay and so *will not be mentioned further*.
[2] Entertaining, of course, too – but then that was the real reason for going down this path in the first place.
[3] Whatever that may be.

A long-standing favourite has been that spike-like bone left over when Gideon Mantell had reconstructed the *Iguanodon* from the miscellany of bones that he and wife Mary Anne had turned up in the Wealden strata. Where else to put it, other than at the end of the nose? This was sensible enough, with the rhinoceros in mind, and sensible also to have the *Iguanodon* as an iguana-like quadruped. Alas, the fine complete skeletons pulled out of the Bernissart coal mines showed that the nose-horn was in fact the thumb, and the reconstructions from that time also began to show this dinosaur standing as proudly upright as any Victorian gentleman of means.

Well, that image has mutated once more, and *Iguanodon* now seems to have walked its Earth most often as a quadruped, although with the option, when sufficiently provoked, to rear up on hind limbs. So here Mantell is at least half-way justified, and in some ways he has the last laugh about the thumb too, as the function of this curious bone seems now to cause as much perplexity as he himself must have felt, bone in hand and feeling perhaps like someone playing the game of putting the tail on the donkey. Defence? Perhaps, but this not-quite-terrible lizard would have had to allow the predators to come dangerously close to use it. For combat in competition over mates? Well, perhaps… As a patent nutcracker? The maltreated nuts seem not yet to have been found. As a leaf-stripper? Ditto. Perhaps one needs yet another inspired misinterpretation to allow some sensible constraints to emerge.

The saurians and other large beasts have always been prone to the odd mistake and, indeed, the larger the beast, the greater the temptation to give normal human fallibility a bit of a helping hand. That noted and notorious mid-nineteenth-century fossil collector, impresario and, by general reputation, shyster-in-chief Albert Koch knew a thing or two about this, as related in Brian Switek's splendid *Written in Stone* (Koch also gets an hon. mention in Richard Carrington's equally charming *Mermaids and Mastodons* from an earlier generation). Not content with improving a quite respectable mastodon with extra ribs to create the awesome, and awesomely named *Missourium theristrocaulodon* for the goggle-eyed public of St. Louis, Koch went on to put together bits of sundry fossil whale skeletons[4] to create the even more spectacular and clearly polyphyletic[5] *Hydrarchos*. Breezily waving away mere technical objections from the likes of Charles Lyell (who, on a visit to Boston while the creation was exhibited there, clearly became tired of being questioned about ancient sea monsters. 'A humbug', he wrote later), Koch made a mint. He even managed to sell the *Hydrarchos* to Berlin museum[6] during a grand European tour. Koch's improved whale was mostly destroyed as Berlin was bombed flat in the second world war, though a few bones still survive in the museum basement.

One might say that the interest generated by such 'mistakes' adds to the general interest in the science as a whole. Certainly, once one takes the backbone out of the science, then every little bit helps generate the fascination that keeps the whole enterprise trundling along, and this is true even if it is honest fallibility that is in play, rather than the enterprising spirit of Phineas T. Barnum. *Hallucigenia*, and indeed all of the worms of a more or less velvet persuasion, still seem to retain an extra glow of fascination from the days of that upside-down interpretation of yore, when it seemed that almost anything was morphologically possible in the white heat of the Cambrian explosion. And, the diverse interpretations of conodonts until they became

[4] Of both mature and immature specimens alike; Koch was not prejudiced as to age or seniority.

[5] In that he used cephalopod shells to assemble the monster's paddles.

[6] It was the impressionable King Wilhem Friedrich IV who made the purchase. That might be used as an argument for republicanism.

… well, just teeth[7] persist in ghostly fashion to give this now more settled clade an air, still, of inherited mystery.

This mystery was of course in part solved via yet another mistake, albeit one of the happiest kinds, when some fossils were found in South Africa's latest Ordovician Soom Shale that looked like graptolites. It would be quite wonderful to find some graptolites in the Soom Shale, not least because it is not only fully marine in character but also that it has some other weird and wonderful fossils that would be nice to place into precise context. Well, these fossils passed from a doyen of graptolites[8], Barrie Rickards (verdict: not graptolites) to one of condonts, Dick Aldridge (verdict: very large conodonts!) and led to that now classic story of the finding of not only more very large conodonts, arranged in their uniquely phantasmogoric dentition, but also of their petrified eyes, muscles and so on. The conodont animal – albeit with assistance with one more of such kin near to deepest Edinburgh – had arrived, causing the sudden extinction of some very imaginatively-created alternative organisms. And there is only a small part of me that thinks it would have been quite nice *were* those initial discoveries to have been graptolites after all.

One should not complain. Graptolites have given rise to rather more than their fair share of honest[9] if over-imaginative mistakes. Though perhaps the first of a long line of these may be regarded as *under*-imaginative, if perhaps sensibly sceptical for its day. When the mighty Linnaeus set up the genus *Graptolithus* he had in mind inorganic rock markings and encrustations, while illustrating what seemed to be both graptolites and plants, with later comments on a 'graptolite or fossil of a strange kind', which probably summed up the state of play nicely. Small wonder that *Graptolithus* was later officially cast into the taxonomic outer darkness for its confusion of fossil with intention.

Then came the industrious palaeontologist Rudolf Ruedemann of the early and mid-20th century, who wrote a great doorstop of a monograph on North American graptolites which included many drawings of many taxa that can most charitably be described as 'charmingly rustic'. Some of the rather more delicate and detailed of these drawings, though, then went on to define, in peoples' minds, these most enigmatic of planktonic colonies for the best part of a century. The illustrations of the phenomena termed synrhabdosomes – essentially colonies of colonies, where clusters of graptolites are bound together – showed the fossils nicely, together with, near their centre where they joined, circular objects that Ruedmenann quite plausibly interpreted as balloon-like floats. And this concept, reproduced in elegantly pastel shades, graced pretty well any and every diorama of the Ordovician or Silurian seas in museum and textbook alike.

Trouble is, they weren't there. The balloon-like floats, that is (the synrhabdosomes remain as real phenomena, albeit still mysterious real phenomena). When a young Paul Crowther, at PhD stage or thereabouts, went to re-examine Ruedemann's original specimens (in the American Museum of Natural History, if memory serves), there was a plethora of graptolites, but – to a fresh and skeptical eye – a distinct absence of pneumatically promising spheres. So, with the usual combination of a curved fracture surface here, and patch of discoloration there, a pattern had grown in Ruedemann's mind's eye that was faithfully transferred on to his sketch pad, from there

[7] Albeit very crazy teeth.
[8] And of pike-fishing too, lest anyone forgets.
[9] Generally honest.

to take over the world[10]. That leaves float-less synrhabdosomes as work in intermittent progress, and one day they will tell us something quite profound about these mysterious no-analogue plankton.

There have been other garden paths in the graptolite world, such as the beautiful little tightly coiled species that was first interpreted as a tiny *Nautilus*, before being redescribed as a *Monograptus*, with the result that its two species names of *veles* (from its parent on the mollusc side) and *discus* (from the graptolite side of the family) have alternated in the literature as various interpretations of nomenclatural priority are argued back and forth.

These sundry interpretations and misinterpretations will always be grist to the mill of historical retrospection, and also spur to further palaeontological inventiveness, whether right or wrong[11]. That deep past may always be more deeply explored – but, of course, never tamed. It's a wilderness forever.

One cannot say the same of the present, though. Here, there do seem to be changes, not just to the world around us, but also to our mental landscape of what is known and unknown, out there. And it's the dinosaur-sized misconceptions that seem to have receded, with the progress of, well, progress[12].

In my days of youth, not a week seemed to pass by without some report that one of the fabulous creatures that were always just beyond the reach of science would be captured – in a cage, by net, by reliable (sober) account or by undeniable (non-fuzzy) photograph. The Loch Ness monster took up a goodly amount of newsprint, culminating in the shadowy paddle-form photograph – alas, very fuzzy, and never repeated – behind Sir Peter Scott's pronouncement of Linnéan authenticity (*Nessiteras rhombopteryx*) for this legend. That was the peak of the excitement, and the poor beast has since clearly dwindled and died. Perhaps someone still keeps a look out for it, now and then, mobile phone-camera at the ready, but the very myth seems now to have become a fossil.

Then there was Mokèlé-mbèmbé, monster of the Congo River basin, which launched 34 expeditions starting with Liévin-Bonaventure Proyart in 1776 (who reported finding 'monstrous footprints') and included the 32-member Smithsonian Institution expedition of 1919–1920, which heard 'mysterious roars which had no resemblance to any known animal'. More recent years have seen TV programmes with titles such as 'Destination Truth' and 'Beasthunters' join in, which inevitably were destined to reach a truth that there is ever less of a beast to hunt.

The same is true for the Yeti, where footprints, fragments of skull or paw, or earnestly stated witness accounts, repeated and elaborated in radio reports and magazine articles, and elaborated yet further in books of poetic fervour, has faded from existence, as those high mountains have become more prosaic. The Bigfoot, the Yeti's North American cousin, that, in that technologically more advanced land, was also seen in distant shaky movie camera images, seems too to have retired from public view.

The space for these creatures, both in potential reality and in imagination, is shrinking rapidly as the cattle ranges and oil palm plantations and megacities advance apace around the world, and

[10] Admittedly a very, very small corner of the world.
[11] For any given meaning of the words 'right' and 'wrong', of course.
[12] Most emphatically for any given meaning of the word 'progress'.

it is sobering to realize that much more than half of the material bulk of all of these planetary novelties has been made in my lifetime (which is not quite yet *terribly* long). Whether that means that the space for imagination and mystery in the world has been halved is an open question. More specifically, the objects that we now make so easily and plentifully in our factories, and which grow ever more diverse and sophisticated year by year, are potentially novel forms of fossil for the future.

Much can be said about this, but in keeping with the spirit of the moment, this can be constrained to proposing that the room for error and puzzlement in far-future palaeontological interpretation is now expanding almost exponentially. We can, now, have a reasonable stab at interpreting the taxonomic relations and functional morphology of a trilobite, an ammonite and even a graptolite, and our far-future palaeontologists should be able to cope with the remains of the shrimps and scallops and lobsters of today. But what will they make of beer-cans and bottle-tops, CDs and ballpoint pens, fridge magnets and toasters (and toast-racks)? Of those little plastic-shafted cotton buds? – the most common single item noticed being washed up on the beaches of Madeira, a palaeontologist colleague of mine recently told me. Of all the myriad of objects, hard-wearing and rustproof and un-munchable by microbes, indeed, that we make? One can imagine the most wonderful of hypotheses being generated: imaginative, sensible, based on scrupulously documented observations – and dead wrong.

We had better do what we can, while palaeontology remains a relatively simple trade.

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Condition of internationally important fossil tree site deteriorating

The Fossil Grove site in Victoria Park in the West End of Glasgow, UK, was included in the Geological Conservation Review (Palaeozoic Palaeobotany Site Number 3043) and is designated as a Site of Special Scientific Interest (SSSI) due to the international significance of the palaeobotanical information the site has yielded. However, concerns have been raised about the site (see <**http://www.geologyglasgow.org.uk/news/article/concerns-about-the-condition-of-the-fossil-grove-glasgow/**>). An informal inspection by Scottish Natural Heritage staff was carried out on 6th December 2015 to investigate these concerns. The fossil material within the site is threatened by fluctuations in humidity and there are "clear signs of localized deterioration in the physical integrity of the SSSI, with the disintegration of some fossil surfaces". At the time of writing, this physical deterioration together with lighting and access issues are of sufficient severity to downgrade the SSSI to 'unfavourable status'.

Fossil Grove in December 2015. Photo courtesy of Iain Allison.

Fossil Grove is a remarkable group of at least 10 Carboniferous trees in life position. Quarry workers, extracting dolerite from the workings, uncovered the upper surfaces of the stumps in 1887. Following careful excavation work to reveal the full extent of the grove, the whole site has been shielded from the elements by a specially constructed building since 1890. It has been a visitor attraction since this time and is also one of the earliest geoconservation sites in the world (Thomas 2005).

While the actions needed to restore the site to favourable status are largely a question of work on the building housing the specimens to control water ingress, it has emerged that, at present, neither Glasgow City Council, who own the site, nor the Trustees of the Fossil Grove are willing to commit any funds to the repair or upkeep of the building.

The most recent review of the overall status of Earth science SSSIs in Scotland, many in remote areas, reports that around 90% of the 500+ sites are in 'favourable' condition (Scottish Natural Heritage 2013 p. 134–137). Yet, this accessible site, which attracted a remarkable 17,000 visitors last year, is deteriorating for want of work on the building to protect the fossils and enable the Grove to serve as an amenity, educational resource, local geodiversity site (Whitbread and Arkley 2013) and data source for palaeobotany within the boundaries of the City of Glasgow.

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"Science without Barriers": towards the take-off of Social Palaeontology

Overview

The term "Social Palaeontology" (Torices *et al*. 2004) was coined to refer to experiences with people with both physical and intellectual functional diversity around a palaeontological site on the Campus de Somosaguas of the Complutense University of Madrid. Further from these pioneering practices, various experiences demonstrate the value of science popularization directed to people with disabilities (especially to people with intense learning difficulties and those who have undergone some sort of educational marginalization; see UNICEF 2010). These activities are not only a learning tool but a way of improving learners' self-image and, therefore, improve their quality of life (*e.g.* De la Ossa *et al*. 2012; Garcia-Frank *et al*. 2014b; Gomez-Heras *et al*. 2014).

Formal education *vs*. non formal education

Standard curriculum designs often lower learning outcome expectations for people with disabilities (Garcia-Frank *et al*. 2014a). This does not only include intellectual disabilities but

Figure 1. Enjoying palaeontological activities! A field-trip to Somosaguas palaeontological site (Madrid, Spain) for students with intellectual disability. Photos courtesy of members and collaborators of "Science without Barriers".

some sensory disabilities such as deafness or deaf-blindness, which is a particular case among sensory disabilities because of the combined difficulty of accessing educational contents and the learning difficulties associated with the complexity of acquiring language. Sensory disability becomes then a factor of deep, although often neglected, educational marginalization. This marginalization is even more noticeable in the Earth sciences, in which barriers to students with disabilities are given more importance than in other disciplines (Atchison and Martinez-Frias 2012). The case is even stronger in the context of non-formal education, although there is an increasing awareness of the importance of taking into account the needs of people with disabilities in designing Earth science curricula and teaching activities. These efforts are carried

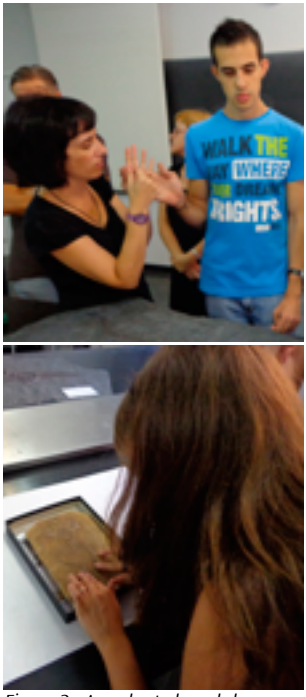

Figure 2. An adapted workshop for deaf-blindness students. Photos courtesy of members and collaborators of "Science without Barriers".

out by associations dealing specifically with these issues, like the International Association for Geoscience Diversity (IAGD) and the association "Ciencia sin Barreras" (Science without Barriers). In addition, long-standing professional organisations in Earth sciences like the Geological Society of London are also committing to diversity, equality and inclusion in geosciences.

"Ciencia sin Barreras" (Science without Barriers)

This association was founded in 2014 by a group of scientists and professionals related to disability seeking to promote inclusive learning and science literacy among people with disabilities, in line with the motto "Science for everybody". The activities organized so far have been done on a volunteer basis; the association's volunteers include, in addition to scientists, psychologists, social workers, university students and others who each bring their own expertise. The association follows mainly three lines of work: organization of activities (either specifically targeted to people with functional diversity or open to everybody); talks, lectures and educational research; and self-training and training of volunteers.

In 2016 the association was recognized as one of the 98 Innovative Practices and Policies with a focus on inclusive education and information and communication technologies (ICT) considered as worldwide role models in their field by the organization "Zero Project". The Project researches the status quo of the implementation of the UN Convention on the Rights of Persons with Disabilities (CRPD).

Palaeontological workshops and field-trips

Many of the activities organized so far deal directly with palaeontology and have been targeted towards people with deaf-blindness, short-sighted and blind people, and people with intellectual disabilities such as Down's syndrome. So far, successful lab-based activities adapted to people with both intellectual and sensory disabilities have been developed (Garcia-Frank *et al*. 2014a; 2014b; Gomez-Heras *et al*. 2014; Muñoz-García *et al*. in press). These demonstrate the great potential of geology to be successfully taught to people with disabilities via sensory activities that allow the acquisition of abstract concepts. They include field-trips to palaeontological sites and tactile workshops with fossils, rocks and minerals, revealing different aspects of geology. Also, a 'walking geological clock', coupled with relevant rock and fossil samples, was designed so that participants could gain a feel for the length of Earth history and its major milestones (Gomez-Heras *et al*. 2014).

One of our specific palaeontological workshops consists of three supplementary activities based on fossil tracks, the evolution of equids' limbs, and the main dentition types in vertebrates

(Iglesias *et al*. 2015). The principal goal of this activity is to teach, in a simple way, about past living beings, using replicas and actual vertebrate dentition and limb fossils, as well as images of animal tracks. In this way participants can reach their own reasoned conclusions regarding the organisms that generated them. It is important to remark that the subjective perception of this experience has been positive and the results of later surveys show the participants still recall most of the concepts learned in the session.

Other experiences are tailored for people with visual impairment and the goal is to share haptic experiences in order to perceive both shape and surface characteristics and internal structure under the 'learning-by-touching' principle (Chicote *et al*. 2015). The value of fossils in relation to this haptic experience lies not only in recognition of their forms, which would distinguish between different groups of organisms, but in the fact that these things are true witnesses of the fascinating history of our planet.

Final remarks

Every activity is prepared and designed with expert educators and other professionals related to disability who usually guide scientists with regard to the learning strategies and specific needs of the attendees. In addition to this, there is always a 'trial and error' component. We usually prepare a pilot activity in which we test the efficiency of the activities and materials proposed. After that, an evaluation is made (questionnaires, structured interview, *etc*.) to highlight the strengths and weaknesses of the activities, from both educational and social perspectives. These past two years have been a steep learning curve for us in which we have learnt from our mistakes and identified the best practices in the design of the activities. The most common errors are the same as those we find in any science dissemination activity: namely, trying to fit too much content in to one activity and failing to 'tune' the language to the public ear.

All of the scientists involved in the activities have experience teaching at university level and they use their expertise and experience of innovation to create materials that can bring scientific concepts within the reach of people regardless of their ability, thus eliminating barriers to learning.

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For further information please see our website: <**http://cienciasinbarreras.theiagd.org/**>

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Figure 3. Palaeontological workshop for adults with intellectual disabilities. Photos courtesy of members and collaborators of "Science without Barriers".

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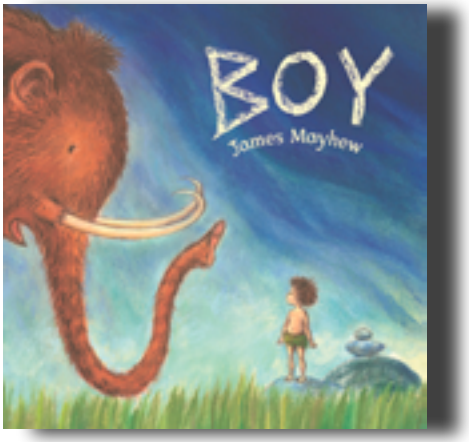
0–5 in 3 billion years

How do you engage a group of under-fives in a museum? Especially a museum whose objects are millions, if not billions of years old, and kept behind glass with a scattering of 'Don't touch' signs? Chesterton Children's Centre in Cambridge, UK, was up for the challenge, and last year a group of 12 families with children ranging from 5 months to 2 years visited the Sedgwick Museum of Earth Sciences, also in Cambridge. Just getting in to the Museum up the stone staircase looks daunting if you have a buggy, but we do have a (soon to be upgraded) lift. After this adventure into the Museum and meeting Iggy our 5m high *Iguanodon* skeleton we settled down to a story.

Stories are a brilliant way to introduce the themes of a museum and a way to introduce objects that are appropriate for handling. When I was planning the session I realized that most of my handling collection, although great for kids because it is fairly indestructible (being mostly made of rock), is not ideal for very small people, who might throw or drop things onto very small feet. However stories like "Boy" by James Mayhew have plenty of potential for introducing touchy feely objects and simple themes like hot and cold.



Courtesy of Hachette publishers.

Boy's cave is cold and he wants to warm up. His adventure takes him into a forest where he meets a sabre-toothed tiger and into the

'Boy' and some of the fabric used to help introduce our youngest visitors to the Museum. Copyright Sedgwick Museum of Earth Sciences 2015.

long grass where he meets a woolly mammoth. Both are great links to our 'Ice Age' fossils and a wonderful opportunity to get wrapped up in furry tiger-striped fabric and hairy woolly mammoth fabric. I had lots of different textured fabrics and cuddly toys for each page of the book. As I read I encouraged the children and carers to walk, roll, hug and get involved with everything, allowing them to determine the tempo of the session. Exploring new textures under foot, hand or knee is important for balance and learning to walk.

After the story we talked about how Boy could keep warm and dressed our Boy doll in some warm clothes – simple things that are easy to identify with like a hat and gloves. We then went on our own adventure through the Museum, which was a great way to introduce the Museum to carers who had not been in before. The Sedgwick Museum is laid out on a timeline; first we stopped in the Jurassic Pond display to investigate some sea-themed objects like shells, sand shakers and blue fabric. Although heavy fossils may not be appropriate for small people, large shells are easier to handle and can be 'matched' to fossils in the display, and small shells can be put inside shakers so they can still be explored without being a choking hazard. We also imagined what it would be like swimming in the sea with the ichthyosaurs and plesiosaurs using simple themes like hot or cold and wet or dry.

We then moved forward in time to the last Ice Age to see if we could spot any mammoth tusks like those belonging to Boy's mammoth. Our Pleistocene display has lots of mammoth teeth, tusks and a sabre-toothed tiger skull, and, because these animals had already been introduced through the book and with some cuddly toy helpers, it became easier for everyone to identify them in the display.

The session was only an hour long but it was a great opportunity to introduce young families to fossils, the Museum and what we have to offer them, such as the book trolley and jigsaw puzzles. It was fun, using a little bit of lateral thinking and a good story for inspiration, to find objects like fabric and shells that are great for handling by small people and provide a link to our collection. Most of the fabric and toys I used were taken from one of our two Early Years loan boxes or from the Early Years resources collection in the Fitzwilliam Museum, Cambridge.

'Boy' with an ammonite in the Sedgwick Museum, Cambridge. Copyright Sedgwick Museum of Earth Sciences 2015.

I thoroughly enjoyed spending time with the families and feedback from the session was really positive too:

Loved the fabric brought out with the story

It's tough with a toddler but my daughter had a lovely time doing something new!

I liked that they had books and cuddly dinosaurs

I am looking forward to repeating the session with a new story and new objects in the future.

Nicola Skipper
Education Coordinator
Sedgwick Museum of Earth Sciences

<www.facebook.com/sedgwickmuseum>

@SedgwickMuseum

For more information about our Early Years loan boxes and how to hire one see <**http://www.sedgwickmuseum.org/index.php?page=loan-boxes**>

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Tim Palmer

Stepping down as Executive Officer after 17 years (1999 – 2016)

Tim joined the Palaeontological Association as a new postgrad student at the Department of Geology, Oxford in 1970, following a Zoology degree. After postdoctoral research at the Smithsonian in 1975/76 on changes in hardground communities across the Phanerozoic, he returned to Oxford as Demonstrator and museum assistant from 1976 until 1981, when he was recruited to Aberystwyth University by Mike O'Hara to teach sedimentology and palaeontology. Tim was one of five editors of *Palaeontology* from 1982 to 1985 and returned to PalAss Council as Treasurer from 1993 to 1999. Aberystwyth closed the Geology and Earth Studies programmes in 1999 to concentrate on Geography, losing all of its soft-rock staff. The Executive Officer position was established as a part-time work-from-home job in 1999 and the Association was delighted to be able to appoint Tim to the post. As Tim now prepares to step down he kindly agreed to answer our prying questions.

How has the role of learned societies changed during the time that you have been Executive Officer?

The growing relationships with the major scientific publishers has been a big change. They have moved in and taken on the production of many journal titles, providing large economies of scale and offering online services that are difficult for societies that have remained independent. Income collected through publishing now makes a significant contribution to total annual income and allows for a big increase in expenditure on outgoings, such as research and travel support for the members.

What is the most unexpected task or situation you have encountered as Executive Officer and what has been the most enjoyable part of the job?

The anticipation and avoidance of too many unexpected situations is part of the job, but the variety of tasks has been a fun challenge. The day I spent getting a travel grant to someone in Madagascar who didn't have a bank account was fairly memorable. At various times I have been driver, cook, psychiatric counsellor, warehouseman, careers advisor, investments manager, bookkeeper, advocate, pest controller, referee, sommelier, editor, general chivvier, ambassador, and spy (identifying libraries that posed as private individuals). The chance to see the old guard moving on and the arrival of the new generation have both given me a lot of pleasure and I have made a number of good friends that I would not otherwise have met once I stopped doing my own research. I am quite pleased that on average I have only lost my rag with people once every few years. The last time did neither of us any harm!

How has the Palaeontological Association changed during the long term of your membership?

The availability of money, and the things that it enables. Prosaic but essential. In my last year as Treasurer, total contribution in grants to members for research costs, meetings, travel, outreach *etc*. was less than £1,000. Last year it was over £100,000.

What is the most surprising development in palaeontology that you have seen during your time with the Association?
So many things are made possible by the combination of computers and human ingenuity. It may be the fact that you can have an electron microscope on your desk, or that you can scan a lump of rock to reveal all the detail, internal and external, of the skull buried inside it, or the ability to generate likely evolutionary trees from a complex data matrix.


Tim and Otto at the Scarborough Fossil Festival 2015 (photo by James Witts).

What aspects of the Association's current offerings (*e.g.* grants, meetings, *etc.*) do you personally feel do the most good for the science and community?
I think that the Annual Meeting and the support of other meetings are essential to foster contact and discussion between all of the people in the subject. I also think our new Undergraduate Bursary scheme will come to be a route by which many people choose to go on to do a higher degree in the subject.

If you were an undergraduate now, would you apply for an undergrad bursary and if so on what topic?
Yes I certainly would. The probable cyanobacteria that appear to mine calcite shells throughout much of the Mesozoic and Cenozoic need more study. How far back in time do they range? Were they utilising calcite rather than CO_2 in photosynthesis? What was their depth range?

If you were a postgrad now, would you be a member of the Association and would you take the hard-copy journal?
You bet I would. Membership is such good value, and I believe in supporting the palaeo community from the earliest stages. I cannot imagine not having the paper journal, but then nor can I imagine being a young postgrad now. Too much focus is expected and there is not enough opportunity to explore the subject more widely.

Is there anything that you feel the Association should be doing but isn't, or something that should have been brought in a lot earlier than it was?
No, Council has had a very good record of steadily introducing new initiatives over the last 15 years as the Association's financial health has steadily improved.

What is your favourite moment from an Annual Meeting?
Mike Coate's theatrical revelation of the octadactyl limb in Devonian amphibians (from his studentship under Jenny Clack) was one of the most memorable talks. For anyone brought up on Alfred Sherwood Romer and the religious belief in the pentadactyl limb underlying all tetrapods, it was a wonderfully iconoclastic moment. But I also enjoy the stories that arise from past meetings, often with no truth in them. Many years ago, a senior member of the

Association appeared one morning with heavy bruising to the face. I heard recently that the culprit had apparently been myself, and that I had been chivalrously protecting the reputation of a young woman. Not true; I wouldn't have been so patronising (Fossil Hunter Lottie would have disapproved). There are some other stories, but only about people who are still alive. Bad luck.

Are Annual Meeting presentations better with PowerPoint than they were before?
Incomparably so. I think Mark Sutton's was the first animated one, at Manchester (and the kit didn't work too well). We introduced the President's award for the best talk at the Annual Meeting back in the 1970s to stop people illustrating their talks with colour slides of unlit biro sketches on the backs of envelopes. Now there is hardly ever a poorly-prepared talk. Posters are another matter; many people try to include too much information.

Many of the UK's senior palaeontologists previously won student prizes for the best talk at the Annual Meeting: whose was the most memorable talk and why?
I've been to 41 meetings and have forgotten many talks, but I remember the first year of the prize because I would have liked to have won it myself. Derek Briggs won with a talk on *Anomalocaris*, and then gave a witty description of the impact that it would have on the clientele of the Irish pub where he intended to spend the £50 when he told them how he had earned it. "Well now sure, 500 million years ago you see there was this giant shrimp with a mouth like a pineapple ring that lived in the ocean that covered the mountain tops of the Rocky Mountains. When it died, its body rotted and became three different types of animal…"

What was the most inspiring talk you have seen at an Annual Meeting?
Paul Taylor's talk on the functional morphology of bryozoan monticules helped me to realize that even the least charismatic groups can be deeply fascinating, and I have always had a soft spot for bryozoans and other hard substrate dwellers.

Have you had any mentors that have been important in your career?
When I was 10 I used to say that I wanted to be a palaeontologist. I liked the long word, but my Scoutmaster's wife, Priscilla, heard me and asked whether I would like to come to tea and meet her father. He liked fossils, she said, and had found some very interesting ones in Africa. So I found myself sitting across the fruit cake from L.S.B. Leakey wondering what on earth to say. I think he felt the same, but we made progress when I asked him what I should do to become a better palaeontologist. He wrote down three pieces of advice with a stubby pencil. First, I should read his book *Adam's Ancestors*. Second, I should collect lots of bones. Third, I should work hard at my Latin. Now I should like to establish a PalAss myth that, on the basis of sage advice from the world's most famous palaeoanthropologist, I travelled a smooth path, without looking back, to the upper reaches of the Palaeontological Association. But it didn't happen like that at all. In fact I looked back quite as much as Lot's wife did before the curious incident of the pillar of salt. *Adam's Ancestors* was very heavy going for a boy more used to Biggles and John Buchan. The bones were limited to Sunday roasts, and the bit about the Latin seemed like a dirty trick. I hated Latin and eventually scraped the most meagre of O Levels with 50%. So by early adolescence I had forgotten about palaeontology and joined the British Lichenological Society. I only rediscovered my earlier interest when Jim Kennedy taught a 'Palaeontology for Biologists' course in my first year at university. It was a fairly traditional course: learn and draw 60 fossils from *Fusulina* to stick bryozoan, but the specimens were all real (not replicas). Also they varied

and, best of all, some of them had old 19th century writing on them, either in Indian ink directly onto the specimen, or on tiny cut-out squares of stamp paper. This was a romantic encounter. Thus was I seduced into becoming a palaeontologist.

Did you benefit from doing joint research with other people?
Yes, greatly so; I find it a great motivator. During my early fieldwork my wife Caroline was brilliant at suggesting research methods and helping with them, and two other people were good friends and important collaborators during my research career: Franz Fursich in the early days at Oxford, and Mark Wilson from the mid-80s to the present.

With hindsight, what was the most important piece of advice you were given as an early career palaeontologist, and would the same advice be of use today?
My first job involved three days per week teaching and doing research, and two days as a museum assistant. Stuart McKerrow (to whose cheerful patience I owe a great deal) told me to get papers published fast and to do as little of the museum work as I could get away with. These days such an approach would soon (I hope) get me into trouble with my employer. At an earlier stage Stuart had suggested that I should choose a doctoral topic that dealt with many different sorts of fossil, not just a single group or a single species. That would be good for future employment, he said, and it worked out like that for me.

How has palaeontology changed as a subject during the course of your career?
Going up (still): *Jurassic Park* and those dinosaurs (we need our poster pin-ups to keep up interest in our subject). Going down: invertebrates, microfossils and biostratigraphy (but they'll be back). Once dominant but now faded: trace fossils, Burgess Shale, conodonts, functional morphology, and all those rotting corpses in Petri dishes.

If you could have dinner with a famous palaeontologist (living or dead), who would you choose?
I should like to have met W.J. Arkell, whose work on the Jurassic was the foundation for my D. Phil. research. I hope he would have appreciated my discovery of sauropod gastroliths in the Great Oolite at Woodeaton (see *Newsletter* 75). But I couldn't have resisted a dinner with Dean Buckland, who would have been much jollier, and the menu would have been more varied.

Can you make public the recipe for your famous (to Lyme Regis outreachers at least) "Creole Crab Gumbo à la Mary Anning"?
It's very simple actually (modified from Robert Carrier's *Great Dishes of the World*, 1963). Sauté two chopped cloves of garlic and a chopped onion in butter and olive oil, then stir in a tablespoon of flour. Gradually stir in milk to produce a roux sauce. Add a pound (450 g) of chopped skinless cod fillet, a bay leaf, lemon rind, and bouquet garni. Then add 5 chopped and skinned tomatoes and 20 small pods of okra (not the large stringy ones). Season with salt and pepper and Tabasco sauce and bring to a slow bubble until the okra and tomatoes are cooked (not very long). Then stir in 12 oz (340 g) of cooked flaked crab and a small carton of cream. Lyme Regis crab is good, but the best crab comes from the fishmonger on the beach at Beer, just over the border into Devon. Remove the rind and the bouquet garni and serve with boiled basmati rice.

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

17th International Bryozoology Association Conference
Melbourne Museum, Victoria, Australia *10 – 15 April 2016*

The IBA Conference is a multidisciplinary meeting that includes morphology, phylogeny, geochemistry, taxonomy, palaeontology, ecology and genetics of the Phylum Bryozoa. Keynote speakers will be Tim Flannery 'Australia: an introduction for scientists', and Michele Prinsep, 'Current state of bioprospecting among bryozoans'. There will be a pre-conference excursion (Tasmania) and a post-conference excursion (Great Ocean Road to Adelaide), which will include a lot of geological and fossil sites. Manuscripts are welcome to be brought to the conference for submission for the proceedings volume.

For more information and to download the final circular, see the website at <**http://iba2016.org/**>, or e-mail <**info@iba2016.org**>. *Abstract submission is now closed*.

1st International Meeting of Early-stage Researchers in Palaeontology-XIV
Encuentro de Jóvenes Investigadores en Paleontología
Alpuente, Valencia, Spain *13 – 16 April 2016*

For the last 13 years, young researchers in Palaeontology have organized an annual meeting on the Iberian Peninsula (Portugal and Spain). This event has gathered pre-graduate, post-graduate, PhD students and post-doctoral researchers, helping to develop their skills in the early stages of their research careers. This year, in an attempt to reach new people and nationalities, the organization has decided to make the event international.

For more information, please see the website: <**http://imerp-ejip2016.blogspot.com.es/**>. *Abstract submission is now closed.*

European Geosciences Union General Assembly 2016
Austria Center Vienna (ACV), Vienna, Austria *17 – 22 April 2016*

The EGU General Assembly 2016 will bring together geoscientists from all over the world for a meeting covering all disciplines of the Earth sciences, including palaeontology. The EGU aims to provide a forum where scientists, especially early career researchers, can present their work and discuss their ideas with experts in all fields of geoscience.

Sessions supported by the PalAss include: "Biomineralisation in the fossil record" and "Experimental solutions to deep time problems in palaeontology". Other palaeontological sessions are included in the programme, such as "Conservation & stratigraphic palaeobiology: deep-time to Recent".

Please see the conference website at <**http://www.egu2016.eu/**> for details. *Early registration deadline is 17th March 2016.*

9th Fossil Preparation & Collections Symposium
Doubletree by Hilton, Colorado Springs, USA *20 – 23 April 2016*

The Association for Materials & Methods in Paleontology (AMMP) would like to invite you to the 9th Annual Fossil Preparation & Collections Symposium. The annual meeting includes presentations, workshops, round table discussions, tours of local facilities, field trips and nightly social events.

Look for registration and travel logistics on AMMP's website at <**www.paleomethods.org**>, and through social media outlets.

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

Registration is now open for this conference on the scientific study of non-marine arthropods and amber. The Conference is usually held every three years and this is the first time that it will be held in the UK. It comprises a reception at the Royal Society of Edinburgh, three days of lectures at the National Museum of Scotland, and two optional days of field-work to Palaeozoic non-marine arthropod sites.

For more information about the meeting and how to register please e-mail Andrew Ross (<**a.ross@nms.ac.uk**>). *Abstract submission is now closed.*

9th International School on Foraminifera
Urbino, Italy *6 — 25 June 2016*

The 9th School on Foraminifera is designed to provide an overview of the taxonomy, ecology, biodiversity and geological history of benthic and planktonic foraminifera. This intensive course is intended for students interested in micropalaeontology, palaeoceanography, palaeoecology, climate history, biology, and environmental applications. The aim is to provide a primer on the study of foraminifera and examples of how foraminifera can be used as (palaeo)environmental and (palaeo)oceanographical proxies. We will review the current classification schemes of foraminifera, discuss their ecology and life history, review their usefulness for biostratigraphical applications, and use case studies to investigate the geological history of the group with lab and practical sessions. The entire course consists of approximately 60 hours of lectures and 60 hours of practical work. Four distinct courses are planned: Foraminiferal Introduction (7–11 June), Larger Benthic Foraminiferal Course (12–15 June), Planktonic Foraminiferal Course (17–21 June) and Smaller Benthic Foraminiferal Course (22–25 June).

To register please submit an application form that can be downloaded from the website at: <**http://isf.tmsoc.org**>, or e-mail <**isf@tmsoc.org**>. *Registration deadline 6th May 2016.*

6th Symposium on Mesozoic and Cenozoic Decapod Crustaceans
Villers-sur-Mer, Normandy, France *14 – 18 June 2016*

The Symposium will be held at the Paleospace-l'Odyssee, Museum of Palaeontology and the cinema, both located in the centre of Villers-sur-Mer. Poster and oral presentations will be followed by field-trips to the Callovian–Oxfordian cliffs of the "Vaches Noirs", Bajocian stratotype and Bathonian Confessionnaux, parts of the Normandy landings locations, a trip to the Cenomanian hard-grounds of Petreval, and the Etretat cliffs which attracted Courbet and Monet. English and French will be the official languages of the Conference. Talks will be 30 minutes long including discussion. The area is popular with tourists, so accommodation should be booked early.

For more information, please e-mail the organizer, Sylvain Charbonnier (<**scharbonnier@mnhn.fr**>) or see the conference website at <**http://www.geosoc.fr/6smcdc/topics.html**>. *Registration is now closed.*

XIV Annual Meeting of the European Association of Vertebrate Palaeontologists (EAVP)
Haarlem, The Netherlands *6 – 9 July 2016*

The XIV Annual Meeting of the European Association of Vertebrate Palaeontologists will be held in Haarlem, The Netherlands, in the beautiful historical building of the Teylers Museum. With a confirmed symposium on early hominid evolution, and another on fossil ethics, as well as field trips to either Pleistocene North Sea beds or the Type Maastrichtian, there should be something for everybody.

Please see the EAVP website for updates: <**http://www.eavp.oscartrapman.nl/**>. *Early Bird Registration is now open. Abstract submission deadline is 31st March 2016.*

Palaeo Down Under 2 (PDU2)
Adelaide, Australia *11 – 15 July 2016*

A full conference programme is proposed, covering all aspects of palaeontology and associated disciplines. Dedicated symposia on the Ediacaran and Cambrian systems will be a highlight of the programme, under the auspices of the respective International Subcommissions on Stratigraphy, focusing on recent rapid advances in our understanding in these areas. The Conference will include guest keynote lectures, general and thematic sessions, symposia and posters.

The Conference will be preceded by a field excursion to Ediacaran and Cambrian fossil localities in the renowned Flinders Ranges to the north of Adelaide, and will also feature the Emu Bay Shale Konservat-Lagerstätte on Kangaroo Island, south of Adelaide. A half-day mid-conference field excursion will be arranged to a location of international geological interest in the vicinity of

Adelaide. A post-conference camping-style excursion to Mesozoic and/or Cenozoic fossil localities in the arid Lake Eyre Basin is also under consideration, pending number of interested participants.

For further information, please see the conference website at <**http://aap.gsa.org.au/PDU2.html**>.
Registration is now open. Abstract submission deadline is 31st March 2016.

9th International Meeting of the Society of Avian Paleontology and Evolution
Diamante, Argentina *1 – 5 August 2016*

The Meeting will be hosted by and held at the Centro de Investigaciones Cientficas y Transferencia de Tecnologia a la Produccion de Diamante (CICYTTP-CONICET). It will be dedicated to Larry Martin (USA), in order to honour his memory and his outstanding palaeornithological contributions. The schedule includes a fossil identification session, and pre- and post-conference excursions.

Please see the conference website for more information, at
<**http://www.cicyttp.org.ar/sape2016.html**>.
Registration is now closed. Abstract deadline 30th June 2016.

64th Symposium of Vertebrate Palaeontology & Comparative Anatomy (SVPCA 2016) and 25th Symposium of Palaeontological Preparation & Conservation (SPPC 2016)
Liverpool, UK *22 – 26 August 2016*

The SPPC (22 August) and the SVPCA (22–26 August) will this year be held in Liverpool, UK. The Symposia will be held at the Foresight Centre, University of Liverpool. SPPC will include a tour of the geology and zoology collections at the Liverpool World Museum, and SVPCA will include a post-conference trip to Chester Zoo on 26th August.

Please see the website for more information, at <**http://svpca.org/**>.

Joint Meeting of the TSOP, AASP and ICCP
Houston, Texas, USA *18 – 23 September 2016*

This is the first joint meeting of these three related geological, geochemical and biological societies: The Society for Organic Petrology (TSOP), The Palynological Society (AASP), and the International Commission for Coal and Organic Petrology (ICCP).

The purpose of this joint meeting is to discuss the close relationships between organic petrology and palynology, to foster thoughtful discussion, and address issues that may be of benefit to furthering the respective sciences. Key themes to be addressed during joint activities include palynofacies and source rock assessment. Symposia include: Microscope methodologies in recognizing and characterizing organic microporosity, Palynofacies and Kerogen, Multi-modal Characterization of Source Rocks, Palynofloral Contributions to Source Rocks, and an Alfred Traverse Symposium. There

will also be a short course on "Integration of microscopy and geochemistry in petroleum source rock evaluation". Pre- and post- conference field trips are planned.

More details will be available in the near future. Please see the TSOP and AASP websites for updates: <**http://www.tsop.org**> and <**http://www.palynology.org**>.

XIV International Palynological Congress and the X International Organization of Palaeobotanists Congress (IPC XIV / IOPC X 2016)
Salvador, Brazil *23 – 28 October 2016*

This will be the first time that both the International Palynological Congress (IPC) and the International Organisation of Palaeobotany Conference (IOPC) will gather together in the southern hemisphere. Several field-trips are being planned in Bahia State and to the Tocantins Fossil Trees Natural Monument (Bielândia/Filadélfia, Tocantins State).

Please see the website for more information, at <**http://www.ipciopcbrazil.com/**>. *Registration and abstract submission are now open.*

SVP 76th Annual Meeting
Salt Lake City, UT, USA *26 – 29 October 2016*

More details will be available in the near future. Please see the conference website for updates, at <**http://vertpaleo.org**>.

DINO11: 11th International Conference on Modern and Fossil Dinoflagellates
EPOC Laboratory, Bordeaux University, France *Mid July 2017*

More details will be available in the near future. Please see the conference website for updates, at <**http://www.laplf.org/dino11/calquedino11.htm**>.

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

Lyme Regis Fossil Festival

Fri 29th April – Sun 1st May 2016

LYME REGIS COAST & TOWN VENUES
AND CHARMOUTH HERITAGE CENTRE

Learn about fossils from top experts ✭ Music
Fossil Walks & Talks ✭ Theatre ✭ Hands-on Science
Hands-on Art ✭ Family activities ✭ Fossil Fair

www.fossilfestival.com

Meeting REPORTS

The Rise of Animal Life: Cambrian and Ordovician biodiversification events
Cadi Ayyad University, Marrakech, Morocco *5 – 10 October 2015*

The Rise of Animal Life Conference brought together international researchers working on the early diversification of animal life, with a symposium bringing focus to promoting geological heritage. The Conference was organized by the Cadi Ayyad University, and hosted in the magnificent Palais des Congrès in Marrakech. As a newcomer to the city, it was a stunning and inspiring location for an event. The coordinator Khadija El Hariri and her organising team deserve commendation for putting on such an interesting and diverse conference in wonderful surroundings.

The Conference opened on the 5th of October with a ceremony including welcome messages from high-level members of the University, many of whom emphasized the need for preserving Morocco's valuable geological localities. **Derek Briggs** (Yale University, USA) then gave the first plenary of the Conference; an interesting and historical talk comparing the Moroccan Lower Ordovician Fezouata biota to those from other exceptionally preserved Ordovician localities. Then followed a cheerful (and remarkably sober) reception.

Full days of talks ran on the 6th and 7th, with the geological heritage symposium running in tandem on the latter day. The conference talks were organized into eight topical sessions across the two days, interspersed with four more hour-long plenaries. **Jean Bernard Caron** (Royal Ontario Museum, Canada) gave us a fascinating tour of fieldwork at the Burgess Shale localities, and the biota at Marble Canyon; starting off the first two sessions on arthropods. These took us on a trip through the assemblages at several different localities, and explored many aspects of arthropod morphology, behaviour and diversity. **David Harper** (Durham University, UK) began the subsequent

Stunning views were the order of the day, like this outcrop on the way to Ouarzazate. Photograph courtesy of Harriet Drage.

Walking on an Ordovician landscape, under the blue Moroccan sky. Photograph courtesy of Allison Daley.

two sessions on the Ordovician with a talk on the Great Ordovician Biodiversification Event. The following day **Addi Azza** (Ministry of Energy and Mining, Water and Environment, Morocco) spoke about the promotion and conservation of Morocco's geological heritage, and **Abderrazak El Albani** (Université de Poitiers, France) gave the final plenary on early multicellularity from Gabon. Sessions on the Precambrian, Cambrian, and Fezouta, simultaneous to the Geological Heritage talks, explored ichnology, various other localities including the Emu Bay Shale, and a range of taxonomic groups.

A number of posters were arranged throughout the reception area of the Palais des Congrès. These presented diverse research ranging from Anti-Atlas Moroccan assemblages and geological boundaries in the country, to trilobite ontogeny, and Cambrian eocrinoids. Tribute was paid throughout the conference to Jacques Destombes, one of the key figures in the understanding of Moroccan stratigraphy, and Mohamed 'Ou Said' Ben Moula, the discoverer of the Fezouata Lagerstätte.

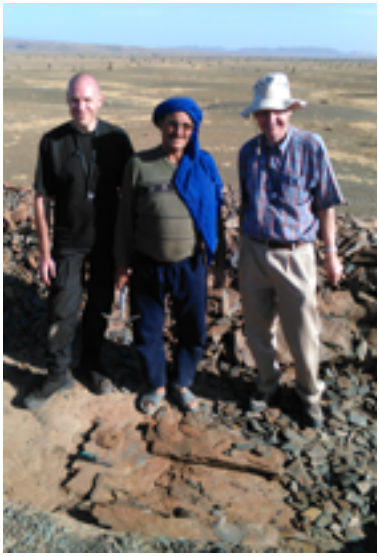
The following day a group of around 60 participants assembled outside the Palais des Congrès for the post-conference field trip. We piled into a small fleet of 4x4s, with our luggage stacked on top, and set off into the desert. The first day gifted us with some beautiful panoramic views of the Cambrian–Ordovician boundary at outcrops through the Atlas Mountains. The long journey to the southeast ended in Zagora, where we finished the day marvelling at constellations and supernovae from high-powered telescopes erected on the roof of our hotel.

The next day we drove back towards Ouarzazate. The morning included stops to examine the geological context of the Fezouata Lagerstätte, followed by an outdoor lunch in the Draa Valley date palm forest (with much opportunity for foraging). In the afternoon the group visited the amazing site of the Lower Ordovician Burgess Shale-type Fezouata Formation excavations, with **Bertrand Lefebvre** (Université Lyon 1, France) and **Peter Van Roy** (Yale University, USA) providing expert knowledge, and **Ou Said** himself excavating a new location. Bertrand and his team explained the surrounding geology, and the recent work by the Université Lyon 1 in collaboration with their Moroccan colleagues. Graptolites were the most common find amongst field trip participants, but

the specimens Ou Said had laid out for us to see were the most remarkable, including juvenile horseshoe crabs and a giant anomalocaridid carapace. We also saw some fabulous tourist sites, including the Taourirt Kasbah in Ouarzazate, and a tour through Aït Ben Haddou, an ancient fortified city built around a mountain, and used as a location for several Hollywood films (think *Gladiator* and *Lawrence of Arabia*).

Our return to Marrakech from the desert heralded the end of the Conference, and our time in Morocco. Huge thanks are owed to everyone who made RALI 2015 such a thoroughly enjoyable and exotic conference and field-trip!

Harriet B. Drage
University of Oxford



Peter Van Roy (left), Ou Said (middle), and Derek Briggs (right) standing over some of Ou Said's discoveries in the midst of current Fezouata excavations. Photograph courtesy of Allison Daley.

The RALI 2015 field trip participants, with the coordinator Khadija El Hariri (front, middle-left) posing under the hot Moroccan sun in front of the stunning walls of Aït Ben Haddou. Photograph courtesy of the RALI 2015 organizers.

2015 GSA Annual Meeting
Baltimore Convention Center, Baltimore, USA *1 – 4 November 2015*

The Geological Society of America's (GSA) 2015 Annual Meeting was an international meeting bringing together professionals, students, teachers and affiliates from 58 countries to communicate their research in geology. With over 7,400 geologists walking through the doors, the variety of sessions was unrivalled, with 342 technical sessions taking place during the Conference. Palaeontologists were in for a treat this year, with over 25 technical sessions and 20 poster sessions, addressing many new and varied strands of palaeontological research. How biotic fauna has evolved over geological time is a vital aspect to understanding past life on Earth, and despite countless studies of and major advances in understanding faunal trends over the last 500 million years, our record is still very much incomplete. So, it comes as no surprise that the themes of evolution, extinction and assessing bias in the fossil record were well-covered topics at the meeting.

A series of talks relating to extinction events explored the causes and subsequent recoveries from these major biotic crises. A session on 'Mass Extinction Causality' began with a talk from **Steve Holland** on the stratigraphy of mass extinction, which highlighted that there is a potential stratigraphic architectural control on the last occurrences of fossils. Steve argued that with the possible exception of the end-Cretaceous (K–Pg), mass extinctions in the fossil record are characterized by clusters of last occurrences at sequence stratigraphical horizons. This may have a significant impact on how we currently infer the tempo and timing of these events. The role of flood basalt volcanism as the ultimate cause of major extinction events was widely discussed during the session. Talks on Deccan volcanism, a controversial contender for the K–Pg mass extinction event, were given by **Loyc Vanderkluysen**, **Paula Mateo**, **Jahnavi Punekar**, **Thierry Adatte**, **Thomas Tobin** and **Gerta Keller**, covering topics including the lava emplacement record and palaeoenvironmental changes associated with the volcanism. **James Witts** assessed the nature and timing of the K–Pg extinction in Antarctica, and the likely contribution of volcanism versus extraterrestrial impact as a causative mechanism. **Steve Stanley** closed the session with a talk on the true intensity of the end-Permian mass extinction.

With a momentary lull in palaeontological-facing talks and the onset of jet-lag fast outpacing the high caffeine intake of the day, a trip to the aquarium was in order. Baltimore's National Aquarium, situated a few minutes from the conference centre in the harbour area, provided unexpected thrills

Inside the enormous Baltimore Convention Center at GSA 2015. Photo courtesy of Autumn Pugh.

for us palaeontologists. A 4D showing of 'pre-historic sea monsters' allowed us to assuage the fear that we would spend the morning in a palaeontology-free world.

Towards the end of the conference, there was an interesting session on the recovery of biota following the devastating end-Permian mass extinction, the largest loss of taxonomic diversity in Earth history. Talks were aimed at redefining "restructuring" intervals by characterizing chaotic palaeoenvironmental conditions, and comparing these to changes in community diversity and ecological complexity. **Margaret Fraiser** challenged current paradigms about hypothesized Early Triassic marine conditions as a control on low ecological complexity, and showed an absence of environmental degradation even when ecological complexity remained low. **William Foster** used a quantitative approach to investigate if marine benthos were impacted by events at sub-stage boundaries during the Early Triassic, and showed that benthic ecosystems were only interrupted by additional crises in the Late Indian (Dinerian) and mid-Olenkian (Smithian/Spathian). **Elizabeth Petsios** suggested that outgassing from Siberian Traps volcanism may have stalled recovery in environments susceptible to temperature rise, particularly in shallow marine settings. **Tracy Thomson** proposed that the rich trace fossil record in deltaic deposits from Utah reveal a 'hidden diversity' in the aftermath of the end-Permian extinction. In another session on broad-scale controls on biodiversity through time, **Richard Twitchett** provided evidence that bioturbation may be a key control on marine diversification following the end-Triassic extinction event.

A change in focus to 'Ancient Life in Deep Time' gave insights into ancient faunas during stratigraphically important time periods. Work by **John L. Moore** showed how small shelly faunas ('SSFs') can be used to help refine a critical interval of metazoan history during the Cambrian, and **Jan Ove R. Ebbstad** presented work on the stratigraphy of the Ediacaran–Cambrian transition, identified by the trace fossil *Treptichnus pedum*.

In addition to the talks, poster sessions allowed the chance to grab a free beer (of which, over 100 kegs were consumed through the course of the Conference) and peruse posters. Poster sessions covered topics including ichnology, palynology, trends in morphology and body size, as well as palaeoecology modern analogues. A huge amount of non-technical sessions were continuously held throughout the day at the conference centre and included courses and seminars on applied biostratigraphy, the concept of the Anthropocene, and Geo-Education. GSA provided a great opportunity to appreciate the numerous ways in which palaeontology is helping to answer major questions about how life and our planet have evolved through time.

Autumn Pugh
University of Leeds

Extant naultiloids at the National Aquarium Baltimore. Photo courtesy of Autumn Pugh.

Plushie trilobites and eurypterids from the PRI, "Paleozoic Pets", on sale in the huge Exhibit Hall. Photo courtesy of Jo Hellawell.

59th Annual Meeting of the Palaeontological Association
Cardiff University and Amgueddfa Cymru – National Museum Wales, UK
14 – 17 December 2015

The 59th Annual Meeting was held in Cardiff, the Welsh capital providing an excellent setting for the Meeting which, as usual, was a highlight in the PalAss calendar. The infectious enthusiasm of each speaker, combined with the vast diversity of research presented, made this both an extremely enjoyable and a highly informative conference. For those who wanted to get stuck-in early, this year delegates were given the opportunity to attend a pre-meeting workshop – a training course on the SPIERS software suite run by **Russell Garwood**, **Mark Sutton** and **Imran Rahman**. Funded by the Software Sustainability Institute, this was an excellent chance for the 25 attendees to get to grips with SPIERS, a free software package used to process and analyse tomographic datasets. Delegates left the session with the skills required to analyse their own data, having learnt how to prepare a dataset, create, manipulate and view a three-dimensional model, and effectively display results for publication.

The meeting formally began with a welcome from **Richard Bevins**, Keeper of Natural Sciences at Amgueddfa Cymru – National Museum Wales, which was followed by a symposium centred on the theme of "Palaeobiotic Interactions". With presentations focused on topics including fossil lichens, Devonian forests and ancient methane seeps, there was plenty to promote discussion during the coffee break, and to whet people's appetite for the following days' talks. **Paul Taylor** was the first to speak, stating that "encrusting palaeocommunities offer largely unexplored possibilities for studying competition in the geological past". Here he discussed the way in which unequivocally *in vivo* symbiotic relationships between fossilized sclerobionts could be used to shed light on competition and symbioses in the geological past. **Paul Wright** followed with a talk about the interactions between burrowing organisms and diagenesis, suggesting a link between the diversification of boring biota and a lowering of the zone of secondary carbonate precipitation. A later talk, given by **Elizabeth Harper** and entitled 'Something ate my fossil: from anecdote to hypothesis testing', addressed the issue of how to convert "interesting fossils with an interesting story to tell into a source of plentiful robust data". While patterns of marine predation formed the focus of this talk, the questions it raised – for instance, how can we effectively combine modern and palaeontological data? – have far-reaching implications across the field of palaeontology.

Photo courtesy of Dave Marshall.

Delegates gather in the Main Hall of Amgueddfa Cymru – National Museum Wales for the icebreaker reception.

The Symposium was followed by an icebreaker drinks reception, held in the impressive surroundings of the National Museum's Main Hall. This provided an excellent chance for a catch-up with old acquaintances over a glass of wine, as well as an opportunity for

introductions. In addition, the location of this event allowed delegates to explore the *Evolution of Wales* galleries, catch a glimpse of the 'new Welsh dinosaur', and have a wander through the temporary exhibition *Reading the Rocks: The Remarkable Maps of William Smith*.

The second day of the Annual Meeting saw the beginning of the oral research presentations and poster sessions. **Mark Williams** began proceedings with an engaging and thought-provoking talk about the 'Anthropocene biosphere', examining mankind's influence on the Earth, and discussing the concept of the technosphere – a system incorporating humans and their technological developments. A morning of further stimulating talks followed, and with topics ranging from sexual dimorphism in *Stegosaurus mjosi* to ancient spiders and the question 'how big is a genus?', there was something to satisfy all interests. In addition, images of three-dimensionally preserved Early Jurassic fossils from the Strawberry Bank Lagerstätte were a particular highlight.

The first part of the afternoon saw a set of parallel talks, where delegates could choose between discussions of crocodylomorph phylogeny, the diversification of Mesozoic marine reptiles, and the preservation of Cambrian neural tissue, to name but a few. Fortunately, no tricky decisions were required later in the day, with all attendees gathering together for the remainder of the day's talks. Two of these presentations, given by **Sarah Baker** and **Brittany Robson**, shared the topic of 'wildfire', discussing changes in wildfire activity during the Toarcian Oceanic Anoxic Event, and the global record of wildfire occurrence during the early Palaeogene, respectively.

The talks were followed by the PalAss AGM and Annual Address, which this year was given by **John Hutchinson** of the Royal Veterinary College. Based in the 'Structure and Motion Laboratory', Professor Hutchinson specializes in evolutionary biomechanics, examining the way in which large animals move, and how such locomotion may have evolved. His talk, entitled 'Computer modelling and simulation of extinct organisms: its utility and limitations for reconstructing the evolution of locomotor behaviour', gave a fascinating introduction into his line of research. With tongue-in-cheek talk of a fire-breathing *Tyrannosaurus rex* (such traits cannot be detected in the fossil record, so how do we know they didn't exist?), the audience was quickly captivated. Hutchinson discussed the methodology employed during his research, stressing that an understanding of anatomy is the foundation for biomechanics, and that the importance of extant taxa should not be underestimated. Through comparison with modern analogues, Hutchinson and his team have been able to assess the running capabilities of *T. rex* – as it turns out, the infamous dinosaur's ankle muscles were simply too small to sustain rapid running.

The day concluded with the Annual Dinner, which took place in the grand surroundings of Cardiff City Hall. Beginning with a drinks reception in the festively decorated Marble Hall, this was a wonderful chance to discuss the day's events. An excellent meal (finished off with mince pies, of course!) and picturesque setting made this a highly enjoyable evening, although there wasn't time to relax too much with the *PalAss 2015 Annual Meeting Intra-Dinner Quiz* to complete!

A true highlight of the evening was the presentation of awards. This year the recipient of the Mary Anning Award – for which those who are not professionally employed in palaeontology are eligible – was **Lutz Koch**, a retired school teacher who has devoted much time to the natural sciences, and is the author of numerous palaeontological texts. The Hodson Award for an early-career palaeontologist went to **Roger Benson**, recognising his already exceptional contribution to the field of vertebrate palaeontology, which includes a "phenomenal publication record". The President's

The Annual Dinner, held at Cardiff City Hall. Photo courtesy of Dave Marshall.

Medal – open to mid-career palaeontologists – was presented to **Graham Budd**, recognized as "one of palaeontology's most accomplished and capable practitioners", and an expert in the fields of arthropod palaeobiology and evolutionary theory. The Lapworth Medal, the highest award of the Palaeontological Association, was presented to **Jennifer Clack**, recognising her outstanding lifetime contribution to palaeontology. Author of the acclaimed text 'Gaining Ground', in addition to numerous landmark papers, Professor Clack has made a phenomenal contribution to her field, and is a worthy recipient of this prestigious award. The Best Paper Prize 2015 for *Palaeontology* was awarded to **Steven Holland** and **Mark Patzkowskyn** for "The Stratigraphy of Mass Extinctions", while the prize for *Papers in Palaeontology* went to **Leonid Popov**, **Lars Holmer**, **Nigel Hughes**, **Mansoureh Ghobodi Pour** and **Paul Myrow** for "Himalayan Cambrian Brachiopods". Finally, Life Membership of the Association was awarded to **Tim Palmer**, who has served as Council member, Editor, Treasurer and Executive Officer of the PalAss, and has played a crucial role in its success.

The third day began with a poster session, where delegates could view over 70 posters, and enjoy a Welsh cake at the same time. This was followed by two sessions of parallel talks, which included presentations on Ediacaran acanthomorphs by **Peter Adamson**, 'Near-stasis in the long-term diversification of Mesozoic tetrapods' by **Roger Benson**, and the trilobite genus *Lichas* by **Sofia Pereira**. Particularly exciting was the chance to see an anatomically correct model of *Psittacosaurus* (complete with colouration and ornamentation!), used by **Jakob Vinther** and colleagues to determine the habitat of this small ceratopsian dinosaur. Utilizing the exceptional preservation of a specimen from the Chinese Jehol biota, the animal's pigmentation was determined from preserved melanosomes, and used to reconstruct its pattern of counter-shading. Then, in a novel approach, grey-scale models of *Psittacosaurus* were subjected to different light conditions in order to determine the environment in which the dinosaur would be most effectively camouflaged. The morning session ended with a short talk by **Jesper Milan** – 'Rock Fossils on Tour' – which gave a

An anatomically-correct model of Psittacosaurus, presented by Jakob Vinther and colleagues. Photo courtesy of Fiona Jones.

fun overview of an exhibition aimed at making palaeontology accessible to a wider audience – by linking fossils to heavy metal and rock music! (See *Newsletter* 90 for more information.)

The afternoon saw the last session of parallel talks. For those wishing to continue their dinosaur education, a talk by **Femke Holwerda** was on offer, exploring the ontogeny of *Patagosaurus*. There was also plenty to satisfy the interests of invertebrate palaeontologists, including a presentation on the relationship between solemyoids and ctenodontids by **John Cope**, a talk on the Cambrian "muscle worm" by **Allison Daley**, and a venture into the world of a "weird and wonderful" bryozoan with **Eckart Håkansson**. Following this, delegates gathered together for the conclusion of the Conference. This began with the final four oral presentations – which included an enthusiastic presentation on the conservation of Chesapeake Bay oysters by **Rowan Lockwood** – and ended with the announcements of the President's awards for the best poster and oral presentations. These went to **Christopher Nedza** for his excellent poster on "Testing hypotheses of niche partitioning in isolated fossil mammal teeth based on quantitative 3D dental microwear texture analysis", and **Jack Oyston** for his engaging talk entitled "What limits the morphological disparity of clades?".

For those wanting to get 'up close and personal' with some real fossils – and see the beautiful Welsh countryside – a field-trip was organized for the fourth day of the Conference. The first stop on the itinerary was an old quarry at Little Cwm Dowlais Farm, south west of Usk. Here, delegates learnt about the Much Wenlock Limestone Formation, clearly exposed at this site. In fact, the quarry represents the most complete section through this formation, where 0.5 m of Lower Elton Formation calcareous mudstones overlay 9.4 m of limestone. Making the most of the unseasonably warm, dry weather, the attendees quickly got to work with their geological hammers, uncovering numerous brachiopods, in addition to corals and a putative bryozoan. Amongst the brachiopods known from this site are *Atrypa reticularis*, *Microsphaeridiorhynchus nucula* and *Leptostrophia filosa*. The second exposure to be visited was located in a nearby quarry, this time at Cilwrgi Farm. A biohermal mound is exposed on the quarry floor, and although the dry weather didn't last, the enthusiasm of the group wasn't dampened as they hunted for fossils including rugosan and tabulate corals, bryozoans (*e.g. Fenestella*), trilobites (*e.g. Warburgella stokesii* and *Dalmanites*) and pelmatozoans. On a grey day in December, it was hard to imagine that the limestones were once part of a shallow tidal environment, teeming with marine life!

The third and final stop of the day was the Big Pit National Coal Museum at Blaenavon, Torfaen. Part of the Blaenavon UNESCO World Heritage Site, Big Pit was a working coal mine from 1860 to 1980, and now offers the public a rare insight into the world of mining. Upon arrival, the group enjoyed a wonderful hot lunch (very welcome after the very wet walk to the restaurant!), kindly provided by the staff in the original Miner's Canteen in the Pithead Bath. After lunch there was time for a quick wander round the site, before the highlight of our visit – the chance to descend 90 m

underground for a guided tour of the pit! An ex-miner himself, our guide had plenty of anecdotes to keep us entertained in the dark, damp tunnels of the mine, and it was extraordinary to see where so many men and boys worked for so many years. Indeed, the visit was particularly poignant given its timing – one day before the closure of the last deep coal mine in the United Kingdom. In the maze of tunnels we were shown where the pit ponies lived, and were given the chance to experience true 'pitch dark' by turning off the lamps on our hard hats. Once back above ground there was just time for some souvenir shopping before getting on the coach back to Cardiff. However, no account of the field-trip would be complete without mention of the amazing efforts of our coach driver, who managed to manoeuvre his way down countless narrow country lanes with admirable skill and perseverance! Thank you – it was much appreciated by all.

On behalf of all 270 delegates (coming from 16 different countries!), I would like to thank the organizers of PalAss 2015 – **Caroline Buttler**, **Lesley Cherns** and **Lucy McCobb** – for a brilliant Conference (diolch yn fawr iawn!). Now we can all look forward to Lyon 2016, which promises to be another wonderful conference … with some delicious French cuisine.

Fiona Jones
University of Oxford

The PalAss field-trip 2015. Clockwise from top left: attendees learn about the Much Wenlock Limestone Formation with field-trip leader Lesley Cherns; hunting for fossils at the exposure; getting ready to descend 90 m (300 ft) at the Big Pit National Coal Museum; field-trip leaders Caroline Butter and Lucy McCobb. Photos courtesy of Dave Marshall and Fiona Jones.

——OBITUARY——

Peter Lawrence Forey 1945 – 2016

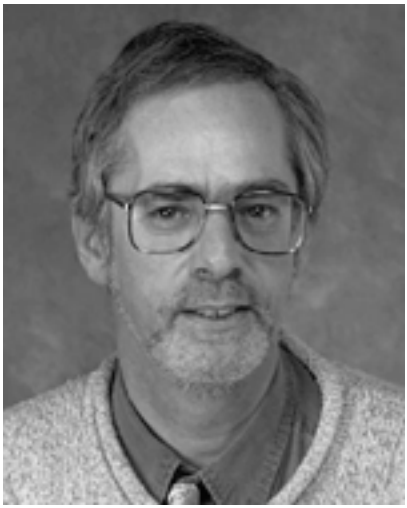


Image © The Geological Society.

Peter L. Forey, the phylogeneticist and fish palaeobiologist based for many years at the Natural History Museum, London, died on 21st January at the age of 70 after a long illness. Peter gained his PhD in 1971 under the supervision of Brian Gardiner at the University of London (Queen Elizabeth College) on an osteological study of fossil and Recent elopiform fishes. The core of this work was published two years later (1973a), and drew together a wealth of detailed and precise observations on elopiform taxonomy that makes this paper as important today as it was then. Although this monograph contained no phylogeny, Peter published another paper the same year (1973b), in which he discussed the relationships of the larger group Elopomorpha. Although the approach is pre-cladistic, he presciently stressed in his introduction that "classification should reflect phylogeny". Thus the two themes, attention to detail and pursuit of methodological clarity and rigour, that mark a common thread to Peter's career, were there from the start.

Following graduation, Peter was Assistant Professor in Zoology at the University of Alberta (1972–1975). In 1975, he joined the fossil fish section in the Department of Palaeontology at the Natural History Museum, London (NHM). This was the time when cladistics was just beginning to be taken up more widely, and the value of phylogenetic systematics was being intensely debated as people began to realize the implications this had for traditional taxonomy. Within the NHM, intellectual debate focused around a small group composed of Peter Forey, Colin Patterson, Dick Vane Wright and Chris Humphries, where arguments for the newly emerging science were honed at extended Friday lunchtimes in a local public house informally christened 'the Cladists Arms'. These debates led to the publication in 1981 of the now classic paper *Lungfishes, tetrapods, palaeontology and plesiomorphy* by Donn Rosen, Peter Forey, Brian Gardiner and Colin Patterson. The main theoretical conclusion of the paper, difficult to accept for most palaeontologists of that time, was that the relationships of major extant groups are better understood first by using the cladistic methodology and second by comparative analysis of extant forms only, rather than by conducting "futile paleontological searches for ancestors" (Rosen *et al.* 1981). This created a veritable maelstrom amongst palaeontologists and the wider community, and triggered harsh critiques and replies, in particular in the journal *Nature* (see Gee 1999). The four authors of the paper were nicknamed the 'Gang of Four' in allusion to the Chinese namesake whose actions some years before had caused such destructive upheaval. Peter did not reply directly to the attacks, but in most of his subsequent theoretical works he addressed the methodological issue raised in the 1981 paper. For instance, he revisited lungfishes relationships (1986) as a case study to address the methodological contribution of the cladistic approach. Two sentences from this paper would, if they had been read more

carefully by irreducible opponents of cladistics, have saved much time and pointless debate: “Many people have questioned the search of ancestors, whether those ancestors be species or supra-specific groupings. This is not a denial of the former existence of ancestors but rather an acceptance that they cannot be recognized”.

Other papers dealt with different aspects of cladistics, such as the impact that fossils may have on the topology of cladograms. In this matter, he was not as extreme as Colin Patterson by recognizing that fossil taxa could overturn a theory of relationships based on modern taxa (Forey 2004).
An offshoot of Peter’s interest in the cladistics methodology was his dislike of the unnecessary theoretical baggage that accompanied the phylocode, set out in particular in an eloquently titled paper “PhyloCode – pain, no gain” (Forey 2002). Peter contributed to the teaching of cladistics through several books and articles, and many Palaeontological Association members will have learned about the finer details of the cladistic method through a series of articles published in the Association’s *Newsletter* (Forey 2005; 2006a-c; 2007).

Beyond his interest in the cladistics methodology and its impact on taxonomy, his main (and probably most appraised) activity was the study of fossil fishes. He had a deep knowledge of teleostean osteology covering a wide range of taxic and temporal diversity, which is not an easy task if we remember that a teleostean skull contains more than 100 bones. He described new taxa of elopiforms, osteoglossomorphs, clupeomorphs, halecomorphs and extinct clades such as ichthyodectiforms, mostly from Mesozoic localities but also with incursions into the Cenozoic and Palaeozoic eras. His 2003 monograph on the teleostean assemblages, co-authored by Li Yi, Colin Patterson and Cliff E. Davies, is a good example of his exceptionally broad expertise across various groups of fishes.

Peter, however, is probably best known and most cited in the palaeontological and biological communities and literature for his work on coelacanths. Although he did not publish many articles on this group of fish, all proved pivotal in one way or another. His first paper (Forey 1980) dealt with the Recent *Latimeria* and represented a complement to the Gang of Four’s paper published one year later. Several papers on *Latimeria* were published in the following years, but, in parallel, Peter worked on a wide variety of extinct taxa of coelacanths, leading to the publication of his 1998 book *History of the coelacanth fishes*. In this 419-page book (my copy is ramshackle for having been opened so often), a huge amount of new data on fossil coelacanths is provided, followed by studies of evolutionary trends and by a phylogenetic analysis. The data matrix for this analysis was the most complete and advanced ever published, and remains the matrix corpus of the ongoing analyses conducted by all succeeding researchers.

The scientific message of Peter’s research was enhanced by the very high quality of his drawings of the fossils that he published on. He used to say that making precise drawings implies the necessity to observe in the most precise way possible the specimen under study and may prevent an over-interpretation of the anatomical structures. This is wise advice in a time where new technical devices allow representations of natural history objects without the medium of a hand which translates what the eyes see. What fewer people appreciate is that Peter also excelled in the production of landscape watercolours, depicting old barns, farms and wonderful vistas of the countryside he lived in. According to his own words, “As a palaeontologist I was used to drawing old bones, so progression to painting was natural and only a matter of time”.

Peter retired from the NHM at the age of 60, but if time was long enough for Peter to accomplish his art, it was too short for him to fully enjoy a prolonged life.

Peter was a measured man and not ready to proclaim loudly his knowledge to those around him, but always with a clear and reasoned stance when probed. He was a patient teacher always willing to take the time to explain issues and point out pitfalls about a methodology, or raise an anatomical issue that was being overlooked and on which an argument could turn. Morning and afternoon tea-breaks in the NHM palaeontology department's fish library were always stimulating and entertaining when Peter was there to make us think over the issues of the day.

Lionel Cavin
Natural History Museum, Geneva

Andrew B. Smith
Natural History Museum, London

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A full bibliography of Peter's publications is in Geological Society, London, Special Publications 2008, v. 295, p. 1–6.

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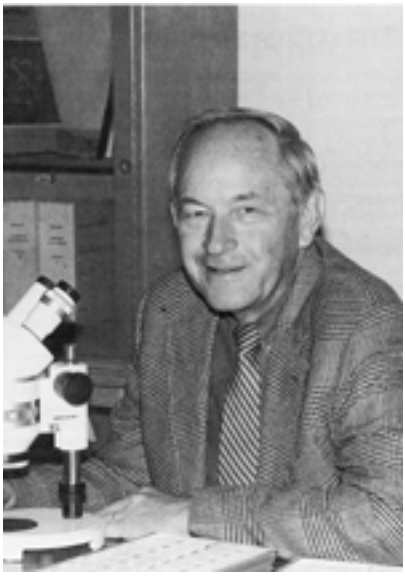
From left to right: Dick Vane-Wright (kneeling), Colin Patterson, Peter Forey, Brian Gardiner and Chris Humphries, at Bow Locks on the River Lea, 1988. Photo by Chris Humphries (and timer!) from Humphries 2000, reproduced with permission of the Linnean Society.

——OBITUARY——

Walter Clarence Sweet 1927 – 2015



One of the best-known conodont workers internationally, Professor Emeritus Walter C. Sweet passed away on 4th December 2015 following a heart attack and by-pass surgery from which he did not recover. Walt was born in Denver, Colorado, USA and received his undergraduate degree at Colorado College. He did his PhD work at the University of Iowa, where his adviser was A. K. Miller, an internationally-renowned cephalopod worker. Walt's PhD dissertation dealt with the geology and conodonts of the Harding and Fremont Formations (Upper Ordovician) in the Rocky Mountains of Colorado.

Walt started his long career at the Ohio State University (OSU) as an instructor in 1954, was promoted to Assistant Professor in 1957, became Associate Professor in 1961 and Professor in 1966, retiring and becoming Emeritus Professor in 1988. During his many years at OSU, Walt was a very successful educator, teaching a wide variety of geology courses and receiving the Distinguished Teaching Award twice (1971 and 1982). He co-authored a textbook on Introductory Geology, published in two editions (1966 and 1973) and used at several universities, and was involved in developing innovative laboratory exercises for introductory geology students. Walt also translated from German Vladimír Pokorný's *Grundzüge der zoologischen Mikropaläontologie*, although this translation was never published. He served as thesis advisor for approximately 40 students, several of whom (for example T. J. M. Schopf, Anita Epstein (Harris), Mark Kleffner and Jeff Bauer) have become internationally known in their careers.

Much of Walt's early palaeontological research was on Ordovician cephalopods; for instance in his 1958 monograph on nautiloids from the Oslo region, Norway, he described more than 20 new species, and several years later, he produced extensive chapters on cephalopods in Part R of the *Treatise on Invertebrate Paleontology*. However, a major focus of his research from the late 1950s onwards dealt with conodonts and conodont biostratigraphy, initially in the Ordovician but later in much of the Palaeozoic and the Triassic. This research resulted in more than 125 publications, and he was considered an authority on virtually all aspects of conodonts. From the 1960s to the early 1980s Walt was a regular and frequently vocal participant in conodont conferences in North America and Europe, and had very close ties to a number of British palaeontologists. In the 1960s he collaborated with Stig Bergström on the development of multi-element conodont taxonomy, that is, the classification of conodonts based on their element apparatus rather than as taxa based on isolated single skeletal parts. Although initially met with some scepticism, this taxonomic approach allows biological species concepts for conodonts, and is now used whenever possible

in conodont taxonomy. Walt's broad knowledge of conodonts was summarized in his book *The Conodonta. Morphology, Taxonomy, Paleoecology, and Evolutionary History of a Long-Extinct Animal Phylum*, which has become a classic and is still used worldwide as the best available summary of this widespread and important fossil group. Walt was also one of the principal authors of the revised conodont part (1981) of the *Treatise on Invertebrate Paleontology*. The wide appreciation of his palaeontological work has been demonstrated by the fact that international colleagues have named at least three fossil genera (*Sweetodus, Sweetina, Sweetocristatus)* and several new species (*e.g. Cahabagnathus sweeti*) for him. Although he described numerous new species and genera of conodonts, much of his work in the Ordovician and Permian/Triassic was biostratigraphic in nature, and he was one of the pioneers in using graphic correlation in the Ordovician and Permo–Triassic.

During his long research career Walt received several major awards, including the Pander Gold Medal (1985), the highest award in conodont research, the Society of Sedimentary Geology's Raymond C. Moore Medal (1988) and the Paleontological Society's Medal (1994), the latter two awards being the two most prestigious in palaeontology and soft rock geology in North America. Only one other person in the world has received all three of these awards. Walt was also active in professional service. He was Secretary (1976–1982) and later President (1983–1984) of the Paleontological Society, and was Chief Panderer (=President) of the Pander Society (1975–1985). For many years, he was also a very active Member or Corresponding Member of the Ordovician, Permian, and Triassic Subcommissons of the International Commission on Stratigraphy. Although he maintained a general interest in palaeontology and biostratigraphy during his retirement years, occasionally attending geology seminars, he published only a couple of conodont papers during the last decade of his life. This was no doubt partly due to an eye problem that prevented him from using a microscope.

Walt was helpful and friendly, but was also demanding of his students and co-workers. Particularly with old and foreign friends, Walt could be easy-going and very enjoyable company, but he had firm opinions on a variety of matters. However, his broad knowledge, sharp and critical mind, and his ability to think 'outside the box' will be greatly missed by many conodont workers and other palaeontologists around the world.

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Research Grant REPORTS

Palaeoneurology and sensory systems in Devonian lungfish: morphological diversity or conservatism in the neurological system?

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Lungfishes (Dipnoi) serve a critical comparative role in our understanding of tetrapod evolution. As the sister group of tetrapods, lungfishes represent the closest extant divergent line in the evolution of the tetrapod neurosensory system. Examination of the neurological system in fossil lungfish is vital to establish whether living lungfish retain the same neurological characters as primitive lungfish. This will have a direct bearing on how suitable extant lungfishes are as a model for primitive tetrapod neurology, but will also provide further characters that may aid in resolving the notoriously unstable Devonian lungfish phylogeny. However, the brain is rarely (if ever) preserved in the fossil fish record and, as such, we must rely on the morphology of the void that once contained the brain and surrounding tissues as a proxy. The positive three-dimensional expression of this void is known as the cranial endocast.

The brain and neurocranium of modern lungfish include two possible synapomorphies with Tetrapoda: loss of a saccus vasculosus (situated postero-ventrally in the forebrain) and the presence of neurocranial endolymphatic sacs (Northcutt 1986). Of these, only the latter is likely to preserve in the endocast. Of further interest, plesiomorphic characters of the sensory system, intimately associated with the neurological system, are also found in some early tetrapods (e.g. the lateral line system in tubes through the bone (Lebedev and Clack 1993). We do not know in detail how these systems vary throughout the Dipnoi, which neuro-sensory features are likely to be plesiomorphic or paedomorphic, and what the functional effect of heterogeneity may be.

In this project I used proven µCT-scanning techniques to extract information regarding cranial endocast morphology from the skulls of three-dimensionally-preserved Devonian lungfish. In particular, I specifically chose to investigate the well-known Middle Devonian lungfish *Dipterus valenciennesi*. Despite having been described in 1828 and having been the subject of detailed study since, the position of *Dipterus* in the Devonian dipnoan tree exemplifies its instability and its position is ambiguous, residing deep within a polytomy along with six other taxa. Besides *Dipterus*, four more Devonian lungfish skulls were scanned using µCT: *Phaneropleuron andersoni*, *Griphognathus whitei*, *Chirodipterus australis*, and *Scaumenacia curta*. Of these, it was found that only *Griphognathus whitei* and *Chirodipterus australis* preserved any neurocranial material and they

have been reserved for further study. The present µCT study has revealed a great deal of new and interesting information about *Dipterus* that has added support to the Devonian dipnoan tree and has also contributed extensively to our understanding of the arrangement of lungfish cranial nerve and senses in the stem group of this most interesting clade.

Sarcopterygian endocasts

The gross morphology of known Devonian sarcopterygian endocasts is relatively conservative. Long, diverging olfactory tracts lead posteriorly to the forebrain which is typically expanded dorsally, sometimes ventrally. Posterior to the forebrain, the midbrain manifests as a lateral and dorsoventral constriction with several key nerve canals entering the endocast. Sarcopterygian endocasts lack the conspicuous bulbous optic lobes typical of actinopterygian endocasts (Giles and Friedman 2014). In an endocast the hindbrain is contiguous with the inner ear and, as such, two large pouches, the sacculolagenar pouches, lie lateral to a canal for the notochord and ventral to the hindbrain proper. On top of these pouches sit the characteristic semi-circular canals of the labyrinth system, large loops oriented at right angles to each other. Rather than being a structureless tube, the region of the hindbrain itself may be elaborated by two dorsal swellings that lead into canals for endolymphatic ducts as well as the tenth cranial nerve emanating posteriorly.

The publication of the first digital cranial endocast of a dipnoan by Clement and Ahlberg (2014) for the Upper Devonian dipnoan *Rhinodipterus kimberleyensis,* as well as earlier interpretations of dipnoan cranial endocasts from steinkerns and partial cranial material, demonstrated five important points relating to dipnoan endocasts:

- Upper Devonian dipnoans appear to possess large, deep forebrains (as do extant dipnoans).
- There is a subtle separation of the sacculolagenar into two respective sections: the sacculus and the lagena (not seen in extant dipnoans).
- Part of the labyrinth system called the utricular recess is enlarged in more derived dipnoans.
- Primitive dipnoans such as *Dipnorhynchus* possess a series of medial canals on the dorsal surface of the endocast, whereas in more derived dipnoans this is limited to the pineal and parapineal recesses in the forebrain.

Dipterus is the first Middle Devonian dipnoan from which the endocast has been realized. It therefore serves as a key taxon to test the hypotheses of polarity of several features such as those outlined above.

Results

Dipterus possesses a notched (segmented) sacculolagenar pouch and shallow forebrain, similar to the basal *Dipnorhynchus,* as well as an additional dorsal medial canal, again, similar to *Dipnorhynchus.* Not seen in any other dipnoans, this arrangement in *Dipterus* appears to be intermediate to the primitive and derived conditions and, as such, defines the polarity of these conditions. However, these primitive characters are also supplemented by a suite of derived characters only seen in the Upper Devonian and extant dipnoans: a large utricular recess and sessile olfactory bulbs in the forebrain. *Dipterus* is an intermediate form in the truest sense of the term (Figure 1).

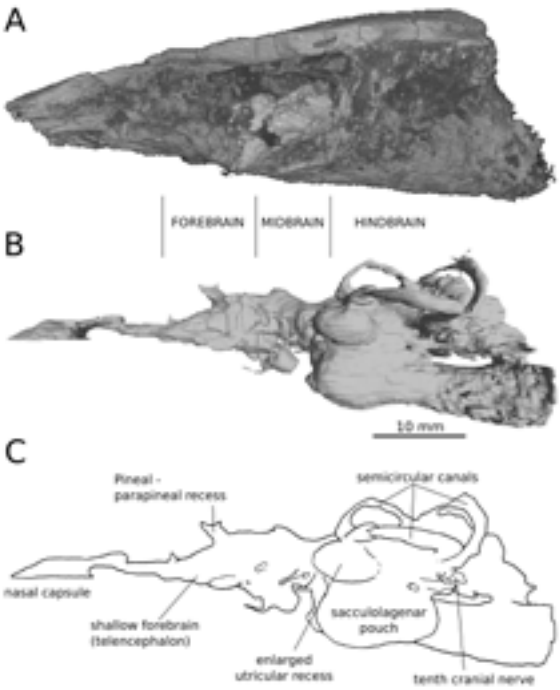

Figure 1. (A) Rendered µCT scan of the skull of specimen NHMUK PV 17410; (B) Digital cranial endocast from specimen BMNH P 17410; (C) Interpretive drawing of (B) highlighting the mixture of informative characters of the cranial endocast of Dipterus *and those mentioned above.*

The scan of one specimen, from the Natural History Museum (NHM), London, holds further secrets. Soft tissue within a skull cavity has questionably never been preserved; the brain tissue decomposes too rapidly. The labyrinth system, however, contains crystalline structures in the utricular recess and the sacculagenar pouches that are employed to sense balance and orientation. In most fish these are solid structures called otoliths but in sarcopterygians they comprise a coagulated crystal mush called the otoconial mass. The NHM specimen preserves a region of dense material in the precise position within the utricular recess that corresponds to the otoconial mass (Figure 2). It is likely that diagenetic conditions during fossilization, rather than dissolving the mass of small calcite crystals, were just appropriate to consolidate the structure and preserve it for posterity. The fortunate preservation of this otoconial mass provides a unique opportunity to test/postulate hypotheses of function, behaviour and sense between stem group lungfish and extant lungfish. The labyrinth system is a mechanosensory system and as such the relative sizes of the components of the system equate to functional sensitivity (Spoor *et al*. 2002). Extant lungfish possess enlarged utricular recesses and sacculolagenar pouches that are replete with a large otoconial mass. Conversely, the size of the semi-circular canals is reduced. The otoconial mass in *Dipterus* sits within a large utricular recess, but is much smaller than those in extant dipnoans relative to the total size of the utricular recess (Figure 2).

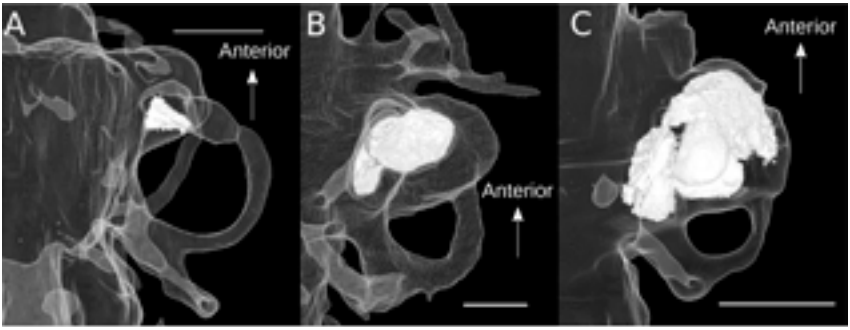

Figure 2. 3D digital renderings showing the labyrinth system and size and shape of the otoconial masses in (A) Dipterus*, NHMUK PV P17410, (B)* Neoceratodus forsteri *and (C)* Protopterus dolloi*, NHMUK 1901.12.261. Scale bars represent 5 mm (D–E) and 2 mm (F).*

The otoconial mass/otolith organ serves to detect linear accelerations and through extrapolation from extant fish (otoliths, Popper *et al*. 2002) and cetaceans (otoconial masses), a small otoconial mass/otolith is most suited to agile, fast swimming organisms where rapid movement of the otoconial mass/otolith will only stimulate a limited number of receptor cells within the utricular recess. Stimulate too many receptor cells continuously and the organism will begin to feel travel sick. Conversely, if the organism is sedentary then slow movements require stimulation of a greater number of receptor cells in order to register the movement. Further to this, the length of arc of the semi-circular canals determines the sensitivity to angular accelerations; larger arcs produce greater sensitivity to angular accelerations compared to small arcs. *Dipterus* possesses all the functional equipment suitable for a fast swimming fish which has subsequently been reduced since the Devonian, until we are left with the sluggish lungfish we are familiar with today. When this process started to happen is not known. Otoconial masses are rarely preserved and post-Devonian lungfish typically possessed cartilaginous or poorly ossified neurocrania that seldom made it into the fossil record. What this study on *Dipterus* has revealed, though, is that aspects of the modern dipnoan brain began to be established in the Mid Devonian.

What about the other scans?

As previously mentioned, those lungfish lacking preserved neurocrania provide little usable information for understanding sarcopterygian brain evolution. The µCT scan data of *Phaneropleuron andersoni*, however, retains the arrangement of the skull bones, palate and teeth with little three-dimensional deformation. This dataset will subsequently be used as a key source of information in re-describing this poorly-known Upper Devonian lungfish. *Griphognathus minutidens* is interesting because it is a long-snouted dipnoan. The rostrum is extended and initial analysis of the µCT data demonstrates an intriguing configuration of the cranial cavity to accommodate this morphology. The last Upper Devonian dipnoan to be scanned, *Chirodipterus australis*, is currently under study as part of an Honours project and will form a test of the hypothesis for the structure of the cranial endocast for this genus, first proposed by Säve-Soderbergh in 1952 from natural casts.

Discussion and conclusions

Morphological disparity of the endocast of Devonian dipnoans is gradually being shown to be greater than previously anticipated. Indeed, the proposition by Säve-Soderbergh (1952) that the

dipnoan 'brain type' has not considerably changed since the beginning of the Devonian can clearly be dismissed, as the different configurations seen in *Dipterus* testify. *Dipterus* possesses a complex ensemble of derived and primitive characteristics implying that characters of the neurocranium were acquired gradually throughout the Devonian rather than all at once. Unfortunately, the new information gained has not helped resolve the large polytomy of Devonian dipnoans that continually recurs in many research articles on the subject. This is less to do with the characters themselves, but more that those taxa comprising the unresolved region of the tree have not yet been analysed in the same way as *Dipterus*.

Rather than being just a vague proxy for morphology of the brain that may help to resolve phylogenies, the presence of preserved otoconial masses and their relationship to the endocast also presents the opportunity to test and infer behavioural hypotheses based on rigorous mechanical principles. In this respect, the small otoconial mass, relative to its enclosing utricular recess, suggests that *Dipterus* would have been a fast swimmer, relative to extant lungfish. This was a rather unexpected result from this study but an exciting one that demonstrates the potentially wide application of cranial endocast study. But the cranial endocast is not just the empty space occupied by the brain. All endosseous nerve and vessel canals form an endocast which, though often excluded from cranial endocast studies, offers a further character-rich complex. *Dipterus* demonstrates this extra information well in the rostrum, in which the cranial nerves can be seen to continually bifurcate peripherally until they are intimately associated with the rostral sensory systems of the lateral line and the cosmine pores. Although these 'patterns' can be used at face value to add further information towards discerning phylogenetic relationships, the potential of the relationship between sensory organ, nerve afferent/efferent arrangement and brain (endocast) morphology is unknown, as yet, and a subject for further investigation.

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Stan Wood Award Report

Ecology and evolution of British marine reptiles

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Introduction

During the Jurassic (~201–145 Ma), marine ecosystems were dominated by pelagic reptiles, plesiosaurs, thalattosuchian crocodylomorphs and ichthyosaurs, that were secondarily adapted to an aquatic lifestyle. There is evidence that these animals often coexisted in the same environment, perhaps sharing the same ecological niches (Andrews 1910; 1913; Massare *et al.* 1987). Comparisons with modern marine tetrapods suggest that this was made possible because of a very diverse array of craniodental adaptations (Massare *et al.* 1987; Kelley and Motani 2015) (Figure 1). In particular it has been shown that modern marine tetrapods, which adopt analogous diets, also share similar skull, mandible and tooth shapes (Kelley and Motani 2015). Such strong correspondence allows us to quantitatively link morphological and ecological datasets and provides an encouraging framework for investigating the ecology of extinct species, for which dietary information is an issue. However, niche partitioning among marine reptiles is a poorly investigated hypothesis and has rarely been tested with quantitative methods. So far only a handful of studies have specifically focused on the ecology and ecosystem dynamics of these animals (Massare *et al.* 1987).

Figure 1. Examples of marine reptile skull and lower jaw. (A) The ichthyosaur Ophtalmosaurus icenicus*, PETMG R58; (B) the pliosaur* Pliosaurus kevani*, DORCM G.13,675; (C) the metriorhynchid* Metriorhynchus superciliosus*, PETMG R10; (D); the plesiosaur* Cryptoclidus eurymerus *PETMG R.283.412. Scale bars equal 10 cm.*

The fossil material of the Middle and Late Jurassic of the UK formations is among the best studied in the world. In particular the Jurassic-aged Oxford Clay Formation (OCF, ~165–163 Ma) and Kimmeridge Clay Formation (KCF, ~157–152 Ma) have been extensively sampled since the 18th century (Andrews 1910; 1913). The revisions of historic material and study of new specimens from these lithostratigraphic units have fuelled a new pulse of research activity in the study of marine reptiles during the past few decades. Consequently, the stunning variety of plesiosaurs, thalattosuchian crocodylomorphs and ichthyosaurs from UK collections is now better known in terms of taxonomy and phylogenetic relationships (McGowan 2003; Young *et al.* 2012; Benson and Druckenmiller 2013).

The OCF and KCF are part of a temporally-stacked succession (~15 Ma) deposited in a single seaway, meaning that the fossil record from these formations reflects the evolution of the same ecosystem. It is well known that the fauna found in the two formations are different in taxonomy and composition, suggesting that a turnover occurred during the intermediate Oxfordian stage. The diversity and abundance of some groups (*e.g.* pliosaurs and teleosaurid thalattosuchians) is thought to decline in the Kimmeridgian, concomitantly with the radiation of others (metriorhynchid thalattosuchians, ichthyosaurs).

Aims

The primary aim of my PhD project is to explain the ecology and evolution of Middle and Late Jurassic marine reptiles using an array of quantitative tests and statistical tools. I plan to use an array of multivariate analyses (Linear Discriminant Analysis, LDA; Geometric Morphometrics, GMM; and Principal Component Analysis, PCA) designed to quantify form and function of marine reptiles' skeletons. Recent studies have used functional and morphological data to assess the evolution and ecology of extant and extinct taxa. These metrics can be ordinated into 'morphospaces' in order to visualize dataset variation, which can be used to explain different trophic specialization and thus sympatric coexistence. Further subdivision of the datasets into time bins will be used to assess the evolution of morphospace occupation through time. Such analyses require direct examination and measures of a plethora of specimens.

The Stan Wood Award funded the travel and accommodation costs of visits to a large number of important museum collections in the UK; the specimens visited form the foundation of my PhD research. Supported by the PalAss small grant, I was able to visit the Hunterian Museum (GLAHM) in Glasgow, Oxford University Museum of Natural History (OUMNH), Bristol Museum & Art Gallery (BRSMG), Dorset County Museum (DORCM) in Dorchester, Peterborough Museum and Art Gallery (PETMG), and the Sedgwick Museum of Earth Sciences (CAMSM) in Cambridge. Multiple visits to two institutions (GLAHM and CAMSM) were necessary due to the inaccessibility of the Natural History Museum, London (NHMUK) collection because of ongoing digitalisation of the same. At each collection I was able to study important specimens, take photographs and make detailed measurements (Figure 2), while also reviewing and updating the taxonomy and stratigraphic record of Middle and Late Jurassic marine reptiles. Further institutions will be visited in the near future.

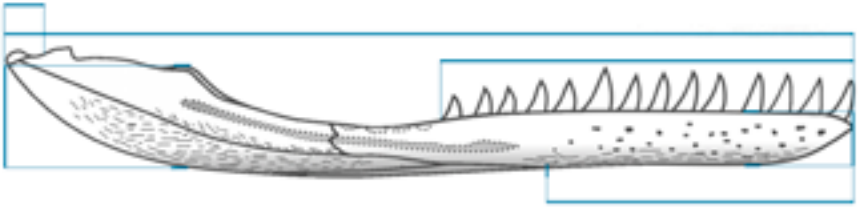

Figure 2. Diagram indicating the measurements taken for the lower jaws. The functional characters adopted in the preliminary analysis derive from combining them (image modified from Foffa and Young 2014).

Preliminary results

During this first phase of the project, over 300 specimens were examined, measured and photographed. For the current version of analyses I isolated the lower jaws of 63 ichthyosaurs, plesiosaurs and metriorhynchid specimens – a subsample of the planned final dataset. The main reason I decided to focus on the lower jaw is that it is the main structure involved in predation and food processing, and so it can be reliably linked to feeding ecology (Kelley and Motani 2015).

PCA of functionally significant characters of the lower jaws of 63 specimens from OCF and KCF has already provided interesting results. In accordance with a qualitative hypothesis, our results show strong partitioning of the morphospace. This suggests that niche partitioning was an important factor facilitating the coexistence of markedly different predators. Other trends can be detected. Intriguingly, but perhaps not surprisingly, ichthyosaur and metriorhynchid morphospace occupation expands across the Oxfordian, likely a consequence of the Late Jurassic diversification of ichthyosaurs and macrophagous metriorhynchids. The importance of size as a partitioning factor is highlighted in the increasing isolation of large-bodied pliosaurs of the KCF, and the constant isolation of plesiosaurs.

Whilst the primary goal of my project is not taxonomy, the extensive museum visits gave me the chance to examine several interesting specimens. The success of my PhD relies on using the most up-to-date and accurate taxonomy and precise stratigraphic record, therefore I worked on two undescribed teleosaurid specimens both hosted in the DORCM (Foffa *et al*. in press). Teleosaurid crocodylomorphs are rare in the British Late Jurassic, so their identification is directly relevant to my PhD as these taxa are previously unknown from the OCF and KCF.

These preliminary findings have so far been presented at two conferences: the Symposium of Vertebrate Palaeontology and Comparative Anatomy (SVPCA – Southampton, September 2015) and at the British Ecological Society Annual Meeting (BES – Edinburgh, December 2015). My participation at SVPCA entailed both a platform presentation and a poster.

Future directions

Preliminary results and analyses will be expanded upon with the acquisition of further data from other museums throughout my PhD. Better time resolution will be achieved by adding a further time bin (Oxfordian) and by further subdividing the current KCF bins. Future analyses will focus on skull, dentition and postcranial elements as well as the lower jaw.

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Sylvester-Bradley Award Report

Controls of $\delta^{18}O$ values in micro-mammal teeth: investigations of a novel palaeoenvironmental proxy

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Introduction

In recent decades, improved understanding and technological advances of stable isotopic data have enabled significant steps towards quantification of absolute past environmental conditions. The oxygen isotope ratio of biomineralized tissue is fundamentally controlled by (i) the isotopic ratio

of oxygen sources (ingested/respired water, food and air), (ii) the temperature of the reaction, and (iii) vital effects (metabolic fractionation) (see Figure 1). Due to thermo-regulation and laboratory study of metabolic processes in certain mammal species, variables (ii) and (iii) above can be controlled for in biogenic apatite, leaving oxygen isotope data to be interpreted in terms of the geochemistry of principal oxygen sources such as drinking water (Longinelli 1984). This enables studies to reconstruct palaeoenvironmental conditions since the oxygen isotopic composition of meteoric water, although seasonally variable, can be a useful indicator of parameters such as mean annual temperature, aridity *etc.*

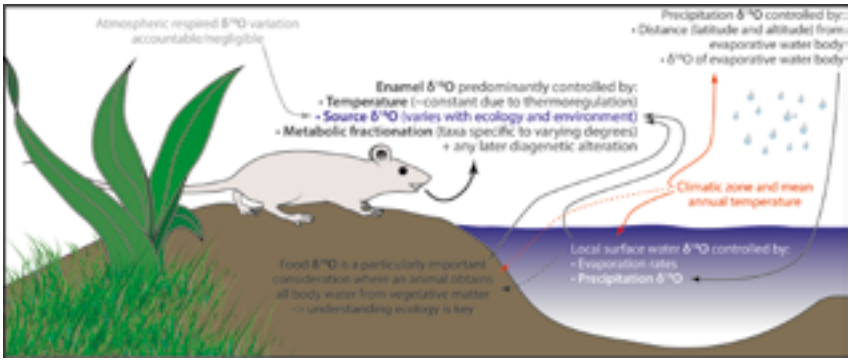

Figure 1. Significant known controls on the $\delta^{18}O$ signature of micro-mammal teeth.

Recent advances in techniques used to analyse bioapatite oxygen isotopes, such as the development of *in situ* laser and ion-probe ablation, and precise chemical purification methods, combined with increased understanding of vertebrate biomineralization, has led to micro-mammal teeth being proposed as an under-exploited source of palaeoenvironmental data for the Cenozoic (Royer *et al.* 2013; Grimes *et al.* 2008; Lindars *et al.* 2001). However, a significant unknown in the analysis of fossilized teeth is the potential for post-mortem modification of the oxygen isotopic signature. Although the phosphate of teeth (in particular enamel) has been proven diagenetically robust and faithful to primary $\delta^{18}O$ signals (Zazzo *et al.* 2004), micro-mammal remains typically accumulate due to predation, and the preserved tissue will have likely undergone at least partial digestion. This raises a potential issue with the use of micro-mammal teeth as oxygen isotope media, as although the physical effects of digestion on mineralized tissues have been investigated (Denys *et al.* 1997; Fernandez-Jalvo and Andrews 1992), the influence of partial digestion on oxygen isotope values in bioapatite has not been considered in previous studies.

The principal objective of this project was to investigate the effect of ingestion and partial digestion on the $\delta^{18}O$ values in teeth of micro-mammals fed to captive predator species held at zoos and wildlife sanctuaries. This study primarily focused on owls, as they often nest in sheltered sites (such as caves) and therefore are one of the most common predators whose waste may contribute to the palaeorecord. Material was also analysed from mammals and reptiles to compare the modification caused by different digestive processes, as owl pellets are regurgitated while reptile and mammal scats pass through the entire digestive tract. This research was a proof-of-concept study that has the potential to determine whether the use of predator-accumulated micro-mammal teeth is feasible as an oxygen isotope medium, and influence whether micro-mammal enamel becomes

a standard source of oxygen isotope data for the Cenozoic. Adoption of micro-mammal teeth as isotopic media would enable enhanced palaeoenvironmental reconstructions (which in turn are useful for the forward modelling of currently stressed ecosystems), due to their abundance in the sedimentary record.

Results and implications

All research was undertaken in accordance with local ethical guidelines and in collaboration with official wildlife sanctuaries and care facilities. All materials were supplied as waste products of the natural operation of these facilities. The oxygen isotopes of enamel and dentine tissue in incisors from laboratory-raised food mice were analysed by secondary ion mass spectrometry (SIMS) and gas isotope mass spectrometry (GIRMS) following ingestion and subsequent excretion/regurgitation and compared against teeth removed from the dead food mice prior to ingestion. Concomitant geochemical changes were investigated via analyses of major and minor element abundances on a laser ablation inductively coupled mass spectrometer (LA-ICPMS). All compositional data were considered in the context of the physical preservation of bioapatite samples, assessed via scanning electron microscopy (SEM) to test correlations between digestion damage and chemical alteration.

Despite substantial natural variation, digestion was implicated as having caused significant changes (>50% modification of values in the control sample) in the abundance and distribution of elements across both enamel and dentine in the teeth analysed. All elements analysed appeared to be affected by digestion, with the exception of Na and Si, with the magnitude of change dependant on the predator species involved. Generally, digestion resulted in the enrichment of B, Mg, Cl, S, Cr, Ni, Zn, Mn and Cu, and the depletion of Ba and Sr (relative to an undigested control), and therefore elements with similar properties are generally affected in the same way.

The $\delta^{18}O$ values analysed by SIMS vary according to tissue type and location along the tooth axis. SIMS analyses showed depletion in $\delta^{18}O$ in the enamel at the base of digested incisors, suggesting that immature enamel is more susceptible to alteration (Figure 2). The incisors of rodents are aradicular hypsodont teeth, which do not form a true root and continue to erupt throughout the animal's lifespan to compensate attrition (Møinichen *et al.* 1996). The rate of incisor growth is species specific; however, teeth are completely renewed in approximately 30–50 days (Royer *et al.* 2013). The biomineralization of enamel in mammalian teeth occurs via amelogenesis, which can be divided into two main phases: matrix production, followed by enamel maturation, where mineralization progressively removes up to ≥97% of the matrix (Hoppe *et al.* 2004). It is reasonable to hypothesize that the basal $\delta^{18}O$ depletion seen in this study is due to a higher susceptibility to isotopic alteration in the less mature enamel, which in life would still have been forming within the jaw. Dentine tissue was also noticeably depleted (a few per mil) relative to enamel in incisors analysed by SIMS, which can be attributed to the histological composition of the different tissue types (see Figure 2). Dentine has an incompletely mineralized structure due to the relatively small crystals with ~30% organic matter, while enamel has relatively large crystals and is significantly more densely crystalline with only ~3% organic matter (Hoppe *et al*. 2004). This supports previous investigations that found a greater preservation of geochemical signals within robust enamel compared to dentine (Fricke and O'Neil 1996; Kohn and Cerling 2002).

Teeth analysed by GIRMS indicate that partial digestion by certain predator species may affect the $\delta^{18}O$ values in phosphate. Although significant variation was observed with overlaps in the data

population, barn owl and perentie digestion resulted in a consistent decrease in $\delta^{18}O$ values relative to undigested controls (Figure 2). This greater modification by barn owls relative to southern boobook owls might be attributable to the gastric environment, as barn owl pellets had significantly less soft tissue and hair in them compared to the southern boobook pellets. The rodent remains in the barn owl pellets had numerous fully articulated skulls, whereas the southern boobook pellets only had broken skulls and jaw fragments. This indicates that the gastric environment of barn owls is less physically destructive and more chemically active compared to southern boobooks. However, the inconsistency of physical and chemical modification and increased physical damage identified in the mammals compared to the owls indicate greater complexity of factors affecting $\delta^{18}O$ values, *e.g.* residence time in the stomach, chemical activity of digestion (enzyme *vs.* acids) *etc*.

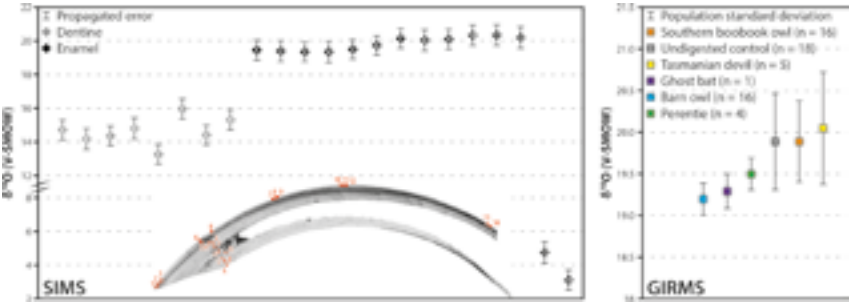

Figure 2. Summary O-isotope data from this study. SIMS data depicts transects from a barn owl-digested incisor.

There were no significant variations observed between the $\delta^{18}O$ values of molars and incisors analysed with GIRMS. This demonstrates that incisors and molars have comparable $\delta^{18}O$ values and therefore can possibly be utilized in subsequent studies on $\delta^{18}O$, which may offer a higher temporal resolution for palaeoenvironmental reconstructions, as it will greatly increase the abundance of biogenic apatite available for analyses. However, molars in mice are brachyodont teeth and therefore erupt once and mineralize early in life (Møinichen *et al.* 1996), and the rodents used in the study were relatively young and were raised in a controlled environment. Therefore, the comparability in $\delta^{18}O$ values between molars and incisors cannot necessarily be extrapolated to an adult rodent in the wild.

Significant natural variation identified in the data (derived from a laboratory-raised population, consumed by animal sanctuary predators on a controlled diet) suggests that heterogeneity of natural populations must be carefully considered in future studies. It is imperative that sample populations are sufficient to establish representative data and, if possible, the nature of the predator resolved. Mature enamel should be targeted, given its greater resistance to chemical modification. Still to be determined in future work:

- the mechanisms by which modification of oxygen isotopic values occur;
- the extent of natural variability in the digestive process (predator health, sex *etc.*);
- reliable screening methods to identify modification of the signal to aid in sample selection for palaeoenvironmental studies.

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Undergraduate Bursary REPORTS

A colourful past – iridescent plumage in modern and fossil birds

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Introduction

Some of the most brilliant colours in the natural word are created by the phenomena of iridescence. Birds frequently use iridescent plumage in signalling, in particular in sexual displays, such as in many birds of paradise. The iridescence is produced by nanostructures in the feather filaments, which consist of layers of pigment-producing organelles (melanosomes) and a protein matrix consisting of keratin. Previous studies have shown that melanosomes can be preserved in fossil feathers (Vinther *et al*. 2008), opening up the intriguing possibility of reconstructing colours of extinct organisms. In particular, black and brown colours as well as iridescent sheen can be distinguished based on distinct melanosome shapes (Li *et al*. 2010). Eumelanin is present in black feathers and has a cylindrical melanosome shape, whereas pheomelanin is typical of reddish brown feathers and forms spherical melanosomes. Eumelanin is also used in the formation of iridescent nanostructures, and Li *et al*. (2012) demonstrated that a high aspect ratio of melanosomes may be a good indicator of iridescence. However, melanosome shape in extant iridescent feathers varies greatly – cylindrical, flat, circular and hollow are all common morphologies (Durrer 1977). The purpose of this study is to document the melanosome shape over a wide range of bird species with iridescent feathers. We sampled over 100 extant species of birds, and quantified melanosome shape using scanning electron microscope (SEM) imaging. We also examined fossil bird specimens including *Scaniacypselus* (stemgroup true swifts) and *Primotrogon* (trogoniform), both of which are from the Eocene Messel Formation. These fossil taxa were analysed and compared to their modern counterparts, which commonly have iridescent plumage.

Preliminary results

Our measurements of melanosome long and short axis were added to an existing database (Li *et al*. 2012) on iridescent, black, grey and brown feathers, more than doubling the number of iridescent samples (n=64). Initial comparison between melanosomes from iridescent and black feathers showed no significant difference in length, aspect ratio or width. However, when hollow melanosomes were excluded, melanosomes from iridescent feathers were shown to have a significantly greater aspect ratio (Z=35.25, p<0.001) and were narrower (Z=30.9, p<0.001), see Figure 1. An exception to this trend is the melanosomes extracted from tree swifts (*Hemiprocne*), which are solid, but with a low aspect ratio (Figure 1). However, these melanosomes are flattened and easy to distinguish. These differences may reflect differences in packing of hollow, flattened and solid melanosomes respectively. We used quadratic discriminant analysis to build a model for

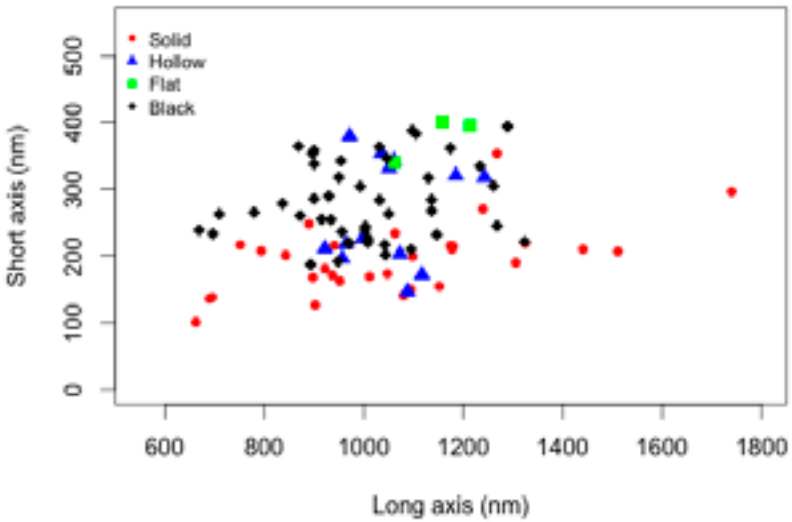

Figure 1. Melanosome length and width for iridescent (solid, hollow, flat) and black feathers. Solid melanosomes from iridescent feathers are significantly narrower than melanosomes from black feathers ($Z= 30.9$, $df = 1$, $p<0.001$), while this is not true for hollow or flat melanosomes from iridescent feathers.

predicting feather colour, and included the variable "solid" to quantify whether a melanosome was hollow or solid. Variables most important for describing colour were aspect ratio, length, "solid" and coefficient of variation for length and width. The model predicted colour with 84% accuracy overall, and could distinguish between black and iridescent in 93% of cases. Our data strengthen support for the model used in Li *et al*. (2012) to predict iridescent plumage in *Microraptor*. Hollow and flattened melanosomes do not necessarily follow the same pattern as solid ones, however since such melanosomes are only found in iridescent feathers, they can be distinguished from these characters alone.

Fossil samples

Scaniacypselus: Melanosomes in *Scaniacypselus* are subspherical, yet larger than an average pheomelanosome (Figures 2 and 3A). Our model is equivocal on this sample, predicting brown or grey colour (p=0.47 and p=0.53 respectively).

Primotrogon: Two distinct melanosome shapes were identified. The narrow type (type 1, Figure 3B) show clear organization, and strong alignment as in modern iridescent feathers. The wider form (type 2, Figure 3C) show no such organisation. These two types closely match melanosome shape of iridescent green feathers and grey down of the extant *Trogon surrucura*, although interestingly, melanosomes are smaller in the extant samples. Melanosomes of the trogoniform genus *Apaloderma* are shorter, however their pattern of organisation is markedly different from that of *T. surrucura* and *Primotrogon* (Figure 3D). Our model predicts type 1 as black (p=0.85) if coded as solid (but not if coded hollow, in which case it, per default, will be classified as iridescent). Type 2 is predicted as grey (p=0.94).

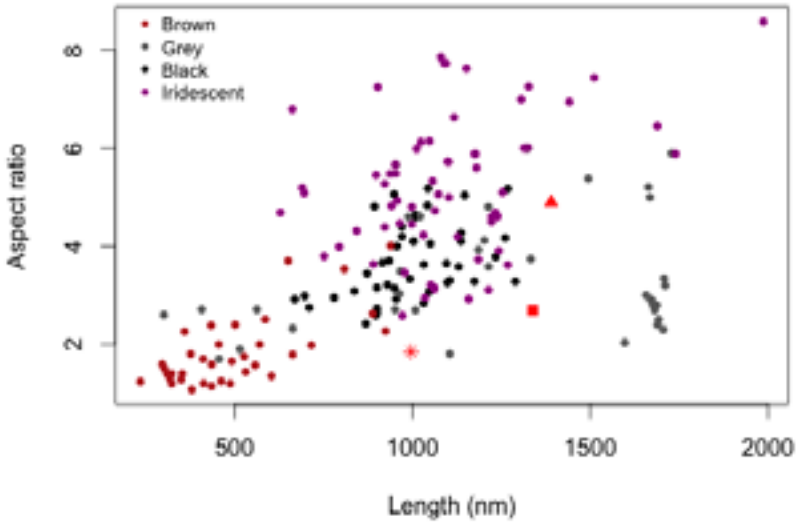

Figure 2. Length:width ratio against length for melanosomes in brown, grey, black, iridescent and fossil samples (red symbols). Red star, Scaniacypselus*; red triangle,* Primotrogon *type 1; red square,* Primotrogon *type 2.*

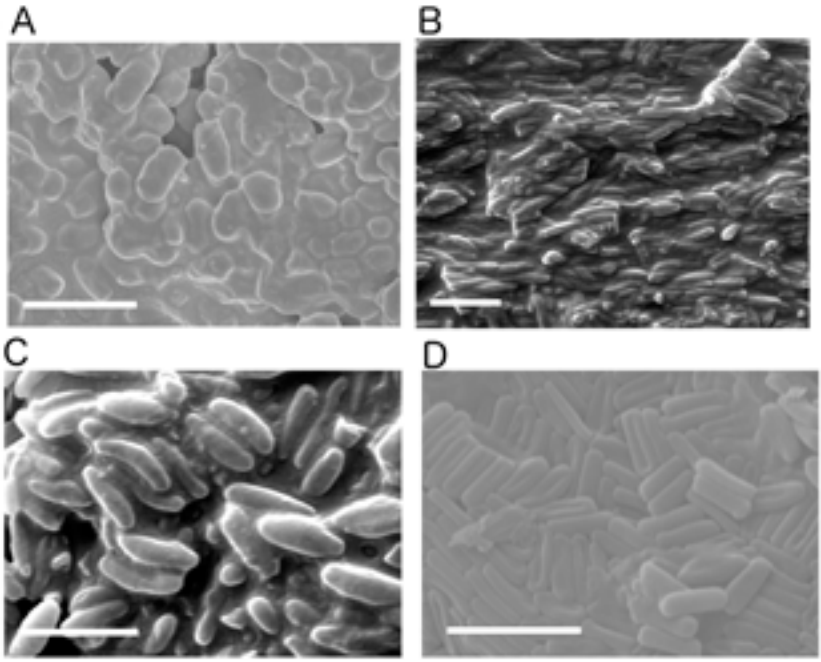

Figure 3. Scanning electron microscope images of fossil and extant bird feathers. A) Scaniacypselus*, B)* Primotrogon *type 1, C)* Primotrogon *type 2, D)* Apaloderma *green iridescent feather. All scale bars 2µm.*

Further work

At the time of writing, only a subsample of all modern bird samples have been analysed with the SEM and work is in progress to extend our data on melanosome shape in iridescent feathers. More samples of *Scaniacypselus* will be studied in detail. Furthermore, this analysis is planned to cross-section the *Primotrogon* samples, to reveal whether this fossil taxon had hollow melanosomes.

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Brachiopod shell thickness around the Ordovician–Silurian Boundary

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Introduction

The Great Ordovician Biodiversification Event (GOBE) reflects the most significant increase in Phanerozoic marine biodiversity, with diversity trends continuing into the Silurian and Devonian despite the prominent impact of the end-Ordovician mass extinction (Harper *et al*. 2015). Brachiopods are among the most prominent groups that flourished during this time and saw a shift in the importance of different higher-level groups, particularly after the end-Ordovician mass extinction (Curry 2007). This shift is exemplified by orthids, which dominated much of the Ordovician but never fully recovered their earlier diversity after the mass extinction, and rhynchonellids which suffered no lasting effects. One aspect of brachiopod palaeobiology that could possibly affect the ecological and evolutionary success across the glaciation-driven end-Ordovician mass extinction is the amount of effort organisms invest in shell secretion. This study aims to quantify brachiopod shell thickness of orthid and rhynchonellid brachiopods during the Ordovician–Silurian in the context of the end-Ordovician mass extinction.

Methodology

Studied specimens come from a variety of locations including Baltica, Russia, Canada and the USA. While below we focus on orthids and rhynchonellids, the full dataset includes a total of 143 valves from 10 orders. After initial impregnation, each specimen was cut in half along the midline, polished, and photographed under a light-microscope. Using Corel Photopaint, the original

photograph was converted into a black and white outline of the shell, then the area and inner length of the anterior half of the shell measured in ImageJ (Figure 1A). The average shell thickness was calculated by dividing the area of the anterior half of the shell by the inner length. In order to obtain a measure more independent of shell length, inner length and shell thickness were treated as the adjacent and opposite sides of a rectangular triangle, and the anterior angle was calculated (Figure 1B). The resulting angle of all 143 valves was plotted against inner length and a regression trendline was calculated from the maxima of 3 mm size bins (Figure 1B). As the range of anterior angles decreases with increasing inner length (Figure 1B), it is necessary to normalize them with respect to inner length. This was done by expressing the anterior angles as the percentage of the modelled maximum anterior angle for a given inner length. For orthids (9 genera, 40 valves, 11 localities) and rhynchonellids (9 genera, 40 valves, 11 localities), this percentage of the maximum angle was plotted against the stratigraphic distribution of specimens (based on the stratigraphic range of the rock formation they were found in, see Figure 2).

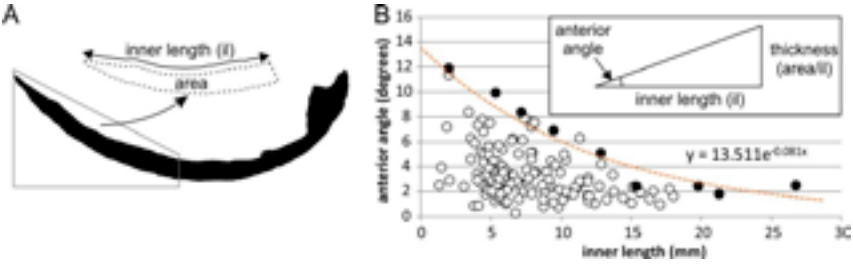

Figure 1. A. Cross section of a ventral valve of Dinorthis *as an example of the measurements taken to estimate shell thickness. B. Inner length versus anterior angle of 143 measured valves from 52 genera. Filled circles represent the maxima of 3 mm size bins which were used to estimate the upper limit (dashed orange line). Inset with triangle highlights the relationship between inner length, area and anterior angle.*

Discussion

Figure 1B shows a clear correlation between the relative thicknesses of shells (plotted as anterior angle) and their inner length. This shows a well-defined constraint on maximum shell thickness with length, which probably reflects a balance between the energy spent on shell secretion and the need for protection from predation and physical environment. Unexpectedly, the two prominent orders Rhynchonellida and Orthida exhibit opposite trends in shell thickness through the studied interval (Figure 2).

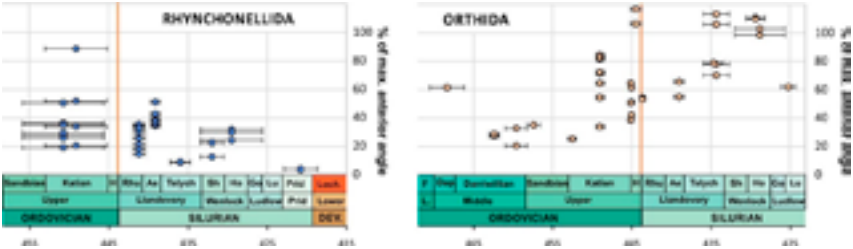

Figure 2. Average anterior angle through time for Rhynchonellida and Orthida. Error bars represent the possible range of occurrence of the measured specimen.

While the data suggest a trend of gradual increase in relative shell thickness for orthids, rhynchonellids appear to gradually decrease their relative shell thickness. The observed trends for both orders extend over 30 Myr, and while they might be punctuated by the end-Ordovician mass extinction, this does not appear to have a lasting effect on relative shell thickness. As the data were not sorted by depositional environment (due to insufficient information) it is currently too early to generalize these results. However, our preliminary data indicate that long-term trends in shell thickness might correlate with order-level evolutionary success in brachiopods.

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Development of a method for determining maximum food particle size in archaeocyathans, and application to Siberian archaeocyathan assemblages

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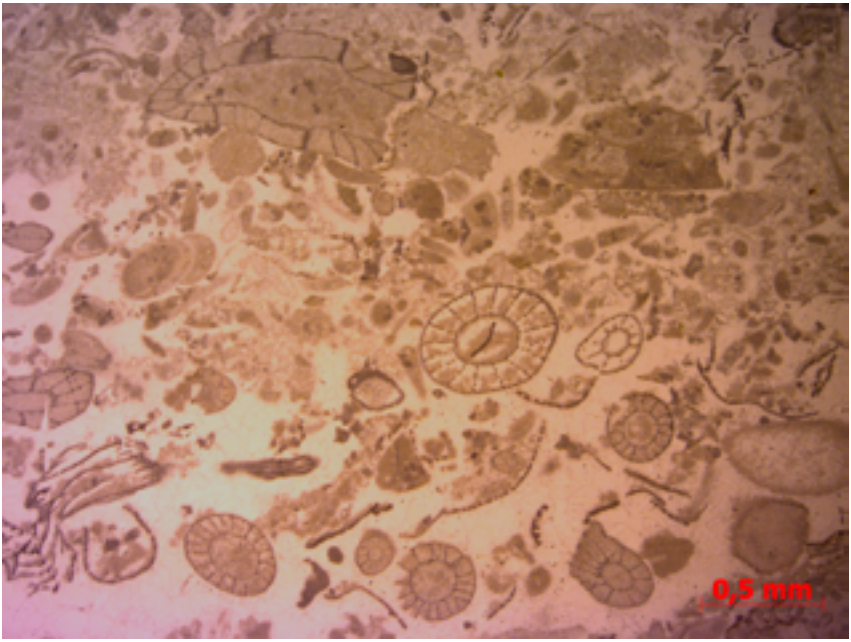
Introduction

The study examined the feeding ecology of the fossil remains of different Siberian archaeocyathan assemblages. The Archaeocyatha are widely recognized as an extinct class of Porifera, or sponges (Debrenne and Vacelet 1984), although their taxonomic affinity was disputed until the 1990s (Rowland 2001). The acceptance of Archaeocyatha into this phylum, as well as studies on their functional morphology, mean that the group are interpreted to have been filter feeders (Debrenne *et al*. 2012). The Archaeocyatha are of great interest as they are one of the first well-preserved animal groups to appear in the fossil record and are the first known metazoans to form reef-like bioconstructions in association with calcimicrobes (Rowland and Gangloff 1988). They therefore play a pivotal role in early Cambrian ecology. However, little is known about their feeding ecology. It is assumed that bacterioplankton formed an important part of their diet as they do for extant sponges (Kruse *et al*. 1995; Debrenne and Zhuravlev 1997), but there is little consideration of the limits on larger types of plankton that could have been fed upon. This study aimed to investigate the feeding ecology of archaeocyathans in greater detail than has been done previously and was facilitated by the development of a new method.

Methods

This study used measurements of the outer wall pores as a proxy for the maximum size of plankton that could enter the archaeocyathan and so put an upper bound on the size of plankton that could have been phagocytosed by internal feeding cells. Archaeocyathan outer wall pore sizes, as well as septal and inner wall pores, have previously been measured, often as part of species descriptions or for taxonomic indicators (Kruse and Moreno-Eiris 2014; Skorlotova 2013; Kruse 1978; and others). In this study the existing techniques had to be modified so that the diameter measured in any one specimen was the one that most restricted the size of plankton that could pass through the pore. This included measuring the gap left between the pore and bracts if they were present, as well as measuring the openings in microporous sheaths and tumuli. The method was also designed so that reliable measurements could be taken from only one thin section per specimen. In this study only Siberian Archaeocyathans from Aldan, Byd'Yangaya, Churan, Oy-Muran, Titirikteekh and Zhurinskiy Mys' were examined. However the approach should be widely applicable.



A photomicrograph of a thin section of material collected from Churan showing an archaeocyathan death assemblage.

Findings

Even considering the fact that the distances measured may have been slightly restricted by living matter, most of the archaeocyathan pores measured were well over 20µm in diameter, indicating that the whole size range of nanoplankton, as well as a proportion of microplankton (sizes as defined by Ōmori and Ikeda 1984), could enter the intervallum of the archaeocyathans measured. Using the restrictive pore size data to make predictions of what nanoplankton and microplankton were being fed on by the archaeocyathans measured is complicated by the fact that the planktonic

assemblages extant before the Great Ordovician Biodiversification are believed to have been quite different to present day assemblages and very little is known about them (Servais *et al*. 2010). One group of plankton present in the Cambrian are the acritarchs, a polyphyletic group defined to include any organic-walled microfossil of uncertain taxonomic affiliation (Evitt 1963). Acritarchs generally have a scale of tens to hundreds of micrometres (Butterfield 1997) and members of the group are regularly interpreted as phytoplankton (see Nowak *et al*. 2015), so they could potentially have made up part of the diet of archaeocyathans.

The data were used to make comparisons of the distribution of pore sizes between different Siberian assemblages. The results suggest that some of these archaeocyathan assemblages had significantly different pore-size distributions to other assemblages. The results showed that there was significant variation in the distribution of pore sizes between localities. All of the restrictive pore sizes were within the microplankton range. The significantly different archaeocyathan assemblages would have differed in the upper size of microplankton that could have been extracted from the water column. For example, the specimens from Aldan and Byd'Yangaya have a greater proportion of small restrictive pore sizes than the other localities so, generally, the archaeocyathans measured from these localities would have had a lower limit on the size of plankton they could extract and would only have been able to take up a smaller range of acritarch plankton. The study successfully piloted a new approach to learn more about archaeocyathan feeding ecology.

Acknowledgements

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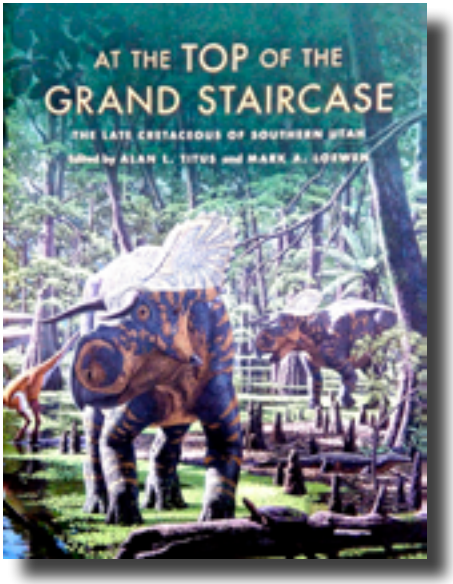
Book Reviews

At the Top of the Grand Staircase: the Late Cretaceous of Southern Utah

Alan L. Titus and Mark A. Loewen (eds). 2013. Indiana University Press. 634 pp. £57 (hardcover). ISBN: 978-0-253000883-1



It's not often (or ever) that a book on fossils is dedicated to Bill Clinton. But if Bubba by chance picks up a copy of *At the Top of the Grand Staircase* at his local bookstore, the opening dedication may be the least of his surprises. In 1996 Clinton designated nearly two million acres of inhospitable badlands in southern Utah as Grand Staircase-Escalante National Monument. At that time it was one of the least explored parts of the continental US, an area so rugged that the only reasonable way in was via helicopter. Today, less than two decades later, it is now one of the premier fossil sites in western North America.

The numbers are almost too good to be true. About 15 years of fieldwork, much of it led by the University of Utah and Utah Geological Survey, with hundreds of scientists involved. Some 2,000 new vertebrate sites discovered, all within the very latest Cretaceous, one of the most fascinating times in Earth history. Around a dozen new species of dinosaurs and counting, not to mention a wealth of new fishes, frogs, salamanders, lizards, snakes, turtles, crocodylomorphs and mammals. And plants, and invertebrates. Entire ecosystems, which we had no idea existed when I started studying dinosaurs, which wasn't that long ago.

The Grand Staircase faunas are now among the best sampled and best understood terrestrial assemblages during the final *ca*. 20 million years of the Age of Dinosaurs, from anywhere in the world. They are also among the most exciting. Odds are, if you hear about a new dinosaur or Mesozoic mammal fossil from the western US, it will come from the Wahweap or Kaiparowits Formations of the Grand Staircase area. This rush shows no signs of slowing down. There is still a lot of ground to cover, so the prospects for new discoveries over the next few decades are among the surest bets in all of contemporary vertebrate palaeontology.

Although work is still ongoing in the area, a few years back some of the scientists leading the fieldwork decided to get together for a small conference to celebrate their discoveries. That conference blossomed into *At the Top of the Grand Staircase*, an edited volume of papers by most of the experts who have been finding and studying fossils from the National Monument. Unlike some

edited volumes, this one does not lack style or focus. The papers are mostly reviews of the age and geological setting of the units in Grand Staircase and the major fossil groups found there, ensuring that this book is an authoritative, go-to source for anyone looking for information on this important area and its faunas. As usual, dinosaurs dominate the proceedings: there are individual chapters on ankylosaurs, ornithopods, pachycephalosaurs, ceratopsids and theropods. There are also a few chapters on new discoveries or descriptions of particularly important field localities. The chapters are well-presented: each one looks like a journal article and the figures are of large size and high quality. Criticisms about page layout and figures have been levied at some Indiana University Press books before, but clearly the publisher has upped its game.

This is a book that I am happy to have on my shelf. It is always my first source of reference for any fossils from the Grand Staircase area, a great gateway into the literature, a useful summary of how everything fits together to give us a glimpse of an ancient fauna. But most importantly, it is a celebration of one of the most remarkable achievements in recent vertebrate palaeontology: how a desolate patch of land in the middle of the world's most developed country was protected by Presidential decree, opened up to exploration, and became a globally important fossil site.

Steve Brusatte
University of Edinburgh

Solving the Mystery of the first animals on land

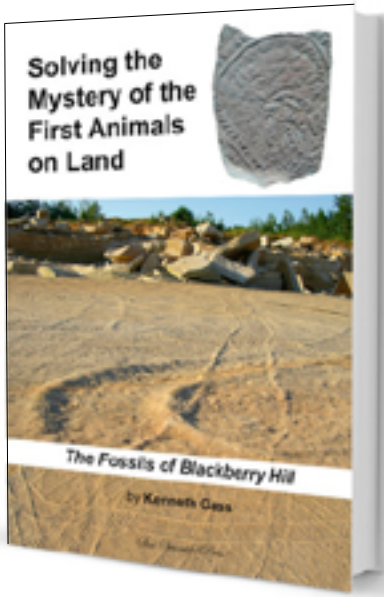
Kenneth Gass. 2015. Siri Scientific Press. 96 pp. £17.50 (soft cover).
ISBN: 978-0-9929979-5-3

My first encounter with the fantastic Cambrian trace fossils from Blackberry Hill, Wisconsin, USA was at Dolph Seilacher's *Fossil Art* exhibition. Among the many excellent casts of trace fossils from all over the world there were several large slabs, and I remember that I was surprised by such large and well-preserved trace fossils from the Middle Cambrian. My mind was put to work, attempting to imagine what kind of animal had made impressions of up to 10 cm wide, resembling motorcycle tyre-tracks on the Middle Cambrian tidal flats.

When reading this book it is easy to see why the fossils were featured in the *Fossil Art* exhibition: they are simply fantastically beautiful. The Blackberry Hills fossils are found in several outcrops and quarries in central Wisconsin, in sandy tidal flat deposits dating back to the Middle Cambrian. What is really astonishing about the outcrops is the preservation of numerous different types of trace fossils and long trackways from animals who were apparently able to move around on the subaerially exposed surfaces, providing the earliest evidence of animals able to walk on land.

Among the traces are excellently-preserved arthropod trackways, and in some cases there are even body imprints of the trace-maker enabling an exact identification, something that is very rare in ichnology. The 'motorcycle tyre-tracks' have been interpreted as being left by large slug-like creatures. Blackberry Hills is also the famous locality of a mass stranding of jellyfish, a group of animals with very little preservation potential, but here their imprints can be found lying close together across large exposed surfaces. Many of the exposed surfaces are so well-preserved that at first glance the traces could have been made yesterday and not 500 million years ago. To cite the author from his first line of the preface to the book: "A picture book on Blackberry Hills was

inevitable. The place is simply too intriguing to remain buried in scientific journals…" I couldn't agree more.



But let's get on to the book itself. It is A5 in size and contains 96 pages, and most are full-sized colour photographs of trace fossils. The text is restricted to one or two pages in between each section of photographs which are divided into different themes, and the text then serves to link the different sections of the book together. In this way it tells the story of the discovery of the site and the palaeontological detective work required to interpret the many tracks and traces from the area. The text itself is written in a fairly clear way, avoiding too much technical jargon to ease the readability for the layman, so it is not a textbook or scientific book in that sense and should not be judged against such books. However, each short chapter contains the bibliographical references to all of the important scientific works on the topic and, as such, this book serves as an excellent introduction for readers who want to dig deeper into the topic and the technical literature. Based on this I would recommend this book to all with an interest in natural history, scholars as well as amateurs.

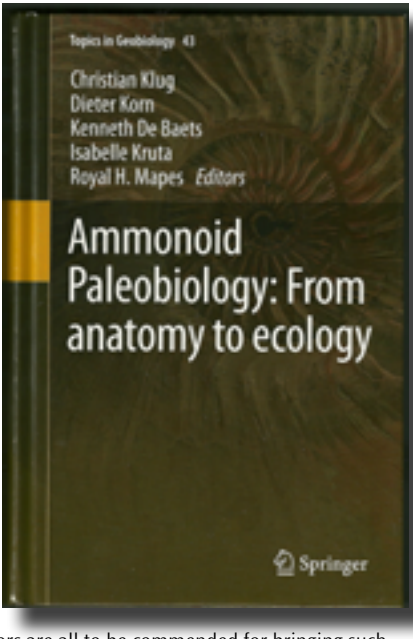
Jesper Milàn
Geomuseum Faxe

Topics in Geobiology 43. Ammonoid Paleobiology: from anatomy to ecology

Christian Klug, Dieter Korn, Kenneth De Baets, Isabella Kruta and Royal H. Mapes (eds). 2015. Springer. 934 pp. ePub £122 / hardcover £153. ISBN 978-94-017-9630-9

During my PhD I relied upon about half-a-dozen key reference books. One of these was *Ammonoid Palaeobiology* published in 1996 and known to ammonoid researchers as the 'Red Book'. The Red Book is a compendium of detailed, authoritative review papers on a host of topics that provide a route into the primary literature, that now sits with battered spine on the 'ready rack' of books beside my writing desk in the home office. The 'Brown Books' (there are two volumes) are an update to the Red Book two decades on from an expanded editorial team with a broad range of experience and interests. I will review the two volumes separately. Volume 43 has a narrower focus on ammonoids, while 44 is, in my opinion, of wider interest to the palaeobiological and geological community.

Volume 43 loosely follows the chapters and organization of the Red Book, although some entirely new chapters are included. Like its predecessor, all of the chapters are densely and thoroughly referenced, providing a clear route into the early literature on various topics from the 19th century. However, the editors and authors have emphasized papers from the last 20 years to highlight



changes in the 'state-of-the-art' since 1996. One of the most notable changes is the sheer number of colour figures and plates in the volume, which are used to great effect in a number of chapters, especially those dealing with non-destructive anatomical imaging. Considerable effort has gone into compiling tables that convey key evidence, with references, about different aspects of ammonoid anatomy. I can vouch for the exhaustive scope of these tables, their accuracy and currency of the literature cited.

In spite of the many advances in imaging, new fossil material and a stronger emphasis on comparative anatomical and extant phylogenetic bracket (EPB) thinking, the papers in the volume show less certainty about the interpretations than was often the case in the Red Book. A sense that the findings remain provisional and that the reader should be opening some museum drawers and reappraising specimens in light of new techniques and ideas pervades the book. The editors and authors are all to be commended for bringing such dynamism to all sections of the volume.

I think it is fair to say that most of the chapters, with the exception of *Theoretical Morphology of the Molluscan Shell* and *Describing the Ammonoid Conch*, will mostly be of interest to researchers in ammonoid and cephalopod palaeobiology. The ability to download individual chapters of the book from the publishers' website does offer a flexibility to those unable to afford the significant outlay. However, it is definitely a volume one would expect to find in institutional libraries. My copy is to hand on the 'ready rack' beside the Red Book and is already well-thumbed.

Al McGowan
GeoBioD

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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.

- *The White River Badlands: geology and paleontology*, by R. C. Benton, D. O. Terry Jr., E. Evanoff and H. G. McDonald.
- *British Polacanthid Dinosaurs*, by William T. Blows.w
- *The Abyss of Time: a study in geological time and Earth history*, by P. Lyle.
- *So You Want to be a Palaeontologist?* by D. Penney.
- *British Jurassic Regular Echinoids, Part 1. Introduction, Cidaroidea, Echinothurioidea, Aspidodiadematoidea and Pedinoidea*, by A. B. Smith.
- *Mammoths and the Environment*, by V. V. Ukraintseva.
- *The Worst of Times*, by P. B. Wignall.
- *The Ammonoidea of the Lower Cretaceous Chalk. Part 6*, by C. W. Wright and W. J. Kennedy.

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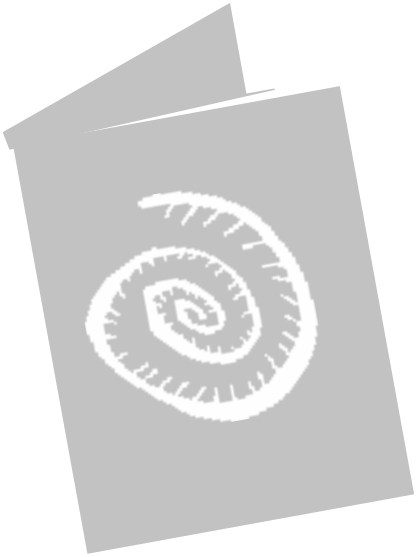

Careering off course!

Inspirational palaeontologists

Mike Simms is Curator of Palaeontology at the Ulster Museum, part of National Museums Northern Ireland. He was responsible for the geological content of most of the natural science galleries in the Ulster Museum at its reopening in 2009. He also curated *Elements: From Actinium to Zirconium*, which opened in 2014 and offers a uniquely interdisciplinary interpretation of the subject. A schoolboy interest in Lower Jurassic echinoderms formed the foundations for a PhD jointly with the University of Birmingham (Tony Hallam) and the NHM, London (Andrew Smith) and subsequent research on the phylogeny of post-Palaeozoic crinoids. Almost fifty years after finding his first fossil he maintains a broad interest in palaeontology and stratigraphy, but serendipitous discoveries have periodically redirected his research interests into Triassic palaeoclimate, karst geomorphology, landscape evolution, lichenology, meteorites and impact structures.

Describe yourself in three words.

Enthusiastic, curious, polymath.

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

In September 1969, when I was almost 9, my teacher asked everyone in the class to write about themselves. I still have that schoolwork. After a long list of 'interests' I boldly state that "when I grow up I want to be a geologist".

How did you first get interested in palaeontology?

When I was 6 I found some 'patterny stones' in the garden, just outside Cheltenham. My dad told me that they were fossils (I still have them; they are Aalenian rhynchonellids) and from that moment I was hooked. By my early teens I was focused (obsessively) on the Lower Jurassic, which is where my main palaeontological and stratigraphical interests still lie.

What is your favourite locality?

Garden Cliff, Westbury-on-Severn. A palaeontologically and sedimentologically fascinating transition from terrestrial to marine Triassic, exposed in an aesthetically beautiful cliff on a bend of the River Severn. I used to go there regularly as a teenager, and an added bonus was seeing the Severn Bore roll by if I picked the right day.

When did you decide to follow the career path you are on now?

This was more by accident than design. As redundancy loomed over my lectureship post at Cheltenham (now University of Gloucestershire) in 1996, a temporary palaeontology curator post came up at the Ulster Museum. Twenty years later I am still here.

What are the main responsibilities of your job?

The main responsibilities are the documentation and interpretation of the geological collections, and public outreach regarding geology and the Museum. I also plan and implement exhibitions and events pertaining to various aspects of science.

What are you most proud of in your career to date?
Among my publications it is the *British Lower Jurassic Stratigraphy* volume of the Geological Conservation Review (GCR). I grew up on the Lias (the family home was located on the Jamesoni Zone, basal Taylori Subzone) and I still have a great fondness for all things Liassic. The Lias GCR volume was an opportunity to indulge that passion and produce as comprehensive an account of the British Lias as I could. If something like it had appeared when I was a teenager it would have been top of my Christmas list! In terms of exhibitions it has to be *Elements*. Inspired by the chance discovery of Theodore Gray's amazing book *The Elements*, it has proven to be very popular with schools, colleges and the general public.

What are your future ambitions?
I have no major career ambitions, other than to avoid being sucked into management. My main wish is to continue to find interesting projects to work on, and to have the time and resources to complete them.

What is your favourite fossil and why?
The early Jurassic crinoid *Pentacrinites fossilis*. They can be exquisitely beautiful (look on p.172 of the DK handbook *Fossils* for one specimen that I found in 1982) but they also had a remarkable lifestyle attached to floating driftwood. This was a topic I investigated during the course of my PhD and the subject of my first published paper (in *Palaeontology*, of course!).

In an average week, how many hours do you work?
The statutory is 37 hours per week, but I often work on geological projects and writing articles on other subjects in my spare time. Geology is as much my hobby as my job; as I often tell people, a true geologist is never off duty.

How many people do you work with on a daily basis?
For exhibitions and events I work with various people in other departments (education, design, interpretation, conservation) but some days I work entirely on my own. This is particularly true of the research aspects.

What's the best thing about your job?
Making geology, and science in general, accessible and relevant to the public through exhibitions, talks and articles. And I can research what interests me and publish wherever I like without worrying about the impact factor, unlike many academics.

What gives you the most satisfaction in your job?
Hearing visitor comments along the lines of "I never realized that geology/chemistry/meteorites/*etc.* could be so interesting".

What are the worst things about your job?
Here, the isolation is the worst thing. In 2007 the Ulster Museum curators were relocated to the Folk Museum miles away, and remote too from the collections that are now housed at another site. This greatly limits everyday interaction with other scientists at the University and Geological Survey, and with visitors to the Ulster Museum.

Do you get to do much overseas travel for work and do you do much fieldwork?
With the financial cutbacks there is now very little money available for travel, conferences or even local fieldwork. If I really want to go somewhere I might have to dip into my own pocket, although, since geology is my hobby, I don't really mind. I'm not really a globetrotter. There is more than enough interesting geology to be investigated in Britain and Ireland - although I am involved in a very interesting archaeological and palaeoenvironmental project in Zambia (fieldwork in 1999 and 2012).

Has there been a paper or book that has influenced your career?
Mike Howarth's 1958 Pal Soc monograph on amaltheid ammonites (my favourites), which took a simple but effective approach to identification. It inspired me to monograph the British Jurassic crinoids as part of my PhD

research (alas I only managed the Lower Jurassic ones) and to keep fossil identification simple.

Who have been the most important mentors in your career so far?
Dick Jefferies, who nurtured my early interest in echinoderms when I visited the Natural History Museum as a teenager. Bob Savage, who gave me another chance to get onto his Geol/Zoo course at Bristol after I failed my A-levels, and who helped me to appreciate that there is plenty of interesting geology outside of the realms of the Lias.

What skills does it take to be successful in your job?
Visitors to the Museum seldom want to know about the minutiae of crinoid systematics or Jurassic stratigraphy, so it is important to have a broad knowledge of many aspects of geology, of science in general, and an ability to communicate this to non-scientists at all levels.

Are there any major obstacles to being successful in a career like yours?
Currently the greatest obstacle is the lack of opportunities at the outset. Permanent curatorial posts in almost any discipline are quite scarce these days and all too often the criteria for selection appear to be based on generalities rather than on any subject expertise the candidate might possess. Museums are going through a particularly bad patch at the moment but hopefully things will improve in the next few years.

Do you have any tips for students who would like to take a similar career path?
Don't plan ahead too much as things never work out the way you expect. Follow your passions and take opportunities when they arise. I would never have worked on such a diverse range of projects if I had been here all of my working life.

If you could have dinner with a famous palaeontologist (living or dead), who would you choose?
William Buckland. He was active in the very early days of the science of geology and his research, on topics as diverse as bone caves and early Jurassic palaeobiology (he was the first to suggest *Pentacrinites* was pseudoplanktic), encompasses some of my own interests. Furthermore, despite being a theologian by training, it is clear that his mind was more open to scientific ideas than many of his contemporaries. I'm sure the dinner menu would be interesting too!

For curatorial jobs the following website may be useful:

<**http://www2.le.ac.uk/departments/museumstudies/JobsDesk**>

Jobs are also shared on the NatSCA and GCG sites and mailing lists:

<**http://www.natsca.org/jobs**>

<**http://www.geocurator.org/news/jobs.htm**>

Palaeontology

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