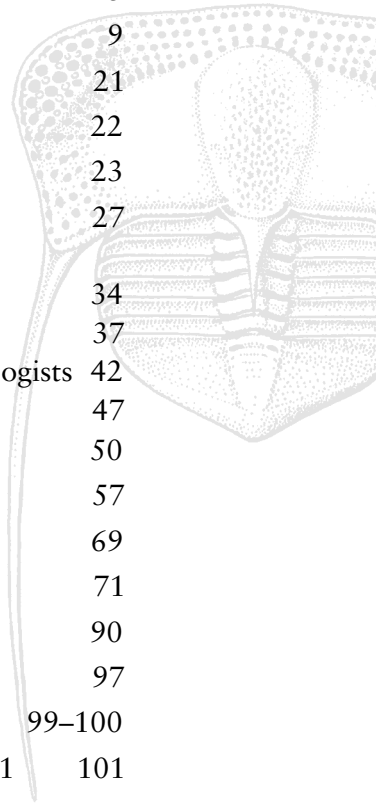


## The Palaeontology Newsletter

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Reminder: The deadline for copy for Issue no. 98 is 4th June 2018.

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

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## Editorial

Many are touting 2018 as the year of women, in recognition of the global #MeToo and 'Times Up' movements, and in the UK it marks a major centenary in the suffragette movement. Awesome women are certainly on show in this issue. **Lene Delsett's** *Legends of Rock* piece documents the life and career of her academic grandmother, Zofia Kielan-Jaworowska. Read **Rachel Warnock's** GSA meeting write-up to find out if she was successful in her quest for a Mary Anning "button".

**Emma Dunne** and **Roxanne Armfield** report on the Early Tetrapod World meeting that honoured the outstanding career of Lapworth Medal-winner Jenny Clack. **Simon Wills** conducted this issue's Careers Q and A with Cathy Whitlock, which concludes with some sage advice for all of us: "[y]ou have to get out there – give talks, introduce yourself to colleagues, and participate in scientific organizations like the Palaeontological Association". However, as **Richard Butler** and **Susie Maidment** show in their piece on palaeontological careers, there is still a clear gender bias in our field, although overall they show career prospects for palaeontology PhD students are much better than a recent Royal Society study might suggest. Of course, diversity is about more than just gender, and **Fiona Gill** gives an update on the Association's study.

Finally, I would like to personally acknowledge **Jo Hellawell** and **Maria McNamara** who have both successfully helmed this *Newsletter*, contributed massively to this issue, and generally been extremely helpful as I learn the ropes.

**Graeme Lloyd**

*Newsletter Editor*

<[newsletter@palass.org](mailto:newsletter@palass.org)>

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## Association Business

### Annual Meeting 2018

#### Notification of the 2018 Annual Meeting, AGM and Annual Address

The 2018 Annual Meeting of the Palaeontological Association will be held at the University of Bristol, UK, on 14th to 17th December 2018, organized by Dr Jakob Vinther and colleagues.

### Nominations For Council

#### AGM 2018

At the AGM in December 2018, the following vacancies will occur on Council:

- Vice President
- Editor-in-Chief
- Editor Trustee
- Publicity Officer

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](mailto:secretary@palass.org)>.

The closing date for nominations is 4th October 2018. They should be sent to the Secretary: Dr Crispin Little, School of Earth and Environment, University of Leeds, Woodhouse Lane, Leeds LS2 9JT; e-mail: <[secretary@palass.org](mailto: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.



## **Editor-in-Chief (five-year term)**

### **Primary roles**

- Oversee the production of the Association's publications and provide vision and leadership for their future development; act as line manager for the Publications Officer and set priorities and goals for the journals.
- Select and invite members onto the Editorial Board to ensure gender balance, geographical coverage and disciplinary representation is achieved.
- Vet the quality of papers being accepted for publication in *Palaeontology* and *Papers in Palaeontology*; act as a member of the Editorial Board in the preliminary sift of all papers submitted. Assign papers of suitable quality to a science editor and write rejection letters to the rest.
- Vet the recommendations made by the Editorial Board with respect to whether papers are fit and ready for publication in light of referees' reports received. Make final decision.
- Fire-fight any issues arising from the publication process (e.g. disgruntled authors, referees or readers).

### **Secondary roles**

- Carry out a final check of all papers accepted to catch grammatical errors prior to typesetting.
- Have oversight of the *Field Guides to Fossils* series (each has its own editors to steer through to production, so input required is minimal).
- Identify key topics and seek submission of high-quality review papers from potential authors.
- Chair and organize the selection of Best Paper Awards for each journal.

## **Editor Trustee (three-year term)**

The Editor Trustees are on the Editorial Board of *Palaeontology* but also serve on the PalAss Council. Their role is: to advise the Editor-in-Chief about policy issues that might arise in the running of the journal; to attend the annual review meeting with the publisher, Wiley; to advise the Editor-in-Chief about the suitability for peer-review of articles submitted to *Palaeontology* and *Papers in Palaeontology*; to select the article to be awarded Best Paper in each journal annually; and to hold a watching brief with respect to the management and well-being of the journals and inform Council of issues arising.

## **Publicity Officer (three-year term)**

Together the Publicity Officer, Outreach Officer and Education Officer comprise the Public Engagement Group (PEG). These posts have responsibility for all 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 inquiries, and initiating other activities that promote and develop palaeontological outreach and education for the Association. The members of PEG work closely together and their roles often overlap; responsibilities particularly associated with the Publicity Officer post include leading the Association's publicity and promotion via social media and other outlets.



## 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, and 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 year.

The career summary, statements of support and publication list should be submitted in MS Word or PDF format, ideally as a single document if possible. Nominations should be sent to <[secretary@palass.org](mailto: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, and further supported by a brief statement from the two nominators. A list of ten principal publications should accompany the nomination. Letters of support by others may also be submitted. Council will reserve the right not to make an award in any one year. If a candidate has taken time out from their professional career for family and other purposes, this should be highlighted.



The career summary, statements of support and publication lists should be attached in MS Word or PDF format, ideally as a single document if possible. Nominations should be sent to <secretary@palass.org> by **31st March**.

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

## ***Hodson Award***

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

The candidate must be nominated by at least two members of the Association and the application must be supported by an appropriate academic case, namely a single page of details on the candidate's career, and a brief statement from each of the two nominators. A list of principal publications should accompany the nomination. Letters of support by others may also be submitted. If a candidate has taken time out from their professional career for family and other 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 to <secretary@palass.org> by **31st March**.

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

## ***Mary Anning Award***

The Mary Anning Award is open to all those who are not professionally employed within 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 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***

The scope of the Golden Trilobite Award is being reviewed by Council. This will shortly be publicized on the website. Nominations should be sent to <[secretary@palass.org](mailto:secretary@palass.org)> by **31st March**.

The Award comprises a 'Golden Trilobite banner' and links to the Association's own website. Awards will be announced in the *Newsletter* and on the Association website.

## ***Honorary Life Membership***

To be awarded to individuals whom Council deem to have been significant benefactors and/or supporters of the Association. Recipients will receive free membership. Nominations should be sent to <[secretary@palass.org](mailto:secretary@palass.org)> by **31st March**.

Honorary Life Memberships are announced at the Annual Meeting.

## ***Annual Meeting President's Prize***

This is 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***

This is 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](http://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 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 using the online application form. Such requests will be considered by Council at the March and the October Council 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 (e-mail <[secretary@palass.org](mailto: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
- 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.





## 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](http://www.palass.org)>.

For more information please contact the Association's Outreach Officer, Dr Lucy McCobb, The Department of Geology, National Museum Cardiff, Cathays Park, Cardiff CF10 3NP, Wales; e-mail: <[outreach@palass.org](mailto: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 2017

### *Lapworth Medal: Prof. Stefan Bengtson*

*Philip Donoghue and Bruce Runnegar write:* Stefan Bengtson is Emeritus Professor and former Head of the Department of Palaeozoology (now Palaeobiology) at the Swedish Museum of Natural History, Stockholm, where he has been for much of his career. Previously, he was Professor of Palaeobiology at Uppsala University for an extended period. Stefan is a world-leading researcher in the evolutionary emergence of animals around the time of the Cambrian explosion. More recently, he has explored the deep history of complex life during the Proterozoic, and has helped establish criteria for the identification of life on early Earth and, potentially, on other planets. He has also been the long-serving, managing/production editor of *Lethaia* (1971–1999), *Fossils and Strata* (1992–1999), and more recently, *Palaeontologia Electronica*. His pioneering approaches to electronic publishing have helped transform the way palaeontologists disseminate their knowledge.

Bengtson began his academic career in Uppsala and Lund before undertaking national service and training as a Russian interpreter. He then completed his PhD with Anders Martinsson at Uppsala University, where he studied the palaeobiology of Cambrian conodonts and mobergellids, as well as other problematical components of the largely phosphatic "small shelly faunas" (SSFs) that were



Photo: Dave Marshall.

then the focus of much controversy. This included fundamental work, describing new species and genera from important new sections, helping monograph entire faunas in China (1989) and Australia (1990), as well as providing new interpretations of previously known taxa of many different clades. He is a master of both synthetic research (using disparate information to elucidate the origin of major evolutionary lineages) and conceptual work (developing new criteria for interpreting problematic fossil remains). For instance, building on the work of K. J. Müller and Y. Nogami, Bengtson proposed an elegant and influential model that rationalized the three grades of

phosphatic microfossils known as protoconodonts, paraconodonts and euconodonts into a single evolutionary series, thus accommodating both functional and developmental differences.

While Stefan's work has focused on the palaeobiology of extinct organisms, he has also made seminal contributions to the regional and global chronology of the Cambrian, through the use of biostratigraphy and geochronology. This has been a thread throughout his research career, stemming initially from work in Siberia where he exploited his training as a military interpreter to open Russian palaeontological science to himself and – through him – to the Western world. Throughout his career, Stefan Bengtson has made a series of seminal conceptual, methodological and scientific breakthroughs. These include the discovery of fossilized animal embryos, the elucidation of their embryology, and the recognition of their significance to understanding the evolution of development in taxa such as the Cnidaria and the Scaldiphora (Kinorhyncha, Priapulida, Loricifera). In so doing, he introduced synchrotron tomography to palaeontology – a technique that he has continued to exploit in the investigation of early life. He has also been provocative and iconoclastic in his interpretation or re-interpretation of controversial fossil remains – such as the description of ~2 billion-year old “multicellular organisms” from Western Australia and Gabon, and the re-interpretation of the celebrated “animal embryos” from the Ediacaran Doushantuo Formation, as protists with a penchant for multicellularity. Bengtson has also been steadfast in his support for the truth, allocating precious time and monetary resources to the evaluation of controversial claims of multicellular organisms in the Palaeoproterozoic of India, and of putative Ediacaran bilaterian animal remains, which he revealed to be diagenetic artefacts.

Stefan Bengtson has not only served his own research community, most notably through his leadership in developing the modern understanding of the nature of “Darwin's dilemma”, the Precambrian–Cambrian transition. He has also devoted a substantial part of his professional career to that key component of scientific endeavour: publication. Stefan began this aspect of his career as an assistant to his former mentor, Anders Martinsson, the founding Editor of *Lethaia*. He assumed leadership of *Lethaia* following Martinsson's untimely death and then led both it and its sister series, *Fossils & Strata*, into the electronic age at a time when most publishing houses were reluctant to



accept articles on disks. This precocious use of word processing and digital imagery led ultimately to the foundation of *Palaeontologia Electronica*, an online-only, open-access journal way ahead of its time. Bengtson's role in these and other influential products (Boreas and the Nobel Symposium volume *Early Life on Earth*) has been transformational.

Stefan Bengtson's excellence has been recognized previously through the award of the Charles Doolittle Walcott Medal by the US National Academy of Sciences (1992), election to membership of the Royal Swedish Academy of Sciences (2003), selection as a Centennial Fellow of the Palaeontological Society (2006) and the grant of an honorary doctorate by the University of Poitiers (2012). Though now retired, Bengtson maintains an infectious boyish glee in carrying out the science that he loves. He continues to make seminal contributions to our understanding of the emergence of animal life, and of life more generally. As always, he challenges and inspires colleagues at all stages of their careers. This surely is the hallmark of a Lapworth medalist.

## ***President's Medal: Prof. Jennifer McElwain***

*Luke Mander and Claire Belcher write:* Prof. McElwain's research has generated fundamentally new scientific information about ancient atmospheres and plant evolution. Her early work laid the foundations for understanding how fossil plants could be used to constrain atmospheric CO<sub>2</sub> levels throughout Earth history. This pioneering body of work resulted in the stomatal CO<sub>2</sub> proxy, which has provided new insights into how the composition of Earth's atmosphere has changed through time. McElwain has used this proxy to constrain biogeochemical models of Earth's atmosphere, to reconstruct palaeo-elevation, and to understand magnitude and mechanisms of geologically rapid CO<sub>2</sub> rise during the Triassic–Jurassic transition (~200 Ma) and the Cenomanian–Turonian oceanic anoxic event (~90 Ma).

Prof. McElwain has undertaken a series of field campaigns to East Greenland in order to investigate plant palaeoecology during the end-Triassic mass extinction. These expeditions have resulted in palaeoecological research of great breadth and diversity. She has undertaken detailed systematic studies of problematic plant fossils, assessments of plant fossil assemblages that explore the macroecological responses of Triassic–Jurassic vegetation to changes in the composition of the



Photo: Dave Marshall.

atmosphere, and ground-breaking work developing methods to assess the rate and mechanism of plant biodiversity loss at this time. This research has resulted in a paradigm shift in palaeobotany, demonstrating that mass extinction events, which punctuate and shape the history of animal life, also had profound effects on both the structure and the biodiversity of ancient plant communities.

Her current research activities involve examining the physiological properties of plants grown in experimental atmospheres produced by climate-controlled growth



chambers. This research has established links between the physiological processes that can be observed and measured in living plants, and the macroevolutionary patterns that can be observed in the fossil record. This world-leading research programme is also providing fundamentally new information on how the evolution of plant physiology has affected past climates on Earth, and how it will affect the future climate of our planet.

Prof. McElwain has successfully mentored a number of scientists who have gone on to hold permanent academic positions around the world. These include Dr David Sunderlin (PhD student; now Associate Professor at Lafayette College), Dr Surangi Punyasena (PhD student; now Associate Professor at the University of Illinois at Urbana-Champaign), Dr Luke Mander (PhD student; now Lecturer at The Open University) and Dr Claire Belcher (Post-doctoral research associate; now Associate Professor at the University of Exeter). This highlights her ability as a mentor and her commitment to developing and supporting the next generation of scientists in her field.

## ***Hodson Award: Dr Stephen Brusatte***

*Rachel Wood writes:* Steve completed his PhD at Columbia University, New York, in 2013. Before this he undertook an MSc at the University of Bristol (2006–2008) under the highly competitive Marshall Scholarship programme for Americans to pursue postgraduate study in the UK. In early 2014 he moved to the University of Edinburgh to take up a Chancellor's Fellowship. These positions are effectively permanent but with minimal teaching for the first five years to help support research development, and are usually given to candidates with an established track record of postdoctoral research. The fact that Steve was awarded such a position immediately after his PhD is an indication of his exceptional calibre. He already had over 50 publications to his name at the time of application!

Steve's research concerns the evolution of dinosaurs, marine reptiles and early mammals. He has already made some real step-changes in our thinking. His work has shown that the rise of dinosaurs was gradual, and that birds evolved piecemeal from theropods but then exploded in diversity when their body plan came together. He has also shown that some dinosaurs were losing diversity before their otherwise sudden extinction. He has been a major force in providing novel and innovative techniques to provide robust phylogenies for several major groups (archosaurs, theropod dinosaurs), and new statistical methods for studying trends in disparity and rates of evolution over time. His



Photo: Dave Marshall.

2014 study on the origin of birds (*Current Biology*) was named a "Breakthrough of the Year" by *Science*.

Steve now has over 100 publications, only ~4 years after his PhD! This number alone is unusually high for such an early-career researcher, but many already have an impressive number of citations (3,088 in total). His publications include several in *Nature Communications*, *Science* and *PNAS*. Of particular note is the single-author textbook on *Dinosaur Paleobiology*



(published by Wiley-Blackwell, 2012). This would usually be an audacious undertaking for an early-career researcher, but his mature scholarship shines through and this work is recognized as an outstanding contribution in a crowded field.

Steve takes a lot of pride in communicating his work to a general audience. He has not only published five popular books, but is also a prominent presence in TV programmes, popular science articles, and was also a consultant on the 3D film *Walking with Dinosaurs*. He co-founded, and has done an amazing job in publicizing the importance of, dinosaur footprints on Skye which has captured the imagination of the public. He is a very accomplished lecturer – to both scholarly and public audiences. Steve has also single-handedly set up the Edinburgh vertebrate palaeontology laboratory (the first dinosaur lab in Scotland) and co-directs the new MSc course in Palaeontology and Geobiology. Under his charismatic leadership he has in four years built up a large and highly vibrant research group of Masters and PhD students and postdoctoral researchers.

Steve is simply exceptional. He excels in all these listed pursuits. He offers outstanding research and public engagement, but also shows a real commitment to education and teaching. Barely a year after he arrived in Edinburgh (2014) Steve was elected a member of the Royal Society of Edinburgh's Young Academy of Scotland as a measure of the high esteem in which he is held. He has boundless energy, enthusiasm and commitment.

## **Mary Anning Award: Mr Mohamed 'Ou Said' Ben Moula**

*Bertrand Lefebvre and Peter Van Roy write:* Mohamed 'Ou Said' Ben Moula was born in 1952 in Alnif. Alnif, being in the middle of an area of extensive outcrops of Cambrian, Ordovician and Devonian ages, belongs to the classical heartland of Moroccan palaeontology so, before long, Mohamed became involved with fossil collecting. With time, his collecting trips led him farther afield, until he started focusing on the Early Ordovician in the area to the north of Zagora, some 200 km south-east of his home town. At the time this was virtually virgin territory, with little or no collecting activity going on. First, he went there to collect classical 'shelly' fossils – mainly trilobites and echinoderms. However, around the turn of the century, some of his digs started turning up other, more unusual creatures. Other collectors likely would have discarded these unfamiliar fossils – but not Ou Said: he knew he was onto something special. In fact, he had unearthed the Fezouata Biota, one of the major palaeontological discoveries of the last decade.

Not only did Mohamed discover the Fezouata Biota and recognize its significance; crucially, he has also always been extremely open and supportive of scientific research on any of the fossils discovered by him: apart from providing unfettered access to all his collecting sites, any exceptionally-preserved fossils collected by him are put aside to be made available for scientific study. All material he collects is carefully kept separate for each excavation, allowing every specimen to be accurately tied to the GPS coordinates of the dig where it was collected. His systematic excavation techniques are textbook, and it would be hard to improve upon them. Last but not least, he is an absolutely remarkable collector, recovering mm-sized fossils that are almost invisible to the naked eye. Repeatedly, he has handed us slivers of seemingly barren shale. After we failed to locate anything of interest on the small pieces of rock, Ou Said, with a big smile, would



point out a minute red dot, that under a hand lens suddenly resolved into a perfectly preserved mm-sized arthropod, priapulid or sponge. Even highly incomplete and fragmentary material does not escape his attention: while most collectors only go for the large and conspicuous, commercially rewarding material, Ou Said understands that even fragmentary specimens of common taxa are of scientific importance since they document the presence of a certain fossil at a certain site.

Although he never received any formal palaeontological training, and in fact never attended school, he displays an amazing insight into the fossils he discovers – to the extent that it would put many ‘professional’ palaeontologists to shame! His understanding of the local geology translates into an uncanny ability to pinpoint sites in the desert for excavation, with a remarkable degree of success. Without Mohamed’s kind help, collaboration and understanding of the fossils, the Fezouata research would quite simply not exist, and it is no exaggeration to state that the success of the Fezouata project can be traced back entirely to Mohamed Ben Moula and his family. While recently, as a result of this success, some other local collectors have also started to take an interest in the Fezouata fossils, Mohamed ‘Ou Said’ Ben Moula undoubtedly remains the master of this remarkable biota. Nowadays, he is joined in the field by his sons Lahcen, Brahim and Yusuf, who exhibit the same talent and enthusiasm for the subject as their father, ensuring decades of exciting discoveries to come.

Unfortunately Mohamed was unable to attend the Annual Meeting in December to collect his award; however, he was able to attend the IGCP Project 653 workshop in Marakesh for a special presentation. On the afternoon of Tuesday 15th February in the splendid setting of the Faculty of Sciences and Technology, Cadi Ayyad University, Marrakech, Mohamed ‘Ou Said’ Ben Moula was uniquely honoured for his services to palaeontology. Speeches were exchanged in Arabic (Khadija El Hariri), French (Thomas Servais, past PalAss Vice-President) and English (David Harper, past PalAss President), while a student band and choir serenaded the 100-plus colleagues, friends and students comprising the appreciative and lively audience. The presentation of the Mary Anning Award recognizes the important role of the amateur in advancing the science of palaeontology. There is no better contemporary role model and worthy recipient of the Mary Anning Award than Ou Said and it was an honour to be able to recognize his contributions on the day.



*David Harper (former President, Palaeontological Association) presents the Mary Anning Award to Mohamed ‘Ou Said’ Ben Moula. Photo courtesy of Aicha Achab.*



## Prizes for the best papers in 2017

The Palaeontological Association awards annual prizes 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.

Each year I ask the science editors (who have had the task of steering 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. For *Papers in Palaeontology* it is novelty, breadth, quality of the description 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 shape future research directions in palaeontology. The nominated papers are then circulated around members of the editorial board and voted on.

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

We again had strong competition for the 2017 prizes, and the editorial board had a difficult choice with so many good papers being nominated. This year the two papers that emerged as winners are as follows:

For *Papers in Palaeontology* the best paper prize went to: Leuzinger, L., Cuny, G., Popov, E. and Billon-Bruyat, J. 2017. A new chondrichthyan fauna from the Late Jurassic of the Swiss Jura (Kimmeridgian) dominated by hybodonts, chimaeroids and guitarfishes. *Papers in Palaeontology*, **3**, 471–511. DOI: <[10.1002/spp2.1085](https://doi.org/10.1002/spp2.1085)>. This paper reports a large-scale study of more than 2,000 isolated shark, ray and chimaeroid remains (teeth, dental plates, spines and dermal denticles) from a site in Switzerland that adds significantly to our understanding of the fish fauna of central Europe. The fauna is extensive, and its careful documentation leads to a reappraisal of the palaeoenvironmental setting of the local region.

For *Palaeontology* the best paper prize went to: Soul, L. C. and Friedman, M. 2017. Bias in phylogenetic measurements of extinction and a case study of end-Permian tetrapods. *Palaeontology*, **60**, 2, 169–185. DOI: <[10.1111/pala.12274](https://doi.org/10.1111/pala.12274)>. This paper makes a major contribution to the debate about how best to approach the analysis of extinction risks in fossil clades. Focusing on the phylogenetic clustering of extinction, the authors used simulations to develop an in-depth understanding of how best to measure phylogenetic clustering of extinction and then applied the most accurate methods to real world data: the evolution of tetrapod clades across one of the major mass extinctions. This work is of interest to all palaeontologists wanting to take a rigorous approach to understanding the role played by life history traits in shaping the evolutionary tree.

The prizes were awarded at the Annual Meeting of the Palaeontological Association in London in December 2017, and my congratulations go to the prize winners.

**Andrew B. Smith**  
*Editor-in-Chief*



## AGM 2017: Small Grant Awards

The small grants awarded by the Association for funding in 2017 include the Sylvester-Bradley, Callomon, Whittington and Stan Wood awards. Council agreed that the following applicants should receive Sylvester-Bradley awards: Jordan Bestwick (£1,498), Thomas Boag (£1,475), Keegan Melstrom (£1,500) and Manuel Weinkauff (£1,500). The Callomon Award went to Anthony Shillito (£1,520), the Whittington Award to David Legg (£1,500), and Stan Wood awards to Nuria Morales Garcia (£1,468) and Jonathan Rio (£1,496.50). Details of the proposed research are given below.

### *Dental Microwear Textural Analysis: reconstructing diets of non-mammalian fossil taxa from the Solnhofen archipelago*

**Jordan Bestwick**

*University of Leicester, UK*

Dental Microwear Textural Analysis (DMTA) is a robust technique for testing dietary hypotheses in extant and fossil taxa. Microwear is produced when organisms feed, as interactions with food items cause microscopic scratching and chipping of tooth enamel. Food items with different material properties are therefore hypothesized to create different wear patterns. Most DMTA research on fossil taxa focuses on mammals, but new evidence suggests microwear from modern reptiles (crocodilians and monitor lizards) also contain dietary signals. Modern reptiles can thus serve as analogues for inferring diets of non-mammalian fossil taxa which can aid in extinct food web reconstructions. One extinct food web of interest is the Solnhofen biota from the Upper Jurassic of Germany, famous for its articulated skeletons of taxa across several principal biotopes (terrestrial, aerial, aquatic). Current ideas on diets for the Solnhofen biota are based on qualitative reasoning with little robust testing. Solnhofen is therefore an ideal case-study to determine the degree to which DMTA can detect dietary differences in non-mammalian fossil taxa. Microwear will be collected from Solnhofen taxa (pterosaurs, theropod dinosaurs, lepidosaurs and crocodyliformes), across the three biotopes. Specimens will be sampled from Munich, Karlsruhe and Stuttgart, and will provide the first, robust dietary reconstructions of the Solnhofen biota, providing insight into whether taxa within and between biotopes competed for food.

### *Investigating the role of oxygen and silica in deep-water first appearances of the Ediacara Biota*

**Thomas Boag**

*Stanford University, USA*

Complex macroscopic eukaryotes first appear during the late Ediacaran c. 571 Ma in deep-water, aphotic slope facies, but are not found in shelf environments until ~560–555 Ma, occurring





stratigraphically above the globally recognized Shuram negative carbon isotope excursion (SIE). Mitigating our ability to discern whether this pattern is a genuine reflection of evolutionary dynamics is an imperfect geologic record; in historically well-studied areas it is not possible to investigate fossil appearances across a basinal transect to test for co-inhabitation of both deep- and shallow-water environments in space and time. A newly characterized, SIE-containing, fossiliferous shelf-to-slope transect in sedimentary strata of the Wernecke Mountains, Yukon, Canada, provides an opportunity to evaluate both taphonomic and palaeoenvironmental conditions which may be influencing this pattern. LA-ICP-MS and electron microprobe analyses will be used to determine whether differential silica saturation states in the deep vs. shallow ocean control fossil preservation and therefore observed bathymetric trends, while iron speciation of shales will reconstruct the basinal redox architecture. Together with a systematic description of newly collected fossils, this integrated taphonomic, sedimentological, and redox framework for the Wernecke transect will provide critical insights into both the veracity and causal mechanisms for the deep-water origination of macroscopic eukaryotes.

## ***A biomechanical study on the feeding ecology of Mesozoic mammalian faunas of the United Kingdom and Portugal***

**Nuria Morales Garcia**

*University of Bristol, UK*

Over the past two decades, remarkably preserved fossils have revealed that early mammals were much more ecologically diverse than once thought. Unfortunately, most of their fossil record consists of teeth and incomplete jaws; however, this material can be digitally reconstructed and from it, cutting edge techniques such as Finite Element Analysis (FEA) are revealing important clues on the feeding ecology of these animals. My project aims to study the feeding ecology of early mammals from the Jurassic and Early Cretaceous of the UK and Portugal by using FEA, mechanical advantage, and beam theory. FEA is used to assess the functional performance of the jaw and uses 3D reconstructions built from CT scan data. Mechanical advantage measures the efficiency of the adductor muscles at the jaw at the moment of biting, and beam theory measures the strength in bending of the jaw. These three comparative biomechanical analyses will inform on the feeding ecology of mammalian faunas from some of the best preserved Jurassic–Cretaceous European localities, including the Early Jurassic Lias Group, the Middle Jurassic Forest Marble and Taynton Limestone Formations, and the Early Cretaceous Purbeck Limestone Formation (UK), all of which are held in British collections, as well as the exceptionally preserved dryolestid material from the Guimarota Formation in Portugal, currently being held at the Steinmann Institut in Bonn.



## *Patterns and processes in early arthropod evolution revealed by new animals from the Lower Cambrian of southwest China*

**David Legg**

*University of Manchester, UK*

Funding was sought to facilitate research on early Cambrian arthropods from exceptionally preserved deposits in southwest China, located in the collections of the Northwest University in Xi'an, and Yunnan Key Laboratories in Kunming. Recent excavations throughout the Yunnan province of China have uncovered countless new sites, such as the Xiaoshiba biota, bearing thousands of specimens of soft-bodied arthropods, including fuxianhuiids, a group famed for possessing some of the oldest evidence of neurological material and the cardiovascular system in the fossil record, and the Cambrian carapace-bearing arthropod *Isoxys*, a cosmopolitan genus phylogenetically linking the large predatory anomalocaridids, and animals possessing a truly arthropodized bodyplan. Potential new species of these taxa will be studied, including the collection of measurement and meristic data, for incorporation into a phylogenetic dataset, the aim of which is to better understand the patterns and processes of these amazing animals during a pivotal time in Earth's history, the Cambrian explosion.

## *The ecological response of crocodylomorphs to mass extinctions*

**Keegan Melstrom**

*University of Utah, USA*

Mass extinctions profoundly influence the evolutionary history of clades that survive these catastrophic events, and many patterns underlying the survival of particular groups remain unknown. My research examines the responses of crocodylomorphs, the extinct relatives of living crocodiles and alligators, to two mass extinctions, the end-Triassic and the end-Cretaceous. Key patterns are recognized, such as after the end-Triassic mass extinction the group appears to recover quickly and undergo a major diversification, which contrasts with the recovery from the end-Cretaceous mass extinction, where no such diversification occurs, but the underlying drivers of the responses remain unknown. To resolve this uncertainty, I will reconstruct the dietary and locomotor ecology of extinct crocodylomorphs to test if the ecology of mass extinction survivors influences its recovery. To this end, I will measure skull and limb disparity, which will allow me to quantify how shape diversity changed through time. These data will be linked to information on the dental morphology of crocodylomorphs, which will then be used to reconstruct their diet. These two aspects will be combined to produce a more complete ecological reconstruction of this extinct group. In sum, this information will shed light on how the ecology of crocodylomorphs changed through time, especially after mass extinctions, and may ultimately elucidate why some groups flourish after mass extinctions and why others do not.



## *The evolutionary history of mekosuchine crocodylians from the Cainozoic of Australia*

**Jonathan Rio**

*Imperial College London, UK*

Only two crocodiles inhabit Australia today, the infamous saltwater crocodile, and the slender-snouted freshwater crocodile, or 'freshie', which first appeared in Australia three million years ago. Beforehand, an obscure group of crocodiles dominated the outback, known as the Mekosuchinae. There are 21 mekosuchine species, which first appeared in the fossil record 50 million years ago, surviving as recently as 10,000 years ago. Their late survival means mekosuchines probably lived alongside indigenous Australians and competed with the modern crocodiles for dominance. During their evolutionary history, mekosuchines evolved an exceptional diversity of skull and body forms, indicating that they specialized to live and hunt differently. There were slender-snouted fishers, similar to living freshies, semi-aquatic ambush predators, like saltwater crocodiles, short-faced dwarfed forms, and tall-snouted forms with serrated teeth that lived entirely on land. A lot is still unknown about the Mekosuchinae, such as the evolutionary relationships within the group, their place in the family tree of modern crocodiles, and how they diversified into so many different niches. Mekosuchines were endemic to Australia and can be studied nowhere else on Earth. This project aims to unravel the evolutionary relationships between the mekosuchines, and determine where they belong in crocodile evolutionary history, by studying the large collections housed in the Queensland Museum, Brisbane, Australia.

## *Trace fossil insights into Early Devonian terrestrial ecosystems – a case study from Gaspé, Quebec*

**Anthony Shillito**

*University of Cambridge, UK*

The sedimentary succession of the Gaspé Peninsula is of huge palaeontological significance for our understanding of the Early Devonian epoch. The Peninsula is known for a diverse early terrestrial plant flora and a world-renowned fish Lagerstätte which bears fossils crucial for understanding the early stages of tetrapod terrestrialization. Despite the importance of this location, the trace fossils of the succession have been largely overlooked in the past – neglecting a potentially powerful tool for our understanding of the behaviour of animals in the complex and diverse depositional environments of Earth's earliest non-marine biomes. This study will rectify this through a systematic survey of the trace fossil communities and sedimentary logging of the lower Devonian Gaspé succession, with an explicit emphasis on linking trace fossils to the sedimentary facies in which they occur. This will be achieved during two weeks of fieldwork, primarily looking at the Emsian Cap-aux-Os Member of the Battery Point Formation. Ultimately, this work will result in a detailed ichnological characterization of a broad range of non-marine sedimentary environments from a crucial interval in the history of life on Earth.



# *The influence of shell calcification rate on stable oxygen isotope composition in planktonic Foraminifera*

**Manuel Weinkauf**

*Université de Genève, Switzerland*

Planktonic Foraminifera are an abundant group of marine protists which build calcitic shells and have existed since Jurassic times. Besides other applications, the isotopic oxygen composition of their shells can be used to reconstruct past climate conditions. This is because planktonic Foraminifera incorporate stable isotope signals from the seawater in their shells, preserving past ocean chemistry. However, due to biological fractionation, the isotope composition in the shells is not the same as that of the ocean water, and this so-called vital effect has been known for a long time. While it is known that the vital effect varies with species, shell size, and ecology, there is still a large portion of stable isotope variation within planktonic foraminiferal shells unaccounted for. Understanding the source and amplitude of this variation can help to make past climate reconstructions more reliable, as well as the climate models which are based on them. In this project, I am using sediment trap material from the North Atlantic to investigate the effect of calcification rate on the shell isotopic composition, assuming that faster calcification limits the ability of the foraminifer to fractionate isotopes and forces shell isotopic compositions to be closer to that of the sea water. The results from this study will help researchers to correct their isotope data from planktonic foraminiferal shells for this effect, so that they can arrive at more reliable reconstructions of past ocean water conditions.



## Diversity study update

The purpose of the Palaeontological Association is to promote the study of palaeontology and its allied sciences, and the Association is open to any adult with an interest in these subjects regardless of colour, ethnic or national origin, race, gender, disability, age, sexual orientation, religious or other beliefs, marital status or family circumstance.

The Association takes issues of equality and diversity very seriously and as reported previously in the *Newsletter* has commissioned a study by consultants Parigen Ltd, running from November 2017 to May 2018. The purpose of the study is to gather baseline data on a range of protected<sup>1</sup> and non-protected characteristics such as gender and socio-economic factors, respectively, in order to consider how the Association's activities can be tailored to be more inclusive and ultimately to increase diversity in the discipline of palaeontology.

Parigen have now completed several elements of the study, including an online survey of current members and other members of the palaeontological community, three focus groups at the Annual Meeting in December, and formal and informal interviews with a number of Association members and other current and former palaeontologists. The online survey had 585 completed responses and Parigen are currently analyzing the data from this and the other activities.

We anticipate that the full findings of the diversity study will be available by May 2018. These will be reported in a future edition of the *Newsletter*, along with details of actions the Association will take as a result of the diversity study conclusions.

**Fiona Gill**

*University of Leeds*

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<sup>1</sup> As defined by the Equality and Human Rights Commission:  
<<https://www.equalityhumanrights.com/en/equality-act/protected-characteristics>>.



# The Palaeontological Association needs mentors!

Are you interested in raising the profile and increasing the competitiveness and diversity of scientists working in palaeontology and allied fields? The Palaeontological Association is establishing a mentoring scheme to assist palaeontologists to progress in their careers. Mentoring is a tool to support the development of an individual, helping him or her make informed choices via the exchange of knowledge and experience. **At this stage in the process we are seeking academics in permanent positions, regardless of seniority, to step forward as potential mentors.**

## **Who will you be mentoring?**

We have identified priority areas as major career transitions, in the first instance focusing on the postdoc-to-permanent-job transition (in academia or elsewhere). You will therefore be paired with a postdoc palaeontologist. Other transition points such as late-stage PhD to postdoctoral position and mid-career to senior leadership role will be the focus of later mentoring schemes.

## **What is required?**

The Palaeontological Association mentoring scheme will be via direct mentoring. That is, direct contact between the mentor and mentee via e-mail, Skype or other forms of communication. The expectation is that you will have formal meetings two or three times per year, and mentors should provide open and honest advice whilst maintaining confidentiality at all times. Full guidelines on lines of communication and flexibility (length of the mentorship) will be provided.

## **How will the scheme be monitored?**

Mentors and mentees will have a point of contact via a member of Council, the Vice-President in the first instance, who will oversee all mentor-mentee pairings and the general running of the scheme.

## **Who do I contact?**

To express interest in acting as a mentor, please e-mail Caroline Buttler (<[Caroline.Buttler@museumwales.ac.uk](mailto:Caroline.Buttler@museumwales.ac.uk)>). To emphasize, we are looking for academics in permanent jobs at any level of seniority. Those obtaining permanent jobs in recent years have as valuable experiences to share as more senior academics.

Aside from the warm glow of knowing you are making a positive difference to someone else's career, there is much to gain from being a mentor, such as enhanced leadership skills and personal reputation. We hope you can take part and contribute to the continued development and success of the palaeontological sciences in a competitive academic world.

**Emily Rayfield**

*University of Bristol*



# ASSOCIATION MEETINGS

## Code of Conduct for Palaeontological Association Meetings

The Palaeontological Association was founded in 1957 and has become one of the world's leading learned societies in this field. The Association is a registered charity that promotes the study of palaeontology and its allied sciences through publication of original research and field guides, sponsorship of meetings and field excursions, provision of web resources and information, and a programme of annual awards.

The Palaeontological Association holds regular meetings and events throughout the year. The two flagship meetings are the Annual Meeting held at a different location each December, and the annual Progressive Palaeontology meeting, run by students for students with the support of the Palaeontological Association. The Association Code of Conduct relates to the behaviour of all participants and attendees at annual events.

### **Behavioural expectations**

It is the expectation of the Palaeontological Association that meeting attendees behave in a courteous, collegial and respectful fashion to each other, volunteers, exhibitors and meeting facility staff. Attendees should respect common sense rules for professional and personal interactions, public behaviour (including behaviour in public electronic communications), common courtesy, respect for private property and respect for intellectual property of presenters. Demeaning, abusive, discriminatory, harassing, or threatening behaviour towards other attendees or towards meeting volunteers, exhibitors or facilities staff and security will not be tolerated, either in personal or electronic interactions.

### **Digital images and social media**

Do not photograph a poster or record a talk without the author's express permission. While the default assumption is to allow open discussion of presentations on social media, attendees are expected to respect any request by an author to not disseminate the contents of their talk or poster.



## 62nd Annual Meeting of the Palaeontological Association

University of Bristol, UK 14 – 17 December 2018

Contact e-mail: <[annualmeeting2018@palass.org](mailto:annualmeeting2018@palass.org)>.

The 62nd Annual Meeting of the Palaeontological Association will be held at the University of Bristol. The Bristol Palaeobiology Group is one of the largest in the UK and our research encompasses everything from the origins of life to mammals and plants, and a bit of dinosaurs even as well. The organizing committee is chaired by Dr Jakob Vinther.

The University of Bristol is located in Clifton in the northern part of the city, and is easily accessible by bus, by taxi or on foot from the Temple Meads train station. Bristol Airport is only 25 minutes' drive from town (regular airport bus to bus station; 10 minutes walk to campus) and serves all the major European cities with regular and fairly-priced departures. Bristol is less than two hours from London by rail, and a high speed line will soon take the journey down to 75 minutes. Several hotels are to be found close to the University. Find out why Bristol is frequently listed as a top European city destination and don't miss the opportunity to visit the Clifton Suspension Bridge and enjoy the gorgeous views over the Avon Gorge.

Outline programme:

- Friday 14th: symposium and reception in the Life Sciences Building
- Saturday 15th: main programme day one, AGM, annual address, and annual dinner – venue: Bristol City Museum.
- Sunday 16th: main programme day two.
- Monday 17th: field-trips – the Triassic microvertebrate sites in Somerset and the Triassic–Jurassic sections of Watchet.

See future *Newsletters* and the Palaeontological Association website (<[www.palass.org](http://www.palass.org)>) for full details, including symposium topics, annual address speaker, details on travel and accommodation advice.

Registration and abstract submission will commence in June 2018, via the Palaeontological Association website. Abstract submission will close in September (date to be confirmed) and abstracts submitted after the deadline will not be considered. Registration after the abstract deadline will incur an additional administration charge, with the final deadline for registration in November 2018.

The logo for this year's Annual Meeting takes inspiration from the hot air balloons that are a frequent sight in Bristol during the summer months, not least during the annual hot air balloon festival. A splendid place to see the balloons over town is from the Victorian Clifton Suspension Bridge shown in the background. For this occasion, the balloon itself has been replaced by an articulate brachiopod.







## The Lyme Regis Fossil Festival

Lyme Regis, UK 5 – 6 May 2018

The Lyme Regis Fossil Festival is running over the weekend of 5th and 6th May 2018, centred around the old town and sea front. The theme this year is “Lyme through Time: 200 Million Years of Geological Time, 200 Years of Discovery”. The rocks and fossils around Lyme Regis and Charmouth date back to the start of the Jurassic, yet we have only spent the last 200 years unravelling the stories that they contain. Who knows what else there is to be discovered, while ever more powerful technologies enable us to discover more. As with previous events, the Natural History Museum, London along with both national and regional science organizations, museums and universities will be displaying their work in the Earth sciences, and there will be plenty of hands-on activities together with walks and talks. More details can be found at <<https://www.fossilfestival.co.uk/>>.



# Manchester

# 7-9th June



# 2018

Hosted by SEES,  
University of  
Manchester  
and  
CEEB, Manchester  
Metropolitan  
University

## Registration opening soon

Panel discussion - 'Careers  
in Palaeontology'

Fieldtrip to the Peak  
District

Workshops on 3D  
Visualisation and  
Biomechanical Modelling



@ProgPal2018



www.facebook.com  
/progpal2018/

Abstract submissions will be open to final year undergraduates,  
masters level and PhD level students





news



## *International Prize for Biology*

Each year the Japan Society for the Promotion of Science (JSPS) awards an International Prize for Biology for a specific research field. This year, for the first time since 2001, the research field is palaeontology. The last recipient was past Association President Prof. Harry Whittington FRS. The call for nominations for the 2018 prize is now open and the deadline is 20th April. For more information on how to nominate a worthy palaeontologist please see the website <<http://www.jsps.go.jp/english/e-biol/index.html>>.

## *Prestwich Medal awarded*

Jan Zalasiewicz, Professor of Palaeobiology at the University of Leicester, has been awarded the Prestwich Medal of the Geological Society for 2018. This medal is only awarded every three years for a distinguished scholar “who shall have done well for the advancement of the science of geology”. Jan has authored many popular science books on geology for Oxford University Press. The first of these books, ‘The Earth after Us’, sparked Jan’s interest in the concept of the Anthropocene as a potentially new epoch-level subdivision of the Geological Time Scale. Jan has been a leading exponent of this idea for a decade, and he chairs the group that is evaluating the geological signature of the Anthropocene for potential formalization. Jan’s work on the Anthropocene has produced many highly cited research papers, as well as numerous popular science articles. His account of this work was singled-out as representing one of the top ten science stories for 2016 by *Scientific American*, and he featured as an interviewee of Jim Al-Khalili’s BBC Radio 4 ‘The Life Scientific’ in 2017. Jan is a very worthy recipient of the medal.



**Mark Williams**  
*University of Leicester*



## *Marsh Award*

Ex-Association Vice-President David Ward is the recipient of the prestigious Marsh Award for Palaeontology for 2017. The annual award was presented by Brian Marsh OBE on behalf of the Marsh Christian Trust and the Natural History Museum, London where the ceremony took place in December. The Marsh Award for Palaeontology is recognition for those people who have made an outstanding or cumulative contribution to Palaeontology in the UK, yet whose efforts have not been recognized widely. David received the award in recognition of his diverse contributions to Palaeontology. He is noted for his expertise in fossil sharks, having named 81 species of predominantly shark, ray and chimaeroid. In recognition of the tremendous amount of work David has contributed to the field he has had 13 species named after him. For the past 30 years David has worked closely with various members of the fossil fish group at the NHM as well as doing significant work with Birkbeck, University of London. Extensive fieldwork in collaboration with Birkbeck across sites in the UK, Central Asia and North Africa has yielded a series of previously unknown fossil vertebrate sites; some of these have since been granted Site of Special Scientific Interest (SSSI) status on the basis of his work. In addition to his academic contributions to palaeontology David was also nominated on the strength of his extensive contributions to outreach, the most notable of these contributions being the fossil ID workshop using material from Abbey Wood. He has been bringing this activity to Lyme Regis Fossil Festival for the past 12 years and it has become one of the highlights of the Festival. In the words of Emma Bernard, Curator of Fossil Fish at the NHM, "David Ward is an unsung UK Palaeontology hero!".



**Zoe Hughes**

*Natural History Museum, London*



## Uncovering Yorkshire's Jurassic

On Friday 23rd March 2018, Sir David Attenborough will open 'Yorkshire's Jurassic World' at the Yorkshire Museum in York, UK. This will be the first new palaeontology/geology exhibition in the Museum for nearly a decade. To celebrate the event, the Yorkshire Philosophical Society, York Museums Trust, Yorkshire Geological Society and the University of Hull are organizing a one-day public symposium to reveal the scientific research behind many of the exhibits. 'Uncovering Yorkshire's Jurassic' will take place on Saturday 19th May 2018 in the Tempest Anderson Hall at the Yorkshire Museum, and will be a free, public symposium, open to all. Speakers at the event include Sarah King (Yorkshire Museum), David Bond (University of Hull), Elsa Panciroli (University of Edinburgh), and Cris Little (University of Leeds); topics will range from the end-Triassic extinction to the mammals of Skye. It is also planned to run a field-trip to the Jurassic of North Yorkshire on Sunday 20th May 2018.

For further details, and to register your attendance, please visit the symposium website: <<https://www.eventbrite.co.uk/e/uncovering-the-yorkshire-jurassic-symposium-19th-may-2018-tickets-42530157847>>.

**Liam Herringshaw**  
*University of Hull*

## Palaeontology in the news

I'm sure this will get picked up elsewhere in the Newsletter, but the Annual Meeting in London in December was terrific. Really terrific. Great science, great socializing, great organization: thanks so much to the Imperial College team for pulling it together so well. Probably the only downside was that there was simply too much good science being presented. I couldn't see all the talks I wanted to, and I've no idea how the judging panels had time to peruse the posters properly.

Shortly after the meeting, the research of Jordan Bestwick (University of Leicester), one of our joint President's Prize-winners (Ross Anderson of the University of Oxford being the other), took flight on the pages of *Nature*<sup>1</sup>. Jordan's 3D textural analyses of pterosaur tooth microwear have shown that *Dimorphodon macronyx* probably fed on insects and terrestrial tetrapods, rather than fish, as had been previously suggested. Other pterosaurs, meanwhile, such as *Rhamphorhynchus*, almost certainly did eat fish. I'm sure that Mary Anning, discoverer of *D. macronyx*<sup>2</sup>, would be amazed at just how much is still being revealed, even after almost 190 years.

Sticking with winged beasts, the review of nearly-bird *Anchiornis* by Satta *et al.* (2018) also threw up some surprises, including that it was 'shaggy'-feathered. This enabled a beautiful new reconstruction by palaeo-artist Rebecca Gelernter, which in turn led to the fuzz-bird appearing alongside a Motörhead-ed crocodile and a ghost-busting ankylosaur in *Vice*'s 'Best Paleo Art of 2017'<sup>3</sup>. Nicely, given the region's importance in tetrapod extinction, the paper also attracted coverage in the *Deccan Herald*<sup>4</sup>.

<sup>1</sup> <<https://www.nature.com/articles/d41586-018-00080-y>>.

<sup>2</sup> <<https://en.wikipedia.org/wiki/Dimorphodon>>.

<sup>3</sup> <[https://motherboard.vice.com/en\\_us/article/wjp5jx/best-dinosaur-art-of-2017-paleoart-scientific-illustration-rom-zuul](https://motherboard.vice.com/en_us/article/wjp5jx/best-dinosaur-art-of-2017-paleoart-scientific-illustration-rom-zuul)>.

<sup>4</sup> <<http://www.deccanherald.com/content/651233/nature-bytes.html>>.



For discovering this, I have our Executive Officer to thank. Jo recently made me aware of the Altmetric system for tracking how our papers get picked up online, be that in the mainstream media, on social media, or elsewhere. Even if a paper doesn't make the national or international news, it will attract coverage, and I've found what it turns up fascinating. I'd never heard of the term 'Archaeopriapulida' before, but the Altmetrics for John Peel's (2017) paper on the feeding behaviour of a new Sirius Passet priapulid introduced me to it<sup>5</sup>. Similarly, I would never have predicted that there would be a Wikipedia page for '2017 in arthropod paleontology', but thanks to the Altmetrics for Vrazo and Czurca's (2018) paper on eurypterid trace fossils I've discovered that there is<sup>6</sup>, and crikey blimey Charlie what a comprehensive piece of work it is! Quite Haldanian in its inordinate fondness for fossil beetles, whilst not forgetting such fine discoveries as brackish-water seed shrimp in Miocene Mexican amber (Matzke-Karasch *et al.* 2017).

Talking of ostracods (or is it ostracodes? I've never had a definitive answer), I want to finish my news round-up with a short digression onto the resurrection of palaeontology at Hull, UK. With two members of the University of Hull now on PalAss council, and various exciting events going on in our neck of the woods – the British Science Festival from the 11th to 14th September being just one of them – it's a great time to be fossiliferous in the East Riding.

First, a reprise. Geology was taught at the University of Hull from 1948 to the late 1980s, at which point the University Grants Committee Review of Earth Sciences (known more commonly as the Oxburgh Report) led to its demise. My understanding is that the report itself did not recommend the extinction event, but that senior management at the University actioned it anyway, possibly with an unfeasibly rapid emission of hot air, but that's for another day. What matters now is that Geology at Hull is back, resurrected in 2013, with our first graduates emerging blinking into the Anthropocene light in the summer of 2016. Just as importantly, of course, palaeontology is back: the department in Hull having once been home to such fine folks as Michael House, John Neale, Martin Brasier and Derek Siveter.

Whether Dave Bond and I count as Lazarus taxa, I'm not sure, but we've definitely found long-lost specimens reappearing unexpectedly. Thanks to our friends at the Oxford University Museum of Natural History, we've been able to track down most of the old palaeontology teaching collections, and are now in the process of migrating them back to their original habitat. Simultaneously, John Neale's family have dropped off a treasure trove of his Hull papers, letters and teaching slides<sup>7</sup>, including all sorts of ostracodous miscellanea. If anyone out there fancies coming over to help us decipher this, or if you might know where other Hullonian specimens (crustacean or otherwise) ended up, we'd be very pleased to hear from you: just drop us a postcard.

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<sup>5</sup> <<https://en.wikipedia.org/?curid=23069405>>.

<sup>6</sup> <<https://en.wikipedia.org/?curid=52199972>>.

<sup>7</sup> [https://twitter.com/Mark\\_Lorch/status/953248720686125056](https://twitter.com/Mark_Lorch/status/953248720686125056)



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<<http://www.ratbotcomics.com/>>

## Featured Article

The Permian–Triassic (PT) mass extinction is Earth’s greatest ever biotic crisis. Radio-isotopic dating indicates that extensive damage was done to both marine and terrestrial ecosystems in a very brief interval of geological time. More than three decades of research has led to a multitude of purported kill mechanisms, from bolide impact to the effects of massive volcanism including volcanic winter, hypercapnia, global warming, increased sediment flux to the oceans, acid rain, extreme atmospheric oxygen depletion, poisoning by toxic trace metals, and ozone destruction and increased harmful ultraviolet-B (UV-B) radiation (read and cite my free review; Bond and Grasby 2017). The case for the latter has just been significantly strengthened by Jeff Benca and colleagues at Berkeley, whose paper “UV-B–induced forest sterility: Implications of ozone shield failure in Earth’s largest extinction” (Benca *et al.* 2018) builds on the earlier identification of unusually large proportions of malformed gymnosperm pollen in the extinction interval that has long been cited as evidence



for ozone degradation (Visscher *et al.* 2004; Foster and Afonin 2005). Thus, Benca *et al.* took an experimental approach to the question that has vexed extinction workers over the past decade: just *how* did the Siberian Traps eruptions nearly wipe out life on Earth?

By subjecting reproductively mature dwarf pines (with pollen similar to that of Late Permian species) to a range of conditions designed to mimic end-Permian scenarios, Benca *et al.* recreated the effects of low ozone on modern plants. Six pines were left outside whilst 24 were grown indoors with elevated UV-B radiation. None of the irradiated pines was killed, but they did develop mutated pollen grains and their all-important cones were infertile. The pines subjected to high levels of UV-B were sterilized, and as noted by Knoll *et al.* (2007), a decrease of just 1% of individuals per generation can lead a species to extinction in a geological instant.

The results of the experiment (Figure 1) lend considerable support to the notion that PT boundary pollen mutations resulted from the effects of a depleted ozone layer. But how does this fit the bigger picture? Benca *et al.* suggest that pulsed Siberian Traps eruptions weakened the ozone shield, thus “reducing the fertility of several widespread gymnosperm lineages ... inducing repeated terrestrial biosphere destabilization and food web collapse without exerting a direct ‘kill’ mechanism on land plants or animals”. This repeated destabilization might explain why the PT crisis is the only recorded mass extinction of insects.

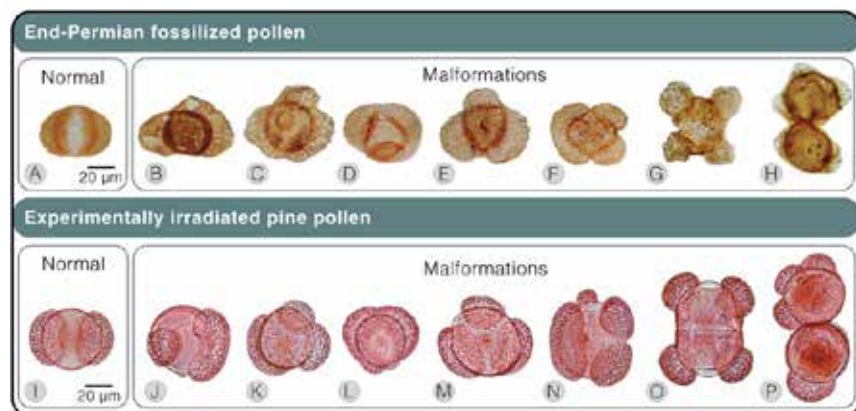


Figure 1. Fossilized pollen of end-Permian gymnosperms and pollen of modern pine irradiated with modelled end-Permian UV-B regimes. From: Benca *et al.* (2018). Reproduced under the Creative Commons Attribution License 4.0 (CC BY).

Benca *et al.*'s scenario is convincing, and it seems likely that the destruction of ozone by the vast volumes of halogens emitted in Siberia (Black *et al.* 2014) had some role in the crisis. The devil, as ever, is in the timing. For the marine crisis to have its origins in the demise of plants, one would expect a clear temporal relationship between the two, with marine losses occurring shortly after those on land. This is not what the fossil record reveals – in some areas at least, the main land plant extinction occurred during the earliest Triassic (Xiong and Wang 2011; Hochuli *et al.* 2016), suggesting that the terrestrial crisis was slightly delayed, and cannot therefore have caused the marine crisis.





I have long advocated that experimental geobiology holds the key to understanding past crises, as well as Earth's near future (and have spent far too many of the past few months playing with “worms on acid”). Benca *et al.*'s experiments are a simple reminder of the power of Uniformitarianism – but their new findings throw up just as many questions as answers about Earth's greatest extinction. Long may it continue!

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## Legends of Rock

### *Zofia Kielan-Jaworowska*

If the PhD supervisor is the academic equivalent of a parent, then Zofia Kielan-Jaworowska is the grandmother that I never met. From my biological grandmothers I inherited my (lack of) height and love for ice cream. When I read about Kielan-Jaworowska<sup>1,2,3</sup> I realize that perhaps I inherited things from her too: my interest in histological thin sections and pelvic girdles, as well as my love for science communication. Kielan-Jaworowska was my supervisor's supervisor, but she was also many other things. Through her life story one can trace the 20th century history of Europe as well as the 20th century's history of science.



Photo courtesy of Jørn Hurum.

Kielan-Jaworowska was born in 1925 in Sokołowo in Poland. The Second World War affected her country more than most, with millions of people killed and large parts of the capital destroyed. This was a problem for her education, but together with other dedicated pupils and teachers she attended illegal education in Warsaw. Eventually she fell in love with evolutionary theory and vertebrate palaeontology through volunteer work in the Zoological Museum, but it would take an impressive invertebrate detour before she would meet her favourite vertebrates: the multituberculates.

Post-war Warsaw was not easy for scientists, but even though the educational system was in constant change, she and her supervisor Roland Kovlowski ran several important research projects, and she finalized her doctoral degree on trilobites. It was awarded in 1953, and in 1959 she managed to submit a large work on Ordovician trilobites just before giving birth to her son. In between fieldwork and the polychaete jaw apparatuses she progressed in academia as a lecturer and researcher.

<sup>1</sup> <<http://www.nhm.uio.no/om/aktuelle-saker/2015/zofia-kielan-jaworowska.html>>.

<sup>2</sup> <<http://paleoglot.org/files/ZKJ%20autobio2.doc>>.

<sup>3</sup> Cifelli (2015)



Poland remained behind the Iron curtain, but Kielan-Jaworowska recognized the importance of international cooperation and strategically built a large network with scholars on both sides. She worked in Paris and visited the UK, the Soviet Union, Scandinavia and the USA on several occasions. From 1980 it became complicated to stay in Poland because of her membership of Solidarity (a trade union), and when a professorship in Oslo was announced, she applied and went on to stay in Norway for eight years until she and her husband returned to Poland in 1995. She worked and published until a few years before she died in 2015.

During her lifetime, Kielan-Jaworowska wrote 220 publications. After finally getting her hands on some vertebrate fossils with the start of the Polish-Mongolian expeditions to the Gobi Desert, she was able to research what would become her largest contributions, on the evolution of early mammals. She was the first female head of a dinosaur excavation expedition worldwide when she led these expeditions between 1963 and 1971. These are regarded as some of the most important and impressive large-scale vertebrate excavations in the last century.

“Mesozoic mammals include the trunk and a bewildering bush of basal branches for the entire mammalian family tree”, she wrote together with her co-authors in 2004, in the large book on Mesozoic mammals (Kielan-Jaworowska *et al.* 2004). No one questions the contributions she made in understanding this bush, as she chose to work not on the dinosaurs but on the minute mammals found in the desert. Multituberculates are the most well-known group of Mesozoic mammals, and even though they have no extant descendants, existed for a very long time. Most multituberculates were rat-sized, while a few were larger, and all had dorsoventrally compressed skulls with large orbits. The multituberculates from the Gobi Desert were giving up some of their secrets because they consisted not only of teeth and a few jaw bones, but articulated skeletons and postcranial elements that made new reconstructions possible. Kielan-Jaworowska used a



Gobi excavation uncovering a large sauropod. Photograph from Kielan-Jaworowska's personal archive.



multitude of techniques, and is especially known for her usage of serial sections through the minute skulls. The access to postcranial material also led her to the pelvic girdle and she wrote in her autobiography that “the peculiar structure of the pelvic girdle was haunting me all the time”. In a 1979 *Nature* paper (Kielan-Jaworowska 1979), she argued that the extremely narrow V-shaped pelvis was not compatible with egg-laying, and suggested that multituberculates gave birth to extremely tiny, live offspring. Nobody has proven her wrong yet.

Throughout her lifetime, Kielan-Jaworowska witnessed an incredible development in vertebrate palaeontology as a science. Her working years saw the introduction of SEM, cladistics and molecular methods, including the rock vs. clock debate. In the second edition of the book *Mammals in the Age of Dinosaurs*, a wide and modern variety of methods are discussed.

Seen as a quite recent invention, Kielan-Jaworowska pioneered in her view on the spread of scientific results. She insisted that the results from the Gobi expeditions be published in English to have a wider influence, and had open access as her principle as editor of *Acta Palaeontologica Polonica*. Similar to many other palaeontologists she saw outreach to the public as very important. In Oslo she was surprised at the old-fashioned exhibitions, and led their renewal, based on experience gained from setting up the large exhibitions based on the Gobi expeditions.

Zofia Kielan-Jaworowska did an impressive amount of work in her lifetime. She was an active researcher and participant in the palaeontological community and is known as an extremely hard-working person with high demands whom it was rewarding to work with.

### **Lene Liebe Delsett**

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## Bug hunt

It's a tough life being an icon, even one that is as resistant to social embarrassment as a long-dead and highly predatory dragonfly<sup>1</sup>. *Meganeura monyi* features on most reconstructions of Carboniferous coal forests, the archetypal monstrous dragonfly of popular culture, as notorious in its way as an emblem of prehistoric time as dinosaur or mammoth. As such, its journey through the stranger regions of both popular and scientific culture has been quite appropriately picaresque.

In *Prehistoric Park*, the time-travelling (human) protagonist failed miserably to snare a *Meganeura* with a butterfly net, but succeeded eventually in capturing one with the help of a supersized water pistol. In the B-movie *Monster on the Campus* it was coelacanth blood that did the trick. A stray and perfectly contemporary dragonfly exposed to this elixir on the mild-mannered professor's desk rapidly reverse-evolved to Carboniferous proportions. Much good this did it, as the professor, forgetting his mild manners for a second, caught and killed the unfortunate throwback. And much good this act of palaeoinsecticide then did *him* as, in the melee, a drop of prehistoric dragonfly blood landed in his pipe which, when smoked, did its own reverse evolution stuff<sup>2</sup>. The ravaging and murderous Neanderthal<sup>3</sup> that resulted – mild manners now definitely on hold – kept the plotline humming along for the rest of the film.

The interpretation of *Meganeura* amid the shadier byways of science has been if anything yet more bizarre. The 19th-century autodidact Jean-Henri Fabre was justly called the 'insects' Homer for his beautiful and detailed biographies of insect and arachnid life, and Darwin praised him as an 'inimitable observer'. Fabre in turn appreciated Darwin's observations and corresponded with him, but was temperamentally opposed to any kind of theory, and through religious belief particularly opposed to evolution. Fabre was later approvingly quoted by a rather less Homeric character, one William J. Tinkle, as including *Meganeura* as an example that the strong have perished and the weak have endured (and therefore natural selection could not possibly work). The Tinkle oeuvre all told is itself fascinating, as noted by Stephen Jay Gould. At a time when the creationists were excoriating evolution as leading directly to eugenics and other horrors, Tinkle was both a creationist and avowed proponent of eugenics. These are storms turbulent enough to take down any dragonfly, no matter how impressively proportioned.

Poor *Meganeura*, though, would have been further confused by being used as prime evidence that it would have been easier to stay aloft in the Carboniferous, on account of it then being on a Reduced Gravity Earth. The reduced gravity – painstakingly laid out via impressive-looking equations and scale models – came about, it was said, because Earth then had a reduced mass, this being one of the variants of the Expanding Earth hypothesis. Proponents of an expanding Earth accept the idea of ocean spreading, but deny that subduction takes place, leaving for them only the vision of an Earth puffing up like a balloon about to pop. It's an idea that grew out of the exciting early days of plate tectonics – the pioneering oceanographer Bruce Heezen briefly adhered to it, before the significance of ocean trenches was realized – and then has hung on

<sup>1</sup> To be taxonomically truthful, a griffenfly, an early but seemingly not terribly close relative of today's dragonflies. But for this narrative the vernacular seems more appropriate.

<sup>2</sup> On second thoughts, perhaps C-movie.

<sup>3</sup> And so into perfect form to be supremely effective in university committee work.



amid ever-smaller and ever-more jealously protective communities of Expansionist geologists, who clutch not only at straws but in this case at the world's most famous prehistoric insect.

In less eccentric circles, *Meganeura* provides the title of the Palaeoentomological Newsletter – and so a sister to these pages (though not the title of the Worldwide Dragonfly Association newsletter, which is *Agriion*, originally the Greek for wild things of the open fields, and subsequently a genus of damselfly). With such notoriety, one could be forgiven for thinking that the Carboniferous forests were alive with giant dragonflies, perched on every branch of every giant fern, and flying off in swarms whenever an amphibian splashed by.

Perhaps not. *Meganeura monyi* remains based on the type material uncovered in a coal quarry at Commentry, in central France, in 1880 and described in a paper nicely commencing 'Sur un gigantesque Neurohoptère...' by Charles Brongniart five years later. One of the specimens figured looks beautiful, and seems nearly complete, but this species seems not to have been found since, at Commentry or elsewhere.

Related forms have turned up now and again. *M. monyi* seems, indeed, by a tiny margin, the second largest flying insect ever recorded, the palm going to *Meganeuropsis permiana* (or *Meganeuropsis americana*, held to be the same beast) with a 71 cm wingspan. And, in the town of Bolsover in Derbyshire a couple of large fossil dragonflies were found by coal miners, a few months apart in 1978. Belonging to two species, then poetically named *Erasipteron bolsoveri* ('Gracefully winged of Bolsover') and *Tupus diluculum* ('Dragonfly of the Dawn'), a subsequent appearance on *Blue Peter* sparked a brief flurry of what was locally described as dragonfly mania, complete with lapel badges. The first find was also nicknamed as the Bolsover Beast, which locals also knew full well not to confuse with the Beast of Bolsover, a.k.a. the Rt. Hon. Dennis Skinner, that magnificently combative Labour M.P.

Other insects have, naturally, turned up in Coal Measures and other strata. Brongniart himself dug deeply over the years into the Commentry strata and in 1893 came up with a doorstop of a monograph, of 493 pages and 37 folding plates devoted to 97 insect species assigned to 48 genera, including 'gigantic Mayflies' (though excluding the cockroaches, which were common enough for Brongniart to plan another monograph on). And in one ten-week field season in 1940 in Oklahoma, Frank Carpenter, Harvard Museum's keeper of fossil insects, and a colleague, reputedly found 5,000 fossil insects (including the *Meganeuropsis americana* wing, still the largest insect wing ever found).

Nevertheless, fossil insects seem to be, by and large, and amid the usual run of strata, rarities, with each find a little cause for celebration. And this scarcity now gives pause for thought, because it has suddenly become a little more important to know how many insects filled the skies, in times long past.

Not so long ago, the insects that surround us day by day seemed to most of us to be an eternal fixture, that we might shoo away as best we can, but that would always, given half a chance, bounce back to rudely buzzing health. That impression, though, may be off the mark to a disquieting extent.

One of the clues is an urban legend of relatively recent date, among both entomologists and car drivers of a certain age. This is the 'windscreen phenomenon' where in the years of Elvis and



the Beatles – and of Callas and Gobbi, too, just to even things up a bit – a car driven at night would soon accumulate an array of splattered bugs on the windscreen, which would then need to be cleaned off the next day (not an easy job, I recall, once the victims had dried and stuck down properly). These days, the cleaning duties seem nowhere near so heavy. It is some kind of indication that the total number of flying insects has declined significantly over a generation. How big a decline, and how significant?

The entomologists have not been idle over the last few decades, and declines in various groups have indeed been reported, with the more significant (to humans, that is) taxa such as pollinators – bees and suchlike – being of more central concern. But studies that are big enough and run long enough to seriously examine the windscreen phenomenon are few and far between – and difficult to fund consistently, in these impatient and cash-strapped days. And as one entomologist put it, ‘we have a pretty good record of ignoring noncharismatic species’ – a partiality that our own trade is not altogether immune from.

Enter the Krefeld Entomological Society, whose members had splendidly and patiently, year by year, collected flying insects by the same means (a tent-like device called a Malaise trap), in the same kinds of areas (nature reserves), and to the same protocols across their region of Germany for 27 years. The results were published last year<sup>4</sup>, and caused a ripple of shock to spread out among even hardened observers of global biosphere change. Between 1989 and 2016, the total mass of flying insects dropped by around 80%.

That is a large change, and may well be more or less representative of other parts of the world (though of course the scale of the ‘more or less’ and of the ‘other parts’ remains to be constrained by however much of the Krefeld spirit has been in action elsewhere). There are all kinds of questions set in train, such as what has caused the insect decline – habitat loss? – ploughing? – insecticides? – the progressive artificial lighting of the night skies? The relative balance of these and other factors seems far from being resolved. There are the knock-on effects, too, such as on insect-eating birds who suddenly have a fifth of the food supply they used to have, and on plants that need to be pollinated by a healthy standing crop of flying insects.

And modulating the scale of the responses to all of these questions is another, underlying, question: what is the real scale of the decline? After all, 1989 is by no means the beginning of mechanized agriculture, or of the widespread use of artificial pesticides, or of street lighting. The use of these modern marvels expanded dramatically in those halcyon post-WWII years, and pesticide residues (for instance) appear widely in sediments in the 1950s. Presumably these would have begun to knock the stuffing out of the insects even then, 40 years before the Krefeld team got down to their serious work.

And before then, the farmers of a slower and more gentle age were not exactly idle. The bucolic horse-ploughed fields and unkempt hedgerows that Constable painted were surely more insect-friendly than is the terrain of contemporary agribusiness, but those pre-industrial farmers could still wage pitiless war against the hexapods, when they put a mind to it. The determined and successful extinction of the once super-abundant Rocky Mountain locust of North America in the late nineteenth and early twentieth century is testament to that. The Constable landscapes were

<sup>4</sup> Hallmann *et al.* 2017.



a far cry, too, from the endless forests that dominated late Pleistocene interglacial mid-latitudes. So – where might one seek a sensible insect baseline, amid this long trajectory?

The fisheries biologists have been wrestling with this ‘shifting baselines’ dilemma for decades now as, in most parts of the world, the advent of super-efficient fishing by humans preceded any serious quantitative observations of fish populations by several centuries. What size were ‘normal’ fish populations, before the carnage started? This big question was left frustratingly opaque, to the extent that serious biological oceanographers have resorted to scouring the diaries written by the captains of Spanish galleons and pirate ships for clues as to how many fish there used to be in the sea, once upon a time.

How far, therefore, has the flying insect baseline shifted – and can palaeontology do anything to help? The experience of the lonely *Meganeura*, lost amid the almost endless strata of the Coal Measures, suggests that fossil insects are rarities, and that such a research quest would be doomed to failure before the hammer was even out of the rucksack. But in less antique strata, there are some intriguing possibilities.

Among the many byways of Quaternary palaeontology, beetles have long had their own special niche. Their wing-cases, often still beautifully iridescent when teased out of some interglacial mud, can reflect the twists and turns of Ice Age climate even more faithfully than can fossilized pollen; beetles can fly faster than forests can grow, after all. But this is still generally qualitative, not quantitative work. Working out the standing biomass of beetles from a handful of elytra, no matter how beautifully preserved, may be trickier. I recall the late doyen of this distinctive subdiscipline, Russell Coope, saying with his own inimitable emphasis that one could lay a fossil elytron from some ancient interglacial on top its modern equivalent so that it would fit like a glove. He thus made the point that these beasts, however sprightly when it came to sudden forced migration, evolved morphologically only at what one might call glacial pace – a metaphor that has itself now been thoroughly out-evolved by a growing realization of the extreme skittishness of Quaternary climate. Working out kilos of beetle per square kilometre from such evidence, though, seems beyond the reach of even paleontological optimism.

Among smaller insects that are less extravagantly iridescent but that have more direct means of attracting human attention, one wonders if there might be richer pickings, quantitatively speaking. Of the almost infinite number of Quaternary fossil proxies that seem now to be present, the use of fossil chironomids (midges to you and me) seems to be growing. The headcases and mouthparts of the larvae of these creatures are tough enough to be preserved in bog and lake sediments, abundant enough to be collected and counted in their hundreds (or thousands), the resulting numbers then being subject to the modern witchcraft of transfer functions to give estimates of such things as temperature, amount of dissolved oxygen, nutrient levels and salinity.

What is less clear is whether the fossil chironomid data tell one much about, well, chironomids, and particularly about how abundant they may or may not have been at particular times in the past. Given that midges (10,000 species globally and counting) make up some 20% of freshwater insects, they might, one would think, show some promise as a potential flying insect baseline proxy. Making this delicate enquiry of a Holocene chironomidologist, though, the answer was the email equivalent of a sharp intake of breath, pursed lips and furrowed brow. That’s a tricky one, was the general tenor of the response. The fossils being of the larvae, there is the uncertainty





of how many of these juveniles survive long enough to take to the skies. Some lakes are more midge-y than others, some midges will be harder-headed than others (taphonomically speaking), there are in any case good midge years and bad midge years, and the other 80% of flying insects might dance to a different ecological tune.

Still, perhaps it's worth furrowing the brow a little more to see if some ingenious new fossil proxy might emerge, to allow the modern insect decline to be placed in proper context. It seems a big enough problem in all respects for palaeontologists to exercise their considerable ingenuity on, especially if one keeps to the shallower end of geological time. In some purely methodological respects, though, it is a blessing that it's Quaternary-style and not Carboniferous-style flying insects that we need puzzle over as proxies. The bugspat windscreen, Carboniferous style, doesn't bear thinking about, while setting up a trap fit for the Meganeuridae would not be a task for the faint-hearted. Bolsover's beast might bite back.

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# Long-term career prospects for PhD students in palaeontology

A PhD is generally a necessary step in the development of a career in academic palaeontological research, in either university or museum sectors. Most palaeontology PhD students express, at least at the start of their PhD project, the desire to build an academic career that allows them to conduct research. However, there exists widespread concern about how difficult a career path this is, and how few opportunities exist to obtain long-term academic jobs. These concerns are certainly not new: we had exactly the same concerns during and after completing our own PhDs over a decade ago, and between us we acquired well over a decade of postdoctoral and fellowship experience before we finally obtained our first permanent positions. However, the growth in social media over the last 5-10 years has perhaps amplified these concerns among students and made them more widely visible.

A 2010 policy document from The Royal Society<sup>1</sup> included a widely-reproduced diagram (Figure 1) that attempted to quantify career routes for those completing a PhD in science in the UK. It suggested that around 30% of PhD graduates go into 'early career' research jobs (e.g. postdoctoral positions), but that many subsequently move into industry or non-academic jobs, and that only 3.5% of PhD graduates ultimately build long-term careers as permanent academic research

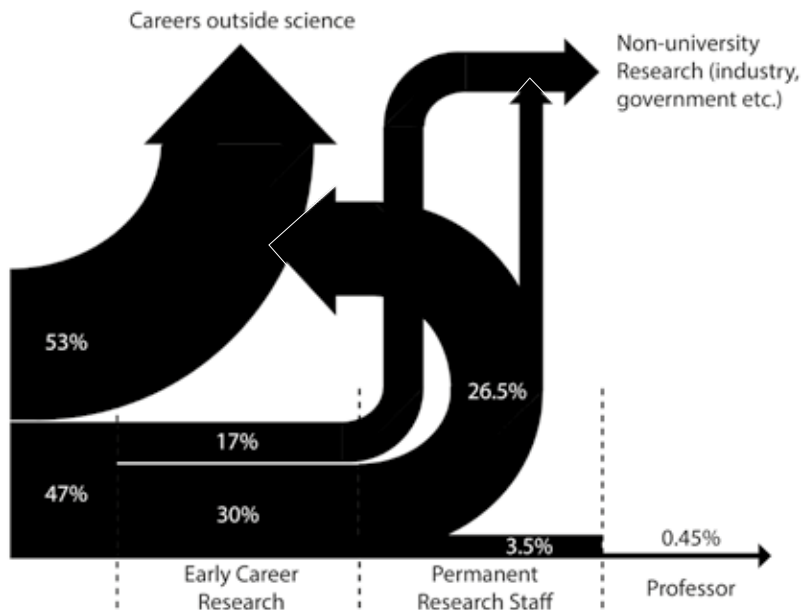


Figure 1. An illustration redrawn from the Royal Society report<sup>1</sup> of the estimated flow of PhD graduates into careers inside and outside academia.

<sup>1</sup> <[https://royalsociety.org/~media/Royal\\_Society\\_Content/policy/publications/2010/4294970126.pdf](https://royalsociety.org/~media/Royal_Society_Content/policy/publications/2010/4294970126.pdf)>.



staff. They also estimated that just 0.45% of PhD graduates become full professors. (It is worth remembering that in the UK only *c.* 12% of university academic staff have the title ‘professor’<sup>2</sup>, differing from the situation in many other academic systems.) In late 2017, *Nature* ran an editorial<sup>3</sup> in which they suggested that only 3–4% of UK PhD graduates will find a permanent staff position at a university. *Nature* did not specify the source of this number, but it seems likely to be based on The Royal Society figure of 3.5%.

We have seen these very low numbers contribute to concerns about careers among PhD students on social media and in our own research groups. But we have suspicions about the applicability of these statistics to palaeontology for several reasons.

First, the Royal Society’s report did not provide detailed information on their methodology. Second, their results are aggregated across the whole of science, and may include fields that train large numbers of PhDs for industrial careers. We are unaware of any previous attempts to estimate comparable values specifically for palaeontology. Third, based on our own experience the numbers seem implausibly low. They suggest that only 1 in every 29 palaeontology PhD students trained will go on to a long-term academic career, and that only 1 in every 222 palaeontology PhD students trained will become a professor. This would imply that the University of Bristol Palaeobiology Group, for example, would need to train 1,332 PhD students merely to replace the six professors currently listed among its staff members<sup>4</sup>. In fact, the Bristol Group list 42% of 144 PhD graduates since the late 1980s as having obtained permanent academic positions<sup>5</sup>, an order of magnitude higher than the Royal Society data. Is this example really so unrepresentative? To answer this question, broader palaeontology-specific data are needed.

Also of interest to us is the gender balance between those who successfully pursued academic careers after graduation, and those who chose, or were forced, to work outside academia. This is because there is clear evidence that there is a ‘leaky pipeline’ in academic careers for women<sup>6,7</sup>, meaning that proportionately fewer women go on to academic jobs than men. Initiatives such as the Athena Swan Charter<sup>8</sup> have been widely adopted across the higher education sector to attempt both to recognize and to rectify this problem. The Palaeontological Association has recently launched a diversity survey<sup>9</sup> and has started a mentoring scheme for academics and PhD students<sup>10</sup> in an attempt to identify and address some of the reasons that might make women (and other under-represented minorities) leave academia. But is there evidence to document the existence of a ‘gender problem’ in palaeontology? We suspect that there is, based on our own experiences. However, to our knowledge, little data exists to support such a claim.

<sup>2</sup> <<https://www.hesa.ac.uk/data-and-analysis/publications/staff-2015-16>>.

<sup>3</sup> <<https://www.nature.com/news/many-junior-scientists-need-to-take-a-hard-look-at-their-job-prospects-1.22879>>.

<sup>4</sup> <<http://palaeo.gly.bris.ac.uk/personnel.html>>.

<sup>5</sup> <<http://palaeo.gly.bris.ac.uk/personnel-recentmembers.html>>.

<sup>6</sup> <<http://blogs.lse.ac.uk/equityDiversityInclusion/2014/03/the-leaky-pipeline-women-in-academia/>>.

<sup>7</sup> Alper (1993).

<sup>8</sup> <<https://www.ecu.ac.uk/equality-charters/athena-swan/>>.

<sup>9</sup> <<https://www.palass.org/association/diversity-study>>; see also Fiona Gill’s update on this study elsewhere in the issue>.

<sup>10</sup> <<https://www.palass.org/publications/newsletter/palaeontological-association-needs-mentors>>; see also Emily Rayfield’s update on this program elsewhere in the issue.



Getting accurate data on long-term career pathways for palaeontology PhD graduates is challenging. Ideally, one would ask all academic departments that have historically trained palaeontology PhDs to provide details of their students, and then trace the subsequent careers of those individuals. Such information may not be available, however, or departments may be unwilling or unable to share it. Here, we use an alternative approach that represents a relatively crude first attempt at tackling this problem. *Progressive Palaeontology* is an annual conference sponsored by the Palaeontological Association, organized by PhD researchers within the UK palaeontological community, with the majority of presentations being made by PhD students (and to a much lesser extent, at least historically, by MSci, MSc and undergraduate students). It has been running for over thirty years, likely captures a relatively representative snapshot of the UK palaeontology PhD community in a particular year, and abstract volumes or meeting reports are readily available for most meetings. Thus, we decided to use the presenters at *Progressive Palaeontology* for the years 2000–2008 as our list of palaeontology PhD students, and track them through to the present day to get an estimate of those who remained in academic careers. This time span begins at the start of the 21st century and ends ten years prior to the present day, as we felt that ten years after attending *Progressive Palaeontology* should represent a substantial enough period of time to assess career prospects.

### **The data**

Although the issues that we discuss affect palaeontologists worldwide, our data can only address career prospects in the UK and Ireland. They represent a preliminary attempt to address these questions, and we recognize that the situation in other countries and academic systems might be very different.

We collated presenters at all *Progressive Palaeontology* meetings from 2000 to 2008, recorded the gender they identified as at the time, whether or not they were a PhD student, their institutional affiliation, their sub-discipline (coarsely characterizing individuals as belonging to vertebrate palaeontology, invertebrate palaeontology, palaeobotany, micropalaeontology or other), whether or not they are still in academia, and if not, their current career. We collected data about presenters from Google Scholar Citations, LinkedIn, Facebook, web searches, and our own knowledge or that of colleagues. We were unable to obtain all data for all presenters, particularly regarding the current careers of those who left academia and whom we do not know personally. We were able to find more data on presenters at more recent meetings, probably because of the widespread adoption of social media in the latter half of the time frame of our study. We defined 'still in academia' as those who had published a research paper in any academic discipline (not necessarily palaeontology) since 2016 and who appeared to be either currently or recently (since 2016) employed in an academic position in a university, museum or research institute. We excluded presenters who we could identify as having been MSc or MSci students and who did not go on to do a PhD in the UK or Ireland in palaeontology. We also excluded presenters registered for PhDs outside of the UK or Ireland, even if they subsequently worked in the UK or were British or Irish, on the basis that we were primarily interested in the career paths of PhD students in the UK and Ireland. Several students presented at more than one *Progressive Palaeontology*; we only counted each presenter once, at their first meeting, and excluded them from later meetings. The resulting dataset comprises 94 unique presenters from 27 institutions over the nine meetings, 43% of whom were identified as female and 57% of whom were identified as male. 41% of presenters were invertebrate palaeontologists, 34% were vertebrate palaeontologists, 11% were



palaeobotanists and 9% were micropalaeontologists, with the remaining 5% belonging to other sub-disciplines such as ichnology or sedimentology.

### **Long-term employment prospects in palaeontology**

Of the 94 presenters, 41 (44%) are still in academia according to our definitions. This percentage is higher than the Royal Society's estimate of 30% of science PhD students going into 'early career' academic positions, and an order of magnitude greater than the 3.5% of scientists the Royal Society estimated attain permanent jobs. It is in line, however, with the Bristol Group data, suggesting that the career outcomes of their graduates are not misrepresentative of the discipline as a whole. We have not attempted to assess which of our presenters have permanent jobs, for the following reasons: (1) it is difficult to ascertain the nature of an individual's contract from their web profile; (2) there are a variety of different routes into academia, some of which never result in a 'permanent' contract, for example some research fellow positions; (3) some of the individuals in our study are postdocs who may have permanent jobs in the future. Despite this, it seems clear that nearly half of the PhD students who presented at *Progressive Palaeontology* are still employed in the field and publishing at least ten years later, leading us to conclude that the prospects for medium- to long-term employment in palaeontology for UK and Irish PhD students are better than often suggested.

### **Does palaeontology suffer from a 'leaky pipeline' for women?**

The picture is less positive, however, when we examine the gender breakdown of those still in academia. Just 20% of female-identified PhD students who presented at *Progressive Palaeontology* are still in academia at least ten years later, in contrast with 61% of male-identified PhD students, indicating that females are leaving academia in droves. There are a number of widely-cited reasons that women may leave academia<sup>11,12</sup>; however, there currently exists no palaeontology-specific data.

We investigated gender differences among the sub-disciplines in order to discover whether this gender disparity was being driven by women in a particular field. Thirty-two of the presenters at *Progressive Palaeontology* from 2000 to 2008 were vertebrate palaeontologists and 66% of them are still publishing. Of these presenters, 31% (10) were female and 69% (22) were male. Three of the ten female presenters (30%) are still in the field. In contrast, a staggering 82% of male presenters (18) are still active researchers. Indeed, only four male vertebrate palaeontology students who presented at *Progressive Palaeontology* between 2000 and 2008 have left the field, and of those, three still regularly attend conferences and are thus part of the broader community even if they are not employed within academia.

Unfortunately, the data suggest that female invertebrate palaeontologists are even less likely to have a long-term career in academia than their vertebrate palaeontology counterparts. Thirty-nine invertebrate palaeontologists presented at *Progressive Palaeontology* between 2000 and 2008; 49% (19) were women and 51% (20) were men. Just 21% (4) of the women remain in academia, in contrast to 55% (11) of the men. It appears that invertebrate palaeontology has a lower retention rate than vertebrate palaeontology overall, but the prospects for female invertebrate palaeontologists are particularly poor. Among the nine women who presented in the sub-disciplines of palaeobotany and micropalaeontology combined, just one remains in the field.

<sup>11</sup> <<http://www.sciencemag.org/careers/2014/12/paradigms-and-prejudice>>.

<sup>12</sup> <<https://newrepublic.com/article/119363/why-there-arent-more-top-female-scientists-leaky-pipeline>>.



The difference in the retention rates of female and male palaeontology PhD candidates is shocking, and we must urgently examine what is leading to so many women leaving our field.

### **Alternative careers for PhD palaeontologists**

Our data on the careers of those who left academia are sparse, but the most common jobs among our sample are in museums, teaching or publishing. Many of these career paths still represent an active and substantial contribution to the palaeontological community, but do not include the research component that has been the primary focus of our analysis.

### **Final thoughts**

Early career palaeontologists have been despondent about the academic job market for as long as we have been in the field (and probably long before that), and yet our data suggest that prospects for PhD graduates to build an academic career are better than they are often portrayed. We believe that the last ten years have seen a substantial growth in the number of academic positions held by palaeontologists at universities in the UK, and this appears to have come about both through growth in numbers of palaeontologists at universities where the subject has long had a strong presence (*e.g.* University of Manchester, University of Leeds, University of Birmingham), but also through palaeontologists gaining positions in academic departments that have limited or no previous tradition in the subject (*e.g.* University of Brighton, University of Lincoln, University of Salford, Manchester Metropolitan University). Quantifying this apparent pattern and its potential drivers goes beyond our scope here, but we see no reason to suspect that this trend will stop in the immediate future, particularly with the Research Excellence Framework 2021 (and its inevitable linked upturn in recruitment) rapidly approaching.

Our message is less positive when it comes to prospects for women. Our data concern those entering PhDs ten or more years ago, and the situation and career chances for women may have improved over the last decade. But this clearly represents an area where we as a community need more data to better understand the barriers to career progression for women, and where we need to do more to support our female students, postdocs and academics. We applaud the initial steps that the Palaeontological Association is making to address this issue.

We strongly believe that those thinking of starting PhDs should receive realistic information on career prospects in academia, and be made aware of alternative career paths. Our admittedly imperfect dataset suggests that roughly half of UK palaeontology PhD students will still be engaged in academic research ten years after finishing their PhDs, and we consider that a reason to be positive about the long-term future of our discipline.

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**Susannah Maidment**

*Natural History Museum, London*

### **REFERENCE**

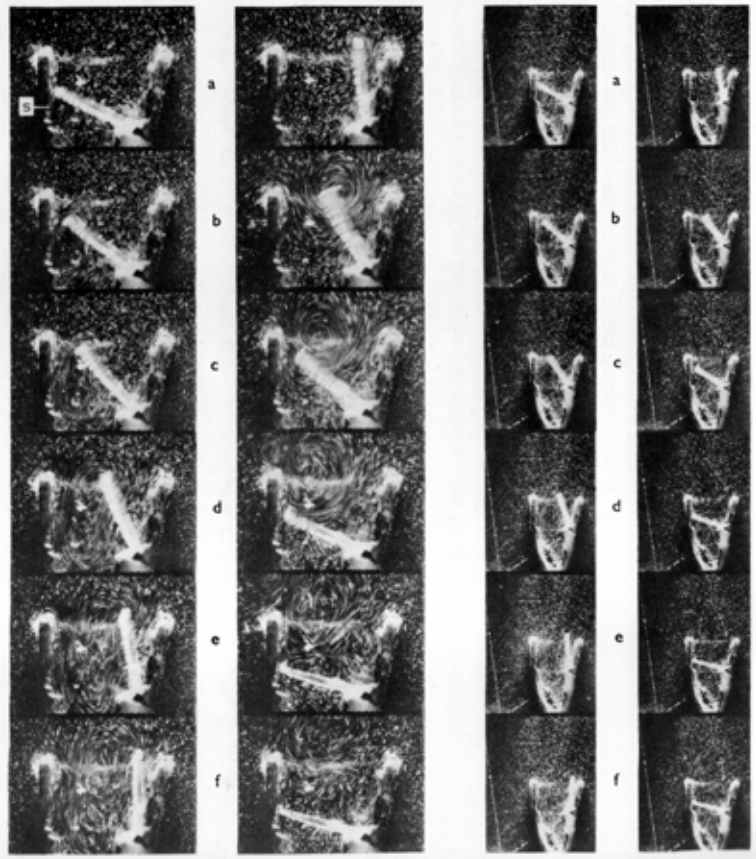
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## A bit of history: paradigms in palaeobiology

I was one of the 70 palaeontologists who in 1957 were at the inaugural meeting of what became the PalAss. However, I left the profession just a decade later, lured away by the equal intellectual challenges of the history of palaeontology and related sciences, and I imagine that for today's PalAss members what I did in the 1960s and 1970s has vanished into the mists of time. But recently David Sepkoski, author of *Rereading the Fossil Record* and other fine works on the modern history of palaeontology (and the son of the late Jack Sepkoski), urged me to write an account – with my historian's hat on – of what I and my students got up to at Cambridge during my first career, and how it fitted into the wider picture of what was going on in palaeontology in the second half of the 20th century. Last year I published a pair of articles on this, but in a periodical which, although well known in its own field, is unlikely to be seen by many PalAss members. The purpose of this note therefore is to summarize the content of these articles, and to give details of how they can be found (both are open access) by anyone interested to know more about the earlier background to some of today's research areas. Although these articles are partly autobiographical, it's not my intention to use them to rehabilitate, vindicate or celebrate my own earlier research, but simply to contribute a modest 'primary source' for the historical understanding of our kind of science (about which I remain as fascinated as ever, although now only as an outsider).

I begin by sketching how, in continental Europe before the Second World War, '*Paläobiologie*' flourished as an approach to palaeontology that put the accent on reconstructing the 'ways of life' of past organisms, rather than on the value of fossils for stratigraphical geology. My research advisor Oliver Bulman (an expert on graptolites and the second president of the PalAss) had earlier chosen to call himself a *palaeozoologist* – a highly unusual word in English at that time – and this was the label that I as his student adopted enthusiastically. I focused my research on the whole fossil record of the Brachiopoda, aiming to understand their morphology and evolution in terms of "growth, form and function" (taking inspiration from the classic works of D'Arcy Thompson and E.S. Russell). It is now difficult to convey how marginal this was to the mainstream of invertebrate palaeontology in the anglophone world in the 1950s and 1960s (the study of vertebrates was then largely separate, both intellectually and institutionally). My paper on "The feeding mechanism of the Permian brachiopod *Prorichthofenia*" (1961) was in fact the very first to be published in the then four-year-old *Palaeontology* with a title that signalled its intention to contribute to the biological tradition of functional morphology. I used it to illustrate what I proposed as a method of '*paradigms*' – using that then unusual word just a year before Thomas Kuhn made it widely familiar with a quite different meaning – as a way of rejecting the then common criticism that functional inferences about extinct organisms were inescapably speculative and therefore almost useless.



*Water currents induced in models of Prorichthofenia. From Rudwick 1961.*

In the following years I published a string of papers – several in *Palaeontology*, taking advantage of its fine collotype plates and its editor's tolerance of lots of line-drawings – in which I reconstructed other brachiopods in terms of their functional morphology. I tried to show the heuristic value of the paradigm method for testing rival hypotheses about the functions or adaptive significance of specific morphological features, and hence of whole 'ways of life'. Following the example of my senior Cambridge colleague the zoologist Carl Pantin, I argued for an evolutionary interpretation of 'organic design', in which natural selection would tend to optimize the adaptive features of an organism's morphology, but strictly within the dual constraints of (a) that organism's specific phyletic legacy and (b) what for any organism is physically possible "in this universe of ours" (in Pantin's memorable phrase). This emphasis on constraints should have forestalled – though in the event it didn't – any objection that the use of the paradigm concept assumed that adaptations are or ever can be '100% efficient': the 'paradigmatic' was to be clearly distinguished from the 'ideal'.





The second of my historical articles continues this narrative by tracing the expansion of this research in the later 1960s and, briefly, to the end of the century. In collaboration with my student Richard Cowen (who was subsequently at UC Davis), I tried to interpret the adaptive evolution of the Brachiopoda as a whole. At much the same time, my student Euan Clarkson (subsequently at Edinburgh, and much later a president of PalAss) published superb work on vision in trilobites, which helped substantially to bring functional morphology into the mainstream of what fully deserved to be called *palaeobiology*. Also in the later 1960s, my own fruitful encounter with youngish American palaeontologists such as Dave Raup and Steve Gould helped to integrate this work with new directions such as Raup's computer-aided 'theoretical morphology' and later – after I myself had left the field – with Dolf Seilacher's tripartite 'constructional morphology'. When the new American journal *Paleobiology* was launched in 1975 it promoted a wide range of research topics; but within a few years a growing focus on the computer-aided quantitative analysis of the fossil record, pioneered by Raup and Gould among others, led to a relative neglect of topics focused on the individual organism, such as functional morphology. And while Gould had earlier endorsed the paradigm method enthusiastically, his famous – or notorious – "Spandrels of San Marco" paper (1979) dismissed it as no better than Kipling's *Just-So Stories* for children, apparently because he had become convinced that its accent on well-adapted structures was incompatible with the new emphasis in evolutionary theorizing on non-functionality. By this time his status as a 'public intellectual' was such that his startling volte-face about functional studies in palaeontology had a profoundly negative impact (though we remained personal friends, and I think he appreciated my later research on the history of palaeontology and the Earth sciences).

My historical narrative and analysis of 'palaeobiology' runs out of steam around the end of the 20th century, but I hope it will be of interest to some currently active members of PalAss. Certainly I hope my articles will be found useful in future to anyone who wants to look further into the fairly recent history of this fascinating science.

**Martin Rudwick**

*University of Cambridge*

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



### **New perspectives on evolution in molluscs: from fossils to next generation sequencing**

Flett Theatre, Natural History Museum, London    *21 March 2018*

The Malacological Society of London and the Natural History Museum, London are co-hosting this special day-long symposium to celebrate the Society's 125th AGM. Talks from world-renowned experts will cover aspects of life history and evolution in the phylum Mollusca ranging from pharmacology, palaeontology, and chemosymbiosis to larval development and shell structure. Although focused on molluscs, these talks will be of interest to evolutionary biologists, biogeographers, marine biologists and palaeontologists. The meeting will run from 10am to 5:10pm in the Flett Theatre, NHM, and will be followed by a wine reception. The meeting is free but registration is necessary. Please register by e-mail to <[MSL-events@nhm.ac.uk](mailto:MSL-events@nhm.ac.uk)>.

See <<http://malacsoc.org.uk/meetings/125th-anniversary-symposium-agm/>> for details.



### **European Geosciences Union (EGU) General Assembly 2018**

Vienna, Austria    *8 – 13 April 2018*

The EGU General Assembly 2018 will bring together geoscientists from all disciplines of the Earth, planetary and space 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. The PalAss will continue to give its support to sessions under the Division on Stratigraphy, Sedimentology and Palaeontology, and for 2018 is sponsoring two sessions via the Grant-in-Aid scheme, SSP4.3 'Advances in palaeobiological modelling' and SSP4.4 'Geochemical-palaeobiological interactions throughout Earth history'. Abstract submission is now closed.

Please see the website for more details: <<https://egu2018.eu>>.



### **3rd International Meeting of Early Stage Researchers in Palaeontology (IMERP)**

JuraPark, Krasiejów, Poland    *18 – 21 May 2018*

The 3rd IMERP will be held in Krasiejów, organized by the doctoral students at Opole University. This meeting follows on from the successful meetings in Alpuente, Spain in 2016 and Sigrí, Greece in 2017. The IMERP events are a forum for pre-graduate, graduate and post-graduate researchers, providing a platform to discuss collaborations and present research in a friendly environment. This year international guest speakers have been invited in the following fields: Scientific Communication, Extinction Events, Evolutionary Patterns, Dating in Stratigraphy, and Popularization of Palaeontology. Abstract submission is already closed but registration remains open until 30th April. The conference fee is only €65 (including accommodation, food, and entrance to the parks).



Please see <<https://www.facebook.com/3rdIMERP/>> for more information, or e-mail <[paleontology@uni.opole.pl](mailto:paleontology@uni.opole.pl)> to request a copy of the third circular.



**Uncovering Yorkshire's Jurassic**

Yorkshire Museum, York, UK 19 – 20 May 2018

On 23rd March, Sir David Attenborough will open 'Yorkshire's Jurassic World' at the Yorkshire Museum in York. This will be the first new palaeontology/geology exhibition in the Museum for nearly a decade. To celebrate the event, the Yorkshire Philosophical Society, York Museums Trust, Yorkshire Geological Society and the University of Hull are organizing a one-day public symposium to reveal the scientific research behind many of the exhibits. 'Uncovering Yorkshire's Jurassic' will take place on Saturday 19th May in the Tempest Anderson Hall at the Yorkshire Museum, and will be a free, public symposium, open to all. Speakers at the event include Sarah King (Yorkshire Museum), David Bond (University of Hull), Elsa Panciroli (University of Edinburgh) and Cris Little (University of Leeds); topics will range from the end-Triassic extinction to the mammals of Skye. It is also planned to run a field-trip to the Jurassic of North Yorkshire on Sunday 20th May.

For further details, and to register your attendance, please visit the symposium website at <<https://www.eventbrite.co.uk/e/uncovering-the-yorkshire-jurassic-symposium-19th-may-2018-tickets-42530157847>>.



**Des journées de rencontre autour du patrimoine minier de la Corniche angevine (JRPM 2018)**

Maine et Loire, France 3 – 7 June 2018

The meeting aims to put a spotlight on geological and palaeobotanical mining heritage, and to make it known to the wider public in the geographic region. Located in the Loire valley near Chalonnes-sur-Loire and the historic Chapelle de Sainte Barbe des Mines, the meeting will consist of four days of talks, discussions, a field-trip, exhibitions, and meetings with schools and the public. Abstract submission will commence shortly and registration is open until 30th April 2018.

Please see further details online, at <<https://jrpm2018.eu/>>.



**IGCP 653: The Onset of the Great Ordovician Biodiversification Event**

Ohio University, USA 3 – 7 June 2018

The third annual meeting of IGCP 653 will be hosted on the campus of Ohio University in Athens, Ohio. The scientific sessions in Athens include a mid-conference field-trip to classic Cincinnati (Katian) sections. The indoor sessions will be preceded by an excursion to late Cambrian through Ordovician outcrops of the Great Basin and followed by an excursion through Katian stratigraphy and palaeontology of Kentucky. Participants will discuss and observe sedimentological, biological



and ecological changes across the GOBE and the resulting ecosystems. Contributions on all aspects of the late Cambrian through Ordovician Earth system are welcomed. Abstract and early registration deadlines are 15th March 2018.

More information is available on the meeting website: <<http://igcp653athens2018.wordpress.com>>.



### 15th Larwood Bryozoan Symposium

Cardiff, UK 6 – 8 June 2018

The Larwood Conference is an international meeting for both palaeontological and zoological bryozoan researchers, held every three years. Larwood symposia are held in Europe in the intervening years, this year in Cardiff. Papers and posters describing new work are welcomed from established scholars and students. This is a forum for informal discussions and a place where PhD students often present their first talk to a specialist audience. The dialogue between zoologists and palaeontologists enhances existing research and frequently results in the development of new interdisciplinary collaborations. The 15th Larwood Symposium will be held in Wales at Amgueddfa Cymru – National Museum Wales located in the centre of Cardiff. During the meeting there will be the opportunity to look around the museum exhibitions and to have behind-the-scenes tours. There will also be a field-trip to the Big Pit National Coal Museum.

Contact Caroline Buttler for more information: <[Caroline.Buttler@museumwales.ac.uk](mailto:Caroline.Buttler@museumwales.ac.uk)>.



### FORAMS 2018

University of Edinburgh, UK 7 June 2018

Papers investigating the impacts of our changing world on foraminifera are welcomed. Contributions are sought on topics ranging from foraminiferal biology, evolutionary and population dynamics to molecular works on single-cell genomics and environmental genomics. Papers are also invited that discuss the impacts of our changing world on foraminiferan geochemical and biomineralization responses to multi-stressor events and biogeographical perturbation. Papers incorporating all aspects of applied micropaleontology, for biomonitoring and industry, are encouraged. The Symposium will also celebrate the 50th year anniversary of ocean drilling (IODP), and the history of foraminiferal research featuring the role of micropalaeontological schools with two dedicated sessions. FORAMS 2018 will also host the TMS Spring Forum and Nanno Group Meeting on Friday 22nd June 2018. FORAMS 2018 specialist workshops will follow the Congress and will be hosted at the nearby coastal university town of St Andrews. The reception will include a ceillidh, and there are several field-trips planned to showcase the geology of Scotland. Registration is now closed.

See the website for more details: <<http://forams2018.wp.st-andrews.ac.uk/>>.

**International Palaeontological Congress (IPC5)**

Paris, France 9 – 13 July 2018

The IPC is organized every four years under the auspices of the International Palaeontological Association (<[www.ipa-assoc.org](http://www.ipa-assoc.org)>). After Sydney (Australia) in 2002, Beijing (China) in 2006, London (UK) in 2010 and Mendoza (Argentina) in 2014, it will convene in Paris (France) in 2018. The organizing committee are ready to welcome you to France for “the Fossil week”, the fifth edition of the International Palaeontological Congress. This event is a unique opportunity for the palaeontological community to present new results and discuss all aspects of the discipline. There will be 42 scientific sessions. Field-trips are planned pre- and post-congress, throughout France, Belgium and Italy. Travel grants will be available to student members of PalAss; see <[www.palass.org](http://www.palass.org)> for information.

Registration is now open and abstract submission has been extended to 8th April 2018. For more information see the website: <<https://ipc5.sciencesconf.org/>>.

**International Conference on Ediacaran and Cambrian Sciences**

Xian, China 11 – 21 August 2018

This is a joint meeting of the Ediacaran and Cambrian subcommissions and will feature three days of topical sessions focusing on Neoproterozoic–Cambrian life and environments. Pre- and post-conference field excursions will be arranged. Registration and abstract submission are open until 30th June 2018, at <<http://www.icecs2018.org/>>.

See the circular for more information: <<http://www.icecs2018.org/uploadfile/2018/0108/20180108041255836.pdf>>.

**10th European Palaeobotany & Palynology Conference (EPPC)**

University College Dublin, Ireland 12 – 17 August 2018

The organizing committee would like to extend a warm welcome and invite you to Dublin in August 2018 to attend the 10th EPPC. The disciplines of palaeobotany and palynology are integrative and multidisciplinary by nature. As a community we are constantly seeking new tools and techniques to answer both long-standing and new questions. Palaeobotanists and palynologists demonstrate a strong history of partnership with disciplines that are outside our core biological and geological fields of research, such as with chemistry, physics, maths and computer science. Our community have been early adopters of state-of-the-art technology in visualization, experimentation and chemical analyses to name but a few. The theme for EPPC 2018 ‘A Multidisciplinary Science’ seeks to highlight multi- and inter-disciplinarity in palaeobotanical and palynological research, past, present and future. We aim to showcase disciplinary diversity in palaeobotanical and palynological research through themed and open sessions, via demonstrations of new technology platforms in a dedicated exhibition space, and during post-conference field excursions. Abstract submissions are now closed.

See the website for more details: <<http://eppc2018.ie/>>.



**Crossing the Palaeontology – Ecology Gap (CPEG)**

University of Leeds, UK 30 – 31 August 2018

This meeting is designed to bring palaeontologists and ecologists together to share ideas, data and methods in areas that are studied by both, but typically independently. These research areas include, but are not limited to, biogeography, community and population ecology, food web dynamics, and extinction selectivity. We invite all those interested in ecology, at any temporal and spatial scale, to present their research and attend this integrative meeting. Abstract submission and early registration close on 1st June 2018.

Please see more details at <[www.cpeg.org.uk](http://www.cpeg.org.uk)>.



**GeoBonn 2018**

Rheinische Friedrich-Wilhelms-Universität Bonn, Germany 2 – 6 September 2018

The German Paläontologische Gesellschaft (PalGes) meeting will be held in Bonn in 2018 as part of the Annual Conference of the Deutsche Geologische Gesellschaft. Topics will include Fossil Ecosystems, Fossilization and the quality of the fossil record, and Applied and industrial micropalaeontology; talks should be presented in English. Abstract submission will open shortly.

See the website for more information, at <<http://www.geobonn2018.de>>.



**66th Symposium of Vertebrate Palaeontology and Comparative Anatomy and the 27th meeting of the Symposium of Palaeontological Preparation and Conservation**

Universities of Manchester and Salford, UK 5 – 7 September 2018

SVPCA is a meeting for current research in vertebrate palaeontology and comparative vertebrate anatomy, and has been held annually in the UK, Ireland or France since 1953. The meeting is held in conjunction with SPPC, a forum for discussion of fossil preparation, conservation and related topics co-organized with the Geological Curator's Group. The 2018 SVPCA and SPPC meetings will be held jointly at the Universities of Manchester and Salford with two days of meetings and a field-trip. The Jones-Fenleigh Fund is available to help delegates with no institutional financial support to attend the meeting.

Please see the website for details: <[http://svpca.org/years/2018\\_manchester/](http://svpca.org/years/2018_manchester/)>.



**The Micropalaeontological Society 6th Silicofossil and Palynology Joint Meeting 2018**

Plymouth University, UK 5 – 8 September 2018

The 6th Silicofossil and Palynology Meeting will be held at Plymouth University with lectures and posters on 5th – 7th September and a field excursion on 8th September. A call for contributions



will be made early in 2018. Local organization will be provided by Prof. Malcolm Hart, Dr Meriel FitzPatrick, and Dr Christopher Smart.

Information will be made available shortly; please direct comments, requests for information *etc.* to <M.Hart@plymouth.ac.uk>.



**78th Society of Vertebrate Paleontology Annual Meeting (SVP)**

Albuquerque Convention Centre, USA 17 – 20 October 2018

Each year, vertebrate palaeontologists, preparators, writers, artists and enthusiasts convene to share the latest research, attend workshops and field-trips, and meet new fossil fans as well as old friends. It's the world's foremost forum on vertebrate palaeontology, usually referred to simply as 'SVP'. The 78th Annual Meeting of the Society of Vertebrate Paleontology will be held in Albuquerque, New Mexico.

Visit <[www.vertpaleo.org](http://www.vertpaleo.org)> for up-to-date meeting information.



**Linnean Society Palaeobotany and Palynology Specialist Group Meetings**

Burlington House, London, UK 21 – 22 November 2018

The 2018 autumn meetings of the Linnean Society Palaeobotany and Palynology Specialist Groups are open to anyone interested in palaeobotany or palynology and related fields. Attendance is free and advance registration is not necessary. The meetings will be held at the Linnean Society, Burlington House, in Piccadilly on consecutive days. For further information on the palaeobotany or palynology meetings, please contact Peta Hayes, (e-mail <[p.hayes@nhm.ac.uk](mailto:p.hayes@nhm.ac.uk)>) or Barry Lomax (e-mail <[barry.lomax@nottingham.ac.uk](mailto:barry.lomax@nottingham.ac.uk)>), respectively.



**JK2018**

Muséum d'histoire naturelle, Geneva, Switzerland 5 – 7 December 2018

The aim of JK2018, the International Meeting around the Jurassic–Cretaceous Boundary, is to discuss eustatic, biological, physiographical, geochemical *etc.* events at/near the boundary (*i.e.* over an interval of time spanning the Kimmeridgian to the Hauterivian, with a special focus on Tithonian to Valanginian strata). Details will become available in due course.

Please check the website for updates: <<http://php5.univ-brest.fr/conference/ocs/index.php/JK2018/JK2018>>.



**3rd International Congress on Stratigraphy (STRATI 2019)**

Università degli Studi di Milano, Italy 2 – 5 July 2019

Following the highly-successful first meeting held in Lisbon (Portugal) in 2013 and a second held in Graz (Austria) in 2015, the 3rd International Congress on Stratigraphy will be held in Italy. The Congress venue is Milan, in the historic buildings of the University, with pre- and post-congress field-trips to the Alps, Appennines, and the Italian islands.

For more information please e-mail <[info.strati2019@unimi.it](mailto:info.strati2019@unimi.it)>.

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*Please help us to help you! Send announcements of forthcoming meetings to*  
<[newsletter@palass.org](mailto:newsletter@palass.org)>.

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# Meeting REPORTS



**61st Annual Meeting of the Palaeontological Association**  
Imperial College London 17 – 20 December 2017

After the welcoming address **Graeme Lloyd** opened the Symposium using theropods to highlight difficulties in interpreting morphospaces. **Russell Garwood** introduced the new software EvoTree and EvoSim which allows for experimenting on simulated evolutionary models. **Natalie Cooper** highlighted how decisions about time-binning disparity datasets can change the results of the study. The Symposium was wrapped up by **Lee Hsiang Liow** who used bryozoans, brachiopods and bivalves to model both inter- and intra-specific biotic interactions in the fossil record.

The Symposium was followed by an icebreaker in the Queen's Tower Rooms where members were treated to beverages and canapés, mixed with old friends and new, and could look at portraits from the Bearded Lady Project.

The following morning started off with three parallel sessions in the Royal School of Mines. Session 1a focused on Cambrian and pre-Cambrian fossils. Session 1b was dedicated to new understandings in Mesozoic reptiles. Palaeobotany was the theme of session 1c.



*President Paul Smith addresses the Annual Dinner. Photo: Jo Hellawell.*

After the break and poster session A, talks resumed in three more consecutive sessions. Session 2a focused on Cambrian–Ordovician invertebrates including talks by **Xiaoya Ma** on a new species of worm *Inquicus fellatus* that infested other worms, making it the earliest evidence of metazoan symbiosis. Session 2b was dedicated to the effects of environmental change on animals in the fossil record. **Maximilian Stockdale** linked rates of body size evolution with cooling temperatures in Crocodylomorpha. Session 2c dealt with early tetrapods. **Jason Pardo** presented on a new species of Nectridea which supports polyphyly in Lepospondyli.

After lunch, members gathered in the Sir Alexander Fleming Building for the next round of talks. These covered a wide range of topics including from **Orla Bath Enright** whose experimental sedimentation and taphonomy experiments of polychaetes indicate that the Burgess Shale fauna was transported, and from **Evan Saitta** who proposed a new approach for identifying sexual dimorphism in extinct taxa.



Following a short break there were another four talks, including **David Bottjer** who showed how genes that allow organisms to biomineralize or to burrow have had a huge impact on how Earth systems have changed over time.

This was followed by the Annual General Meeting and then by the Annual Address given by **Mark Purnell** who presented on 101 uses for a dead fish, where members got to see and, thanks to cleverly hidden vials, smell the decay sequence of lampreys.

With the smell of lamprey cleared from their noses members moved on to the Millennium Hotel for the Annual Dinner. During dessert, members were treated to a PalAss first in the form of a plasticine fossil building competition.

The following morning began with another three parallel sessions. In session 5a **Cedric Aria** explored disparity through time in Euarthropoda. In session 5b **Rachel Belben** used Jurassic brachiopods to highlight the benefits and problems with using digitized museum collections to measure body size. Session 5c had a fishy theme where **Martin Ruecklin** looked at how early Osteichthyes resorbed their teeth prior to replacing them.

After a quick coffee break and poster session B, the final set of three parallel sessions began. In session 6a **James Lamsdell** looked at the gills of a eurypterid which indicated that they were similar in morphology to horseshoe crabs. In session 6b **Emily Rayfield** analysed the jaws of early mammals and found that miniaturization allowed for jaw modification, challenging the traditional hypothesis. In session 6c **Bas van de Schootbrugge** showed that butterflies with sucking proboscises predated angiosperms.

After a lunch break, members gathered in the Sir Alexander Fleming Building for the next round of talks. **Emma Randle** showed that jawed fish preyed on jawless fish, but this did not lead to the latter's demise. **Catherine Klein** used molecular clocks to show that all modern snakes originate from five lineages that survived the K-Pg mass extinction and that one of these clades diversified in the Paleogene. After a quick coffee break there were four more talks, including by **Robert Lemanis** who used FEA to challenge the hypothesis that complex septal walls in ammonites evolved to



*On the field-trip to the Isle of Sheppey. Photo: Jo Hellawell.*



support increased hydrostatic pressure. On the final day of the Conference there were two field-trips. One was to Downe village for a visit to Darwin's house while the other was to the Isle of Sheppey for a fossil hunt.

Congratulations are due to **Christopher Nedza** for his poster on taphonomic controls on melanin-bearing tissues in lamprey. Two President's Prizes were awarded, to **Ross Anderson** for his talk on the mineralogy of Burgess Shale-type fossils and how this can help us identify new sites; and to **Jordan Bestwick**, on using tooth microwear to investigate dietary ecology in pterosaurs. This year's Annual Meeting was a roaring success with huge thanks owed to Mark Sutton and co-organizers who put together a really enjoyable meeting with a huge wealth of presentations.

**Aodhán Ó Gogáin**

*Trinity College Dublin*



**8th International Meeting on Taphonomy and Fossilization (TAPHOS2017)**

Vienna, Austria 14 – 17 September 2017

The 8th International Meeting on Taphonomy and Fossilization attracted numerous taphonomists, palaeontologists, anthropologists, ecologists and biologists from Australia, India, Italy, Poland, Spain, USA and many more countries to visit the beautiful and heritage-rich Austrian city of Vienna. The Taphos conference has quite a long history, established originally in Madrid, Spain in 1990. This conference soon became popular with scientists working in the field of taphonomy and fossilization from all over the world and was promptly promoted to an international conference with subsequent meetings in Spain, Germany and Italy. The 2017 meeting was organized and hosted by Martin Zuschin (University of Vienna, Austria) and Mathias Harzhauser (Natural History Museum of Vienna, Austria). Although Vienna's flair is characterized by grandiose buildings and a picturesque setting, all eyes stayed focused on the conference's topic: taphonomy.

During the pre-conference field-trip, the organizers and their associates led the participants through iconic Neogene outcrops and introduced these ancient ecosystems with the advantages of first-hand research and long-term experience of working on the material. One of the highlights on this field-trip was a visit to Krahuletz-Museum in Eggenburg, where local fossil treasures captured the interest of the followers. Another highlight was the Fossilienwelt Weinviertel, where 17 Ma giant oysters form the largest known fossil oyster bank in the world.

After the field-trip, the icebreaker was held at the Natural History Museum Vienna. The Conference opening was accompanied by passionate debates and fine finger-food and beverages. Andreas Kroh (Natural History Museum Vienna) guided interested attendants through the Museum, describing its historical background and architectural finesses. Both the historical and physical climax was reached at the Museum's rooftop, providing a terrific (though windy) view over the roofs of Vienna where Andreas described the epochal past of the surrounding area. Altogether, this day heralded a great start to the meeting.

The first technical day of the Conference opened with a welcome speech by **Martin Zuschin** and was followed by two morning sessions including ten oral presentations on fossilization processes and their results in the fossil record. In contrast to the morning presentations, which ended on the topic of small fossils, the eight afternoon talks began with presentations on marine mammals, followed



by a vivid discussion on this topic. Other presenters showed the significance of modelling the fossil record to obtain a more precise estimation of ancient communities. Reasonable breaks in between the sessions helped keep delegates focused on the demanding topics and always offered the chance for a chat at any of the 30 posters exhibited in the coffee area. After the oral presentations, the posters invigorated numerous discussions and shortened the waiting for the evening BBQ where a culinary feast was provided.

The second and last day of the topical sessions started with death and destruction, marine aliens and the like, after which the audience heaved a sigh of relief when these thrilling topics changed into 'safer' statistical methods investigating ancient life. After a coffee break, the session continued with taphonomic details on shelly invertebrates from the Cretaceous to modern environments. The ten presentations in the morning sessions were followed by three talks on prehistoric vertebrates and their signals in the fossil record. The oral sessions then ended with a coffee break at the posters for final discussions after which a referendum was held to choose the venue for the next Taphos meeting, in 2020. Following a unanimous decision, the birthplace of the Taphos Meeting, Madrid, will host the next conference. In the last announcement, **Martin Zuschin** gave the closing speech and invited all participants for dinner at a "Heurigen", a traditional Austrian vineyard tavern. The dinner, supported by Vienna's mayor, facilitated further exchange of ideas and discussions.

After these exciting technical sessions, the post-conference field-trip brought us to important Miocene stages of the Paratethys Sea where we were introduced to ancient reef structures. Despite the rain, this post-conference field-trip was as enjoyable as the preceding days of the meeting.

In conclusion, the 8th International Meeting on Taphonomy and Fossilization was a memorable, well-organized and rewarding conference. At this place, again, thanks to the organizers, the scientific committee and all helpers for this wonderful Taphos meeting in the heart of Vienna.

### **Tobias B. Grun**

*University of Tübingen*



*Mathias Harzhauser (Natural History Museum Vienna) explaining the geological background of the Burgschleinitz Formation of the Kirchenbruch outcrop during the pre-conference field-trip.*



*Oleg Mandic (Natural History Museum Vienna) introduces the municipal sandpit of the Burgschleinitz and Gauderndorf Formation where manatees from ancient times have been recovered.*

**Advances in Computational Paleobiology at the Geological Society of America****129th Annual Meeting**

Seattle, Washington, USA 22 – 25 October 2017

The only thing I really knew about Washington State's largest city before visiting for the first time last October was that the best way to convey the weather in the West of Scotland to an American was to say, "it's just like Seattle" – that, and that the locals made really good coffee. Fortunately for the 8,000 geologists and palaeontologists attending the Geological Society of America (GSA) Annual Meeting, the city delivered on just one of these reputations. The weather was uncharacteristically warm and dry, enough to enjoy lunch outside, while the many coffees were delicious.

An enormous number of palaeontologists attend the GSA meeting each year so it provides an excellent venue to catch up with old pals and a chance to make new ones. A highlight of this meeting for me was connecting for the first time with many of the contributors to methods in *Computational Palaeobiology*. This term broadly defines the application and development of computational and statistical methods used to understand the evolution of life. This isn't a new field of research – indeed, many of the pioneering computational methods used in palaeontology were published during the last century – but the field is fast-evolving in many directions, especially as palaeontology collides with other disciplines, and it's already intractable for any one individual to keep on top of all the advances and literature published in this area.

With this in mind, together with **Alexander Dunhill** (University of Leeds) and **Erin Saupé** (University of Oxford), I co-organized a Palaeontological Association and Paleontology Society sponsored session on *Advances in Computational Paleobiology* and an accompanying workshop on *Phylogenetic Modelling*, led by **Michael Landis** (Yale University). Our goal was to bring together researchers working on diverse aspects of this field, to provide an overview of recent advances and the impact these have had on our understanding of the fossil record, but also to emphasize the challenges we face. The resources being developed and the problems encountered by different computational researchers may be unknown but highly relevant across sub-disciplines. For example, those developing theories for statistical analysis may be unaware of the challenges faced in generating comprehensive taxonomic and stratigraphic databases required for the robust application of their methods. Similarly, those doing the most intense data collection may not be aware of the caveats and the underlying assumptions of available statistical models.

**David Wright** kicked off the session on the subject of *Phylogenetic Palaeobiology*, describing the elegant use of phylogenetic comparative methods to study morphological diversity among crinoids. This segued into talks about both the challenges and importance of modelling stratigraphic uncertainty in estimating key parameters in phylogenetics and macroevolution by **Peter Wagner** and **Steve Wang**. Our first keynote speaker **Michael Landis** described an approach for dating species divergence times using a model of biogeography, in the absence of fossil occurrences. Next, **Drew Muscente** and **Adiël Klompmaker** moved us on to the subject of palaeoecology, outlining statistical and network-based approaches to inferring ecological interactions in Phanerozoic and Neoproterozoic communities. **Peter Smits** went on to talk about modelling change in functional diversity among Cenozoic mammals and **Daniel Dick** described a machine learning approach to inferring ecological niches.



**Judith Sclafani** presented the first talk of the session focused on methods for data collection and presented *Structure from Motion*, an efficient way of obtaining data for morphometric analysis that can be achieved using a standard camera phone. Our second keynote speaker **Lee Hsiang Liow** then talked about the tricky business of inferring causality in the fossil record and gave an overview of methods used to link causal mechanisms to patterns observed in palaeontology. **James Boyle** took us back to the theme of biogeography and showed using simulations that different approaches to measuring geographic range size can have different implications for establishing extinction risk. Our final keynote speaker **Shanan Peters** talked about advances in the automation of database generation using tools for extracting specimen data from the literature (known as GeoDeepDive) and linking this output to the Macrostrat database to obtain contemporary age estimates. **VJP Syverson** next described the scope and challenges of quantifying the impact of natural history collections on the published literature. It should come as no surprise that specimens with the “highest impact” are dinosaurs. Returning to the use of simulated data, **Steven Holland** described a modelling framework used to examine the impact of tectonic processes on metacommunities and their contribution to regional versus global diversity patterns. Rounding off the session, **Scott Lidgard** discussed living fossils as providing a useful conceptual framework for directing the application of new methods in palaeontology, and finally **Michael Urban** introduced machine learning imaging techniques for discriminating among species of grasses.

Beyond our session, computational methods infiltrated many of my favourite talks and sessions throughout the GSA meeting, especially the session on *Integrating Paleontological and Neontological Approaches to Macroevolution* (organized by **Shan Huang**, **Paul Harnik** and **Lee Hsiang Liow**) and the numerous sessions incorporating phylogenetics. In particular, I enjoyed hearing **Sandra Carlson**'s perspective on the uncertainty inherent in the taxonomy and phylogeny of brachiopod species, and the necessity to incorporate taxonomic practices into our phylogenetic models. It was also great to hear some of the talks from the New Voices in Geobiology session, which provided an explicit platform for early career researchers and students, including undergraduate **Stephanie Plaza-Torres**, who gave an excellent talk on her work using geochemistry to unravel the diet of dinosaurs.

In addition to providing easy access to quality coffee and cheeky beers, the Washington State Convention Centre was an excellent conference venue – all the palaeontology sessions were held in the same location, presenting plenty of opportunities to bump into friends. I also got a lot out of the poster session I participated in and had the pleasure of presenting alongside **Laura Soul**, also a contributor to the field of *Computational Palaeobiology*, who was presenting her work comparing different methods for estimating diversification rates using simulated data.

Finally, I was really pleased to see the efforts of several societies, including GSA, in promoting diversity and equality in the Earth Sciences. A much sought after conference trinket was the Paleontology Society Mary Anning “button” (this is the American word for badge) for the promotion of women in palaeontology, to accompany a reception on this theme. Despite my efforts, I failed to obtain one until the very last day when my session co-convenor Erin presented me with one, having



located the end of the stash. I came away from the meeting full of (coffee) beans, feeling inspired and optimistic about the future of computational methods in palaeontology, and happy not to have unpacked my heavy-duty raincoat.

### Rachel Warnock

*ETH Zurich*

### Acknowledgements

We are grateful for Grant-in-Aid number PA-GA201709 from the Palaeontological Association that supported the attendance of two keynote speakers.



### 26th International Workshop on Plant Taphonomy

University of Göttingen, Germany 24 – 26 November 2017

After a cosy icebreaker on a cold, rainy Friday night, the meeting officially started on Saturday morning, hosted and chaired by Eva-Maria Sadowski, Leyla Seyfullah, Alexander Gehler and Alexander Schmidt from the department of Geobiology in Göttingen. The conveners welcomed 24 participants from six research institutes in Germany, USA and the Czech Republic, with topics covering a wide range of palaeobotanical research areas including wood anatomy, geochemistry and amber.

Eleven talks and eight posters were presented on the Saturday. Two keynote presentations, both particularly vibrant talks, introduced the main topics of the workshop. The first keynote by **Jiří Kvaček** and **Jakub Karch** from the National Museum, Prague demonstrated state-of-the-art radiography and tomography of plant fossils, with an emphasis on conifer cones. They showed that these new techniques allow digital thin-sectioning of different kinds of plant fossils at high resolution, without destroying valuable specimens. A further talk about non-invasive 3D imaging was given by **Carole Gee**. She introduced a fossilized conifer cone and made it come alive using X-ray computed tomography and neutron tomography. The second topic of the workshop, amber and its preservation, was introduced by **Paul Nascimbene** from the American Museum of Natural History in New York. He gave the second keynote on the origins, taphonomy and conservation



*Participants of the 26th International Workshop on Plant Taphonomy in Göttingen. Photo by Juliane Germer.*



of fossil resins and their organismal inclusions. His vivid presentation reflected his long-term experience in amber preparation and conservation using epoxy resins. The topic of amber inclusions was complemented by two further talks, from **Leyla Seyfullah** and **Alexander Schmidt**, who showed how amber and its inclusions of plants, fungi and lichens have the potential to reconstruct palaeoecosystems and palaeoclimates.

Further talks demonstrated the different levels of how leaf fossils contribute to our understanding of past environments. **Klaus Wolkenstein** revealed the geochemical perspective of leaf fossils by introducing us to the field of molecular palaeontology. In his studies of leaf fossils from the Miocene, polyphenolic compounds give insight into the autumnal colour of trees. **Lutz Kunzmann** highlighted the potential of leaf assemblages for palaeoenvironmental, palaeoclimatic and palaeoatmospheric reconstructions, while **Christian Müller** assessed plant–animal interactions through feeding damage on fossil leaves. Petrified wood, a further topic of the workshop, was richly presented by **Ludwig Luthardt** who showed us beautifully-preserved petrified deadwood and how to recognize decompositional structures which allow the tracing of fungal activities. **Steffen Trümper** detailed a palaeobotanical excavation carried out at the Zuckerwald (Saar Nahe Basin) locality and its plant taphonomy.

The coffee breaks with stollen, lebkuchen and spekulatius had a very Christmassy flavour, but were also great opportunities for networking and budding new research collaborations. The lively discussions continued at the workshop dinner in the African restaurant Sambesi in the city centre, which was otherwise predominantly non-botanical with meals including ostrich, zebra and crocodile.

On Sunday morning **Alexander Gehler** guided participants through the historic Königsberg amber collection, but also showed other palaeontological treasures of the geoscience collections. The amber topic was continued by **Eva-Maria Sadowski** who introduced the storage of amber, highlighting sensitivity of amber specimens to various hazards and the importance of a stable storage environment. She further demonstrated techniques of grinding, polishing and embedding of amber and the imaging of its inclusions.

As in recent years, the Plant Taphonomy Workshop was a relaxed meeting and a great opportunity for students and postdocs in their early careers to network with senior scientists from the field. Students attended for free and had the chance to present and provide posters in an informal atmosphere alongside the senior scientists, a really valuable experience. The future hosting institutions will be the Hessisches Landesmuseum Darmstadt in 2018 and the Urweltmuseum Geoskop in 2019. We are looking forward to the next Plant Taphonomy Workshops and would like to particularly encourage early-career palaeobotanists to participate in these upcoming meetings.

The Palaeontological Association generously provided travel support for Jiří Kvaček and Paul Nascimbene via their Grant-in-Aid scheme (PA-GA201714), and this was greatly appreciated by all participants.

**Eva-Maria Sadowski**  
*University of Göttingen*





**The Early Tetrapod World: Laying the foundations of the modern vertebrate fauna**  
University of Cambridge, UK 13 December 2017

To mark Professor Jennifer Clack's formal retirement from the University of Cambridge and to celebrate her 70th birthday, a one-day conference, hosted by the Department of Zoology and the University Museum of Zoology, showcased new research by Jenny's colleagues, collaborators and former students on many of the topics that she has explored during her remarkable career.

**Howard Baylis**, Head of the Department of Zoology at Cambridge, opened the conference by describing a few of the highlights of Jenny's extraordinary career to date, beginning with a BSc in Zoology from Newcastle University in 1970. Following this, Jenny worked in Birmingham City Museums and Art Gallery as a museum educator, and later returned to Newcastle to undertake a PhD under the supervision of Alec Panchen. Jenny joined the Museum of Zoology at the University of Cambridge as an assistant curator in 1981, and in 2006, she was awarded a personal chair, taking the title Professor of Vertebrate Palaeontology. Jenny's greatest accolade undeniably came in 2009 when she was elected a Fellow of the Royal Society, the first woman in the field of vertebrate palaeontology to receive such an honour. Jenny's most recent award came in 2015 when she received the Lapworth Medal from The Palaeontological Association. Jenny's prominent dedication to early tetrapod palaeontology revitalized the field of work, with her most recent research changing our understanding of tetrapod biology during Romer's Gap.

The first session of the conference focused on fish, beginning with **Tim Smithson** speaking about Traquair's lungfish from Loanhead and the importance of this material for understanding dipnoan diversity and tooth plate growth in the late Mississippian. **Sam Giles** presented her team's extensive work on cryptic diversity in Devonian actinopterygians and its implications for the Carboniferous radiation. **Mike Coates** described findings from recent work on an exceptionally well-preserved specimen of the actinopterygian *Mesopoma*. Closing the first session, **Zerina Johanson** discussed the ontogenetic development of the otic region in the new model animal *Leucoraja* (the little skate).

After a coffee break held in the spectacular Whale Hall of the soon-to-be-opened Museum of Zoology, there were talks from four members of the TW:eed project (Tetrapod World: early evolution and diversification). This multi-disciplinary collaborative project, led by Jenny for the past six years, has focused on early Carboniferous tetrapods and the palaeoenvironment of key fossil localities in Scotland and closing Romer's Gap, an apparent gap in the tetrapod fossil record during the Mississippian. **John Marshall** began by describing the palynology of the *Acanthostega* locality in East Greenland and recent discoveries at a new Late Devonian site in the Scottish Borders, followed by **Dave Millward** who discussed palaeogeography during Romer's Gap and its potential influence on tetrapod terrestrialization. **Sarah Davies** then spoke about her team's work uncovering the landscapes of Romer's Gap, and **Henning Blom**, who previously worked with Jenny as a postdoctoral researcher, described recent work on the Late Devonian successions of East Greenland.

The second half of the day focused on tetrapods, the stars of Jenny's life's work. **Per Ahlberg**, who was Jenny's first PhD student at Cambridge, presented some thoughts informed by new data on the origin of tetrapods and terrestrialization. **Jason Anderson** described an enigmatic tetrapod from Five Points in Ohio and its implications for understanding the survivorship of stem tetrapod lineages. **Angela Milner** spoke about work she has recently been able to return to on *Keratraperdon*,



the earliest horned nectridean. **Andrew Milner** concluded the session's talks with a description of two primitive temnospondyls from the coal mines of Nyraňy in the Czech Republic. The session was closed by a video call from **Mike Lee**, now based at Flinders University in South Australia, who completed a PhD with Jenny at Cambridge. Mike spoke warmly about his years working, and later collaborating, with Jenny, emphasizing the incredible generosity she shows to students, colleagues and everyone else she meets. It was clear from every speaker just how highly Jenny is held in their esteem, not only for her passion and enthusiasm as a researcher, but as a teacher and colleague who had such a positive impact on their careers, with generous assistance for no personal acclaim.

The final session was dominated by studies on tetrapod morphology, beginning with **Nick Fraser** talking about restoring the 'flat pack' skull of the Triassic protorosaur *Tanystropheus*. Per Ahlberg stepped up once again to present the work of **Sophie Sanchez** on the life history traits of stem tetrapods; Sophie was unfortunately absent on the day. **Eva Herbst** described the new insights she has gleaned from computer tomography into the morphology of the *Crassigyrinus scoticus*. **Stephanie Pierce** discussed her work on how fins can turn into limbs, while introducing the room to the frogfish, bizarre fish that "walk". The session ended with insights from **Marcello Ruta** on the evolution of the tetrapod humerus.

**Paul Brakefield**, the director of the University Museum of Zoology, closed the conference by first thanking Jenny for her outstanding contribution to the development of the Museum, then reiterating the sentiments echoed by each of the speakers: Per Ahlberg proudly stating "Everything I've done these past 30 years is down to Jenny". All those present owe a great debt to Jenny for her years of academic research and her collaborative approach to science, but most of all for the academic community that she has helped to shape and develop across the world. The day ended



Coffee break in the Whale Hall, Cambridge University Museum of Zoology. Photo by Rachel Aucott.



with a reception, again held in the magnificent Whale Hall, where all attendees celebrated Jenny's work to date and looked forward to the work still to come, despite her official retirement.

The organizers were grateful for generous sponsorship of the meeting from the Palaeontological Association (Grant-in-Aid PA-GA201715), the Linnean Society, and Dunedin Academic Press. Most of the new and critical work presented at the conference will appear as a Festschrift in Jenny's honour, published in the *Earth and Environmental Science Transactions of the Royal Society of Edinburgh*, guest edited by the conference organizers Per Ahlberg, Marcello Ruta and Tim Smithson.

**Emma Dunne**

*University of Birmingham*

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*University of Cambridge*



**Annual Meeting of the Society for Integrative and Comparative Biology (SICB)**  
San Francisco, USA 3 – 7 January 2018

As part of the Annual Meeting of the SICB conference in San Francisco a symposium was held entitled *Evolution in the dark: unifying understanding of eye loss*, brilliantly organized by Megan Porter, University of Hawaii at Manoa, and Lauren Sumner-Rooney, Oxford University Museum of Natural History. The goal of this symposium was to bring together a cross-disciplinary group of researchers working on how eye loss evolves in the dark. Throughout the full range of animal diversity, a repeated occurrence of eye reduction and eye loss can be observed under decreased or completely absent levels of light, either associated with particular lifestyles, such as fossorial or parasitic, or within certain environments such as deep sea or subterranean habitats. There is no clear consensus on the evolutionary mechanisms involved, all the more so as there seems to exist a certain plasticity, and apparently there are no morphological or developmental constraints.

The participants at this symposium came together to present their findings and to discuss possible underlying general principles on the basis of molecular mechanisms, such as gene loss in blind mammals or the crustacean *Asellus aquaticus*, or gene regression as seen in subterranean diving beetles. Areas of discussion during this interesting symposium were the visual system of caecilian amphibians, the patterns of gene loss in blind cavefish, transcriptome evolution in blind cave crayfish, examples of gene regulation and heterochrony, diversity of opsins in eyeless ostracodes, relicts of reduced eyes as elements of developmental chains, and many others. Of course it was indispensable in this context to consider the fossil record, and thereby show principles of eye reduction in the past, their modes, manifestations and occurrence across time and species. I was supported by PalAss Grant-in-Aid (PA-GA201707) to deliver a keynote talk entitled "Evolution of eye reduction and loss in fossil arthropods" to conclude the symposium.

Partly in parallel there was another symposium of interest to palaeontologists: *From small and squishy to big and armored: genomic, ecological and paleontological insights into the early evolution of animals*, excellently organized by Erik Sperling, Stanford University, and Kevon Kocot, University of Alabama. Topics included ecological innovations in the late Ediacaran, the Cambrian radiation, temporal and environmental contexts of early animal evolution, the influence of pumping, swimming and visual predation as a fluid dynamic view on early metazoan evolution, the elongation of body plans, a new Burgess Shale polychaete revealing the origin of the annelid head,

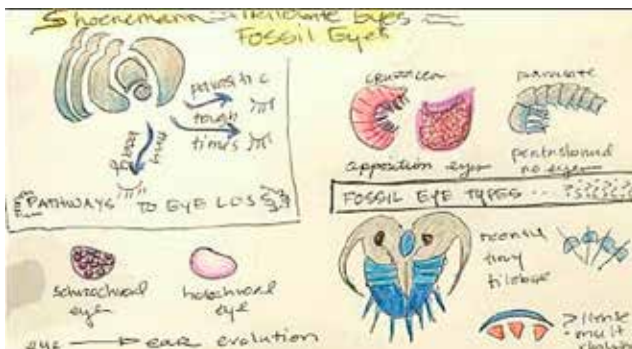


evolution and discussion of phylogenetic positions of jellyfish, ctenophores and sponges, the influence of oxygen requirements of sponges and the origin of metazoan development, evolution of gene regulatory networks, comparative transcriptomics, the reconstruction of the genome of the first animal, and considerations of the origin of phyla, with insights from the Burgess Shale among others.

San Francisco itself was a wonderful place to hold such a conference, the venue being close to stations for the famous cable cars, the huge Pacific waves and the impressive exhibitions of the California Academy of Sciences. Impressive in a different sense was a powerful 4.5-magnitude earthquake in the early hours of 4th January, at 2.39am. The whole skyscraper hotel shook for about ten seconds but, because of the well-adapted architecture, there was no noticeable structural damage. It was the result of a movement of the Hayward Fault, a fault parallel to the San Andreas Fault. When the symposium participants returned home they had plenty of powerful impressions from the meeting, and continue to keep their eyes peeled for common principles of acquired secondary blindness and eye reduction during evolution in the dark.



A cable car in downtown San Francisco, trimmed for the holidays. Photo by Brigitte Schoenemann.



Wonderful sketches by Ajna Rivera, University of the Pacific, drawn rather than taking notes during the symposium. Reproduced here with Ajna's kind permission.

**Brigitte Schoenemann**  
University of Cologne



## — OBITUARY —

# Nigel Trewin

## 1944 – 2017

Nigel Trewin, who died in late October last year, finds an epitaph in the numerous papers and books he produced on Scottish geology and palaeontology, mainly on the Old Red Sandstone and particularly on its fish. He worked on the classic assemblages from the Middle Devonian of the Orcadian Basin, including the Achanarras and Sandwich Fish Beds. These had been made famous by Hugh Miller, whom Nigel greatly admired, and they remain a key fossil archive of vertebrate evolutionary history, providing insights into the nature of the environments in which vertebrate bodyplans were established. Nigel helped to describe placoderms, lungfish and jawless fish from these deposits, established their stratigraphy and correlation, as well as biogeographic connections to faunas elsewhere. However, his major contribution was to elucidate their palaeoecology, in life and in death, establishing that the spectacular mass mortality assemblages were a consequence of the episodic overturning of the otherwise thermally stratified lake environment. While an ardent collector of these fossils, his enthusiasm also extended to living species. He enjoyed fishing for salmon, although, in his own words, he was “ashamed . . . that the race between number of salmon caught and peer-reviewed academic papers was narrowly won by the academic papers and books”.

Among the latter is a series of seminal works on the Rhynie cherts, our earliest preserved terrestrial ecosystem. Working with Clive Rice, also a professor at the University of Aberdeen, he literally re-opened the field with excavations and boreholes resulting in a much better understanding of the geology, the processes resulting in fossilization, and the fossil fauna. Much of this work was drawn together in a synthetic volume of the *Transactions of the Royal Society of Edinburgh, Earth Sciences* (2004), that has become a key modern reference work. Many publications followed and his last, published just weeks before his death, focused on the exceptional quality of the preservation of the Rhynie biota and how this sheds light on the early evolution of life on land (Trewin and Kerp 2017). Nigel was very generous to many visiting researchers and students, taking the time to show them his wonderful collections at the University of Aberdeen, lending materials for research purposes and guiding visitors to the Rhynie chert itself. Sadly he was unable to attend the Royal Society discussion meeting in March 2017 that celebrated the centenary of the first detailed account of the Rhynie biota by Richard Kidston and William Lang, but the ensuing thematic issue of the *Philosophical Transactions of the Royal Society* is dedicated to him. The authors of the introductory paper on the historical and contemporary significance of the chert owed much to his rigorous refereeing.



© The Friends of Hugh Miller.



His books included *The Geology of Scotland*, as author and editor, *Fossils Alive*, *Scottish Fossils* and various excursion guides to the geology of the Aberdeen area, and to East Sutherland and Caithness – a demonstration of his commitment to communicating his passion for geology and fossils. As a speaker he was much in demand, his lecture on the geology of Scotch malt whiskies being particularly popular. His diverse activities in science and engagement have been recognized by medals from the geological societies of Edinburgh and Glasgow.

Nigel began collecting fossils at the age of ten: his personal collection is now housed in the National Museum of Scotland, Edinburgh. He also acquired ephemera, books and letters of the pioneering Scottish geologist and writer, Hugh Miller. Nigel was a trustee and former chair of The Friends of Hugh Miller and had donated his collection to the Hugh Miller Museum in Cromarty, a venture very close to his heart. He also had an extensive library of antiquarian geology books, particularly relating to those of Scotland. At one time, he possessed a copy of William Smith's great map, until it became too risky to keep it at home. In addition to his academic activities he was an avid collector in wider fields. He built fine collections of Scottish eighteenth century trade tokens and other coins and postal history ephemera relating to Aberdeen and Aberdeenshire, publishing his research on the latter in "*The Scottish Post*".

Even when plagued by illness, he remained active in many aspects of natural history. He was especially fond of his garden, describing himself as "a latter day bumbling Victorian naturalist". He was an enthusiastic 'birder' and to sit at his kitchen table for breakfast was an ornithologist's dream come true. The hospitality of Nigel and his wife, Margie, made visits to his home an absolute delight. Nigel was a charming man. It was a privilege to know him and he will be missed by his many friends and colleagues.

### **Dianne Edwards**

*Cardiff University*

### **Acknowledgements**

I am grateful to Phil Donoghue for information and to the Royal Society for permission to reproduce parts of the Dedication published in the thematic issue 1739 of the *Philosophical Transactions of the Royal Society B*, vol. 373, 2018 – "The Rhynie cherts: our earliest terrestrial ecosystem revisited".

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# Research Grant REPORTS

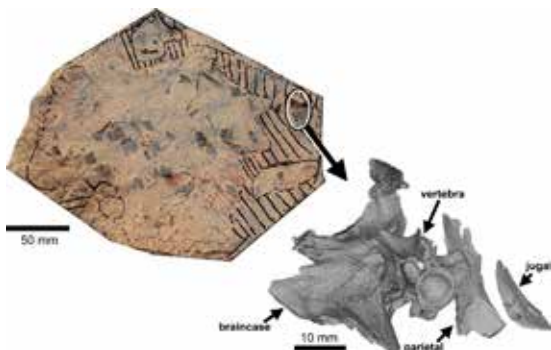
## *Anatomy of the oldest candidate snake based on a new skeleton*

**Roger B. J. Benson**

*Department of Earth Sciences, University of Oxford*

Squamates (lizards, including snakes) comprise >9,000 extant species. These inhabit most of Earth's surface ecosystems, including deserts, temperate regions, and the tropics. They are also ecologically diverse, demonstrating diverse diets and specialized locomotory modes such as marine swimming, aerial gliding, and terrestrial burrowing, and including multiple origins of limblessness. Palaeontology has much to say about the evolutionary origins of modern groups. Nevertheless, deep divergences of squamates are among the more debated areas of vertebrate phylogeny, with a serious lack of congruence between current morphological and molecular hypotheses (Losos *et al.* 2012). This may be in part because of the poor early fossil record of squamates. Rhynchocephalians (the sister-group of squamates, represented today only by *Sphenodon*, the tuatara) occur from the Middle Triassic (240 Ma), but squamates have no definitive fossil occurrences until the late Early Jurassic and Middle Jurassic (Bathonian), indicating more than 60 million years of missing evolutionary history. Furthermore, these earliest fossil squamates have been known from fragmentary remains obtained by screenwashing. Nevertheless, they are interesting, and include hypothesized representatives of extant groups such as agamid iguanians and stem-group snakes (Evans *et al.* 2002; Caldwell *et al.* 2014).

Continuing fieldwork in Middle Jurassic rocks of Scotland (a collaboration with Stig Walsh at the National Museums Scotland) has recovered new Bathonian squamate skeletons. I, along with co-applicants Susan Evans (UCL) and Jason Head (University of Cambridge), successfully applied to PalAss for funds (grant PA-RG201601) to prepare and scan one of our early and most important finds: a large association of bones found by Stig Walsh, representing a single individual (Figure 1).



*Figure 1. Slab containing the Parviraptor-like skeleton following preparation, CT scanning, and further preparation. The specimen is marked-up indicating the regions containing bones. Removal of portions of the slab allows high-resolution 3D imaging of which one example is shown.*



The specimen is particularly important because of its completeness, and *Parviraptor*-like features. *Parviraptor* is an early squamate that was previously only definitely known from vertebrae and tooth-bearing cranial bones (Evans 1994; Caldwell *et al.* 2014). Caldwell *et al.* (2014) had proposed that *Parviraptor* and similar specimens represent the earliest stem-group snakes. This would place snakes among the earliest squamates, meaning that deep squamate divergences had occurred very early in the history of the group.

The block was large (35 x 30 x 15 cm), and substantial preparation was required before it could be studied effectively. In particular, the thickness of the block (originally 15 cm) needed to be reduced by acid preparation. This painstaking work was done by Scott Moore-Faye (Wavecut Platforms Ltd.), reducing our specimen to a slab of 2-3 cm thickness. We then CT scanned the slab. Because of low penetration on its long axis, this was time-consuming and resulted in terrible scans – which we had anticipated. Nevertheless, this scan allowed us to locate the positions of bones, and to remove substantial portions of the slab using a trim saw without harm to the specimen. This allowed scans at higher resolution, allowing much greater precision on the locations of bones, and a detailed mark-up of the slab, showing the locations of specific elements, and empty regions. We are now in the process of removing portions of the slab and conducting high-resolution CT scans (Figure 1). The resulting data are very clean and detailed, and have allowed us to begin study of the complete anatomy of this *Parviraptor*-like specimen, and its implications for squamate phylogeny.

We do not yet know whether *Parviraptor* is a stem-group snake, or even belongs in the crown-group of squamates. Nevertheless, we are rapidly accumulating morphological data for phylogenetic analysis. This should resolve this question, and questions of the anatomy of one of the earliest fossil squamates.

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# *Phylogeny of basal sauropodomorphs: insights into the early radiation of the group and the transition to Sauropoda*

**Alejandro Otero**

CONICET, Museo de La Plata

## **Introduction**

Sauropodomorpha constitute a major and diverse clade of dinosaurs (c. 140 valid genera) that dominated terrestrial ecosystems all over the world in a time-span between the Late Triassic to the Late Cretaceous. Two major milestones characterized the evolutionary history of this group: the early radiation of primitive biped forms from basal saurischian ancestors, and the transition from basal sauropodomorphs to sauropods (Galton and Upchurch 2004). However, a high degree of controversy surrounds such transformations. In the first case, due to the discovery of a large number of new taxa in recent years, one of the current discussions is the phylogenetic position of basalmost forms (e.g. *Panphagia*, *Chromogisaurus*, *Pampadromaeus*), changing our understanding of the relationship amongst the most primitive sauropodomorphs. Moreover, the placement within basal Sauropodomorpha of some basal forms still remains in discussion (e.g. *Guaibasaurus*, *Eoraptor*) (Martínez *et al.* 2012). On the other hand, the transition from basal sauropodomorphs to sauropods is one of the most dramatic evolutionary transformations recorded in the history of dinosaurs, which took place between the Late Triassic and the Early Jurassic (Yates and Kitching 2003; Galton and Upchurch 2004), but is currently poorly understood. Key points in the origin of Sauropoda are the transformations of the postcranium related to the acquisition of quadrupedalism and graviportal locomotion from the bipedalism present in basal sauropodomorphs (Bonnar and Yates, 2007).

Despite the large number of representatives, the phylogenetic relationships of basal sauropodomorphs, however, remain controversial (Peyre de Fabrègues *et al.* 2015). One of the major issues in sauropodomorph relationships is the extent to which the basal forms represent a monophyletic Prosauropoda (e.g. Upchurch *et al.* 2007); or a paraphyletic assemblage (Yates 2007; Yates *et al.* 2010; Otero and Pol 2013). A PalAss Research Grant gave me the opportunity to carry out an exhaustive phylogenetic analysis of basal sauropodomorphs. The general objective was to increase our knowledge of morphological and evolutionary aspects of sauropodomorph dinosaurs through a phylogenetic analysis of the relationships of basal sauropodomorphs, understanding two significant stages in the evolutionary history of this group. In this regard, the main focus of the study relied on the rise and early radiation of Sauropodomorpha, and the transition through Sauropoda. The ultimate goal of this project is to elaborate a comprehensive and updated phylogenetic dataset, including figures/photos, unifying character statements, modifying character states, and to add new characters with explanations of character states.

## **Research plan**

The plan comprised a visit to the following vertebrate palaeontology collections: PVL, Instituto 'Miguel Lillo', Tucumán Province, Argentina; ZPAL, Institute of Paleobiology of the Polish Academy of Sciences in Warsaw, Poland (Figure 1); IVPP, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing (Figure 2) and NGMJ, Nanjing Geological Museum, Nanjing, China



(Figure 3). Additionally, this grant allowed me to arrange multiple gatherings at the Museo Paleontológico 'Egidio Feruglio' in Trelew, Argentina, together with collaborators Drs Diego Pol and Cecilia Apaldetti. The project involved a thorough review of the two main phylogenetic datasets on the group (*i.e.* Upchurch *et al.* 2007; Yates 2007) in order to unify character statements, modify character states and add new characters. Special emphasis was put on the basal-most branches by increasing the number of basal forms in the phylogenetic dataset. The phylogenetic relationships of basal sauropodomorphs were tested using parsimony, and the phylogenetic hypotheses obtained will be used for different kinds of analysis, such as phylogeny calibration and stratigraphic fit; character mapping to determine the time of appearance, as well as to determine patterns and processes that acted on the distribution of the group.



Figure 1. Referred specimen of *Silesaurus* in Warsaw, Poland (ZPAL Ab III/364).



Figure 2. Skull of *Lufengosaurus* in Beijing, China (IVPP V15).

### Methodology

Although this project has not yet concluded, hitherto the dataset for the cladistics analysis consists of 450 osteological characters coded for 73 taxa. The operational taxonomic units (OTUs) comprise five outgroups and 68 sauropodomorphs as the ingroups. The characters represent the unification of the two main data matrices used in cladistics analyses for basal Sauropodomorpha (*i.e.* Upchurch *et al.* 2007; Yates 2007), with the addition of several characters from other sources (*e.g.* Smith and Pol 2007; Yates *et al.* 2010; Ezcurra 2010; Apaldetti *et al.* 2012, and references therein; Otero and Pol 2013). Each character was reviewed, modifying the definition and character states when necessary. Character data were stored using Mesquite (Maddison and Maddison 2009). Each character state was photographed, drawn or described and this information was stored in the matrix developed in Mesquite. The data matrix will be analysed using a heuristic search in TNT (Goloboff *et al.* 2008) under the parsimony criterion, assuming equal weights for all characters. So far, the phylogenetic relationships of basal sauropodomorphs were tested preliminarily (Apaldetti *et al.* 2015; Otero *et al.* 2015).



Figure 3. Mounted skeleton of *Yunnanosaurus* in Nanjing, China (NGMJ 004546).



## Acknowledgements

I would like to thank the Palaeontological Association for Research Grant PA-RG201402, which gave me the opportunity to travel for this project. I also wish to extend my gratitude to the people who allowed me access to collections under their care and for their hospitality: Pablo Ortiz (PVL), Jerzy Dzik and Tomasz Sulej (ZPAL), You Hailu, Nancy Chang and Wang Yaming (IVPP), Wang Tao (Bureau of Lufeng County) and Yue Shu-Kai (Lufeng World Dinosaur Valley).

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# Small Grant REPORTS

## Revisiting mammoth evolution in Eurasia

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### Project progress

Among the most celebrated fossil mammals in popular culture, the mammoth has recently emerged as an important model organism for understanding the finer patterns and processes during the deep time evolution of large mammals. Whereas a wealth of palaeobiological data are available for the final member of the lineage, the renowned Late Pleistocene woolly mammoth *Mammuthus primigenius*, we know significantly less about the earlier mammoth species in Eurasia, species which had a considerably longer temporal duration (Lister *et al.* 2005). The general *M. rumanus*→*M. meridionalis*→*M. trogontherii*→*M. primigenius* model of Plio-Pleistocene mammoth evolution on the Eurasian mainland is widely accepted (Wei *et al.* 2010) due to the abundance of fossil molars that clearly illustrate a punctuated, stepwise increase in number of lamellae and crown height (Lister and Sher 2001; Lister *et al.* 2005). However, skull morphology, with a much broader array of diagnostic characters, has introduced much nuance to the delineation of mammoth species in Eurasia, while our knowledge is limited by the low number of specimens due to the poor preservation potential of cranial materials coupled with the absence of an in-depth synthesis. My project aims to increase our understanding of these nuances by extensive first-hand restudy of the best available early mammoth skulls in European museums as part of my broader objective to reappraise the phylogenetic systematics of living and extinct elephant species.

*Mammuthus meridionalis* represents the earliest Eurasian mammoth supported by an extensive fossil record. However, the taxonomy of the *M. meridionalis* complex has been a cause for uncertainty. The type collection for this species from the Early Pleistocene of the Upper Valdarno in Tuscany, northern Italy is characterized by a high, oblong-shaped vertex (Azzaroli 1977; Lister 1996; Lister *et al.* 2005) as shown in Figure 1. By contrast, cranial remains from the French Haute-Loire and the Russian Black Sea region (North Caucasus), apparently of the *meridionalis*-grade as indicated by molar morphology, are characterized by a more modestly



Figure 1. Lectotype skull of *Mammuthus meridionalis* (IGF 1054) on display at the Museo di Storia Naturale in Florence, lateral view.



developed skull that exhibits the classic mammoth-like triangular-shaped vertex in lateral view (Lister *et al.* 2005), see Figure 2. Alexeeva and Garutt (1965) erected a separate species, *Archidiskodon gromovi*, for representatives of this morphotype from North Caucasus. Lister (1996) and Palombo and Ferretti (2005) suggested that the morphological differences are of intraspecific level within *M. meridionalis*, as would be indicated by the presence of the French-Russian morphotype in the Upper Valdarno sample. On the contrary, the presence of only one distinct morphotype in each sample would suggest a process of phyletic transition, or even distinct taxonomic status.

Palombo and Ferretti (2005) reported a partial cranial vault from Upper Valdarno, housed in the Naturhistorisches Museum Basel (NMB), that has a low, triangular skull roof. Upon first-hand re-examination of this specimen I concluded that it should be interpreted with caution, as the top of the vertex is heavily reconstructed with wood, thus does not represent actual cranial osteology. A better preserved early mammoth cranium at NMB is that of a bull in his prime years, from Senèze, Haute-Loire (Figure 2). Despite having undergone partial reconstruction, the vertex is largely genuine (Loïc Costeur, personal communication).



Figure 2. *Mammuthus cf. meridionalis* skull (NMB Se.547, partly restored) on display.

My observations of the specimen are broadly consistent with remarks by Azzaroli (1966), that the cranial vault shows markedly less posterior projection; the premaxillaries are more downward than forward-pointing; and that an extremely pronounced and downturned symphyseal spout is developed at the mandible when compared to the Upper Valdarno specimens in the Museo di Storia Naturale in Florence. I have examined other *meridionalis*-grade specimens from Chiljac, Haute-Loire (Musée paléontologie de Chiljac), Stavropol (Zoological Institute, Russian Academy of Sciences (ZIN), St. Petersburg) and the Taman Peninsula (Paleontological Institute, Russian Academy of Sciences (PIN), Moscow) in the Russian Black Sea region. Another celebrated early mammoth specimen, a skeleton from Nogaïsk in South-Eastern Ukraine mounted in ZIN, also possesses a low-domed skull; however, this skull is heavily restored after sustaining severe breakages during transport, and thus regrettably of negligible significance in resolving the taxonomy of *meridionalis*-grade mammoths.



Azzaroli (1966; 1977) deemed the morphological distinction between the Valdarno and the French-Russian type samples of *M. meridionalis*-grade mammoths to be evolutionarily significant. He suggested that the low-domed skull morphotype with triangular vertex from the Haute-Loire and the Russian North Caucasus is closely affiliated with the ancestry of subsequent mammoth species in the Northern Hemisphere, whereas the Italian skulls appear morphologically too highly derived and should be precluded from the ancestry of subsequent mammoth species (Azzaroli 1977). Azzaroli's model of Eurasian mammoth evolution has barely been tested in the decades since he published his account. In September, I presented a preliminary phylogeny of the elephants based on my first-hand observations of numerous specimens housed in the museums of Europe, USA and China at the VII International Conference of Mammoths and Their Relatives (ICMR 2017) in Taiwan. The preliminary cladogram marked a first attempt to tentatively test Azzaroli's hypotheses by treating the high- and low-domed skull morphotypes of *meridionalis*-grade mammoths as separate terminals (Zhang *et al.* 2017).

### Future work

The preliminary cladogram requires further validation, particularly accounting for intraspecific variability of cranial characters using specimens of extant elephant species for ground-truthing. My work will attempt to fully quantify cranial variations in mammoths by employing a landmark-based 2D geometric morphometric approach, to discern patterns difficult to delineate based on human observations. New perspectives from recently discovered exceptional early mammoth cranial material from China, including possibly the first skull of *Mammuthus rumanus* and a possible transitional form between *M. meridionalis* and *M. trogontherii*, will be integrated within my framework to reappraise mammoth and elephant evolution.

### Acknowledgements

I sincerely thank the Palaeontological Association for Sylvester-Bradley Award PA-SB201604 to support my research visits to NMB, ZIN and PIN, and Loïc Costeur, Florian Demmayer (NMB), Gennady Barishnikov, Andrei Bublichenko, Alexander Averianov (ZIN) and Constantine Tarasenko (PIN) who facilitated access to specimens. I further extend my gratitude to the Geological Society of London, Jeremy Willson Charitable Trust, Quaternary Research Association, American Museum of Natural History, Paleontological Society and the Larry Agenbroad Memorial Fund for supporting my research visits to Florence, Chilhac and New York. Thanks also go to Mark Puttick, Max Stockdale and Marco Ferretti for their contributions in generating preliminary phylogenetic analyses. I am extremely grateful to my supervisors Mike Benton, Adrian Lister and Wang Yuan for advice and encouragement. My travel to Taiwan to attend the ICMR and to undertake examination of specimens was kindly supported by the ICMR 2017 Traveling Support, the Palaeontological Association Postgraduate Travel Fund and the University of Bristol Bob Savage Memorial Fund.

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## *Measuring genome size in the earliest fossil plants*

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Speciation and evolution of plants are strongly connected with changes in their genome size (Soltis *et al.* 2014). Polyploidy events are present in the history of ferns (Clark *et al.* 2016) and seed plants (Li *et al.* 2015). Including fossils in palaeogenomics studies enables us to track variations of genome size through the evolutionary history of plants. This is possible due to a well-established proxy measure based on a positive relationship between stomata guard cell length (GCL) and genome size (GS); stomata guard cells tend to be larger in plants with larger genomes (Beaulieu *et al.* 2008). The literature-based research by Lomax *et al.* (2013) came to the important and novel conclusion that early land plants had exceptionally large genomes. The phenomenally well-preserved plants from the Early Devonian Rhynie Chert (Scotland, UK) allow the possibility of a fine-scale investigation of early land plant GS.

We chose the lycopod *Asteroxylon mackiei* to be an “experimental” species. *Asteroxylon* was the most advanced plant in the 407 Ma Rhynie ecosystem, with an aerial axis irregularly but densely covered with non-vascularised leaf-like appendages (Figure 1A). Being a relative and morphologically similar to the extant *Huperzia* (Lycopodiaceae) makes *Asteroxylon* a suitable plant in terms of comparison to living species with known GS. Investigated specimens are stored in the collections of the Natural History Museum, London (NHM), the Hunterian Museum at the University of Glasgow, the University of Aberdeen and University of Münster. Data were collected from historical slides and small chert blocks.

Using standard light microscopy, measurements were made of GCL, which is a value that remains constant in open or closed stomata. A total of 528 stomata were measured from 14 specimens. The analysis of *Asteroxylon* shows a very large range of GCL, from 39  $\mu\text{m}$  to 92  $\mu\text{m}$ . This is unexpected, considering that the observed range in one early fossil plant spans over 90% of the known range of GCL in all living plant species. To understand the distribution of GCL in the fossils, comparisons were made to close modern analogues of known GS in the families Selaginellaceae and Lycopodiaceae.





Figure 1. *Asteroxylon mackieii* from the Rhynie Chert, Scotland, UK: A, longitudinal section of aerial axis. Vascular bundles do not reach the “leaves”; B, stomata on abaxial side of a “leaf”; C, stoma on a stem. Scale bars are 0.5 mm.

The results showed that the relationship between GCL and GS holds broadly for known Lycopodiaceae and Selaginellaceae. Nevertheless, none of the examined extant plants displays such a broad range of guard cell sizes.

The PalAss grant enabled me to re-examine the Rhynie Chert historical slide collection at the NHM to help clarify previous observations of *Asteroxylon* specimens at the minimum and maximum GCL range. The aim was to determine any significant morphological differences that would allow me to evaluate the presence of possibly more than one *Asteroxylon* species. Edwards *et al.* (1998) described two types of stomata in *Asteroxylon*: sunken and not sunken. They differ slightly in size and shape, and are separated on two different types of “leaves” – sunken stomata are confined to short spiny “leaves” and the not-sunken form are on longer fleshy “leaves”. During my visit to the NHM, I made a detailed examination of *Asteroxylon* specimens paying special attention to the state of preservation and the part of the plant from which stomata measurements were taken. Stomata are present on both sides of leaf-like appendages (Figure 1B), as well as on a stem (Figure 1C). *Asteroxylon* had a simple stomata complex, circular to oval in shape, comprising of two well-developed reniform guard cells (Figure 2A). Guard cells are usually surrounded by 6-8 unspecialized subsidiary cells. The aperture is sunken, but it is difficult to diagnose whether guard cells are sunken or form an even surface with epidermal cells. In most specimens, guard cells seem to be slightly lower than the epidermis surface, but none of the stomata were distinctly deeper than others. Some stomata have ledges clearly marked.

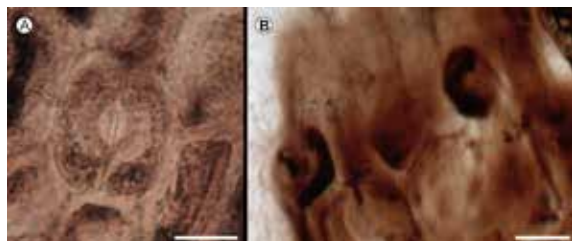


Figure 2. Stomata complex of *Asteroxylon mackiei*; A, well preserved stomata, with both guard cells clearly visible; B, poorly preserved stomata. Guard cells are detached and out of focus. Scale bars are 50  $\mu\text{m}$ .

A close study of the stomata led me to exclude many from the analysis (e.g. stomata with only one guard cell preserved; stomata with partially visible guard cells; stomata situated deep within the chert and therefore out of focus) (Figure 2B). Only conspicuous stomata with both guard cells completely preserved and attached were measured (Figure 2A). Within a single slide the preservation of stomata can differ. Unfortunately, thin sections, from which most of the stomata were measured, present only a small piece of plant epidermis. No clear differences were distinguished in the stomata morphology to diagnose the presence of more than one *Asteroxylon* species.

### Acknowledgements

I wish to thank the Palaeontological Association for Whittington Award PA-WA201601 that allowed me to visit the Rhynie Chert collection at the Natural History Museum, London to re-examine *Asteroxylon* specimens. These results are essential to the completion of my manuscript on using fossils in reconstructing changes in plants genome size. I would also like to thank Dr Paul Kenrick for his help with this project.

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# Undergraduate Bursary REPORTS

## *Functional drivers of the evolution of beak shape in birds*

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### **Introduction**

Bird beaks are an often-cited example of the tight relationship between form and function. However, recent work has suggested that skull and beak morphology vary as a predictor of dietary ecology between different groups; for example, in diurnal raptors, beak shape is constrained by size, phylogeny, and integration with the braincase (Bright *et al.* 2016). The link between morphology and ecology has been documented in some bird clades, however the functional morphology of bird beaks remains largely unexplored. We set out to test how variation in beak morphology affected mechanical function, specifically the ability to dissipate stress. To achieve this, 25 theoretical 3D models of beaks that captured beak shape variation throughout the Passeriformes clade were created, then subjected to finite element analysis to create a functional landscape of bird beak mechanical performance.

### **Materials and Methods**

The variation in beak shape throughout the passerine clade had to be quantified in order to relate shape to function. To achieve this, photographs of the lateral shapes of 227 passerine bird skulls were taken (spanning all the known passerine families), from collections at the Natural History Museum at Tring and the Smithsonian Institution National Museum of Natural History. These were then digitized with landmark co-ordinates, followed by a full Procrustes fit to extract shape information and Principal Component Analysis (PCA) to explore the main axes of beak variation. From this, 25 two-dimensional hypothetical beak shapes spanning the first principal component (PC1) and PC2 morphospace were calculated following methods outlined in Olsen (2017). 77% of beak variation is explained by the first two principal components (PC1 = 49%, PC2 = 28%).

As our analyses required three-dimensional samples, we extracted width measurements from Mark My Bird (<<https://www.markmybird.org/>>), a community science project with 3D models of many bird beaks (Cooney *et al.* 2017). Width measurements from this database combined with length measurements from the landmark coordinates allowed us to assess the trend between the shape (PC1 and 2) and width:length ratio of Passeriformes beaks. A multiple linear regression found a significant linear relationship between both principal component axes and the width:length ratio ( $F = 157.0032$ ,  $p < 0.0001$ ,  $R^2 = 0.6145$ ).

The predicted width:length ratios calculated from the regression were then applied to each 2D shape calculated from the morphospace to generate 25 3D beak shapes using the 3D modelling



software Blender (Figure 1). A cross-section from Van Hemert *et al.* (2011) was used to generate a simplified cross-sectional shape for all beaks, and the actual shapes (from Mark My Bird) of taxa close to each morph on the morphospace were used to guide the overall 3D shape.

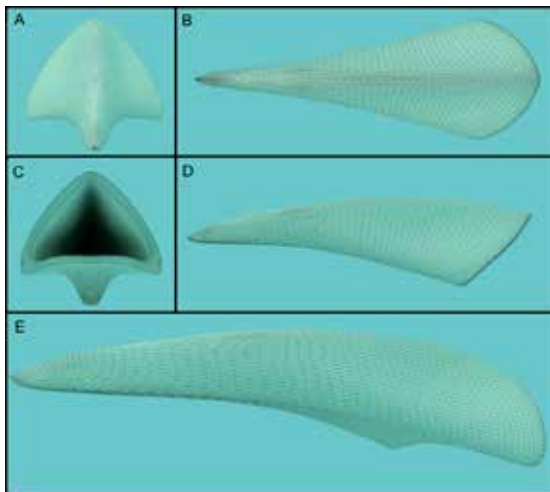


Figure 1. Hypothetical beak shape at the centre of the PC1-2 morphospace. (A) is orthographic anterior view; (B) orthographic dorsal view; (C) orthographic posterior view; (D) orthographic lateral view; and (E) perspective view.

These models were then prepared for, and subjected to, finite element analysis (FEA), using Hypermesh (Altair) and Abaqus (Simulia). A convergence test was performed foremost on the central beak shape (*i.e.* the shape at the centre of the PC1-2 morphospace), to find an optimal mesh density for the analysis (Bright and Rayfield 2011). The optimal mesh density was found to be approximately 15-16,000 faces before Hypermesh alteration. Each model was given the same material properties of bone; no soft tissue or keratin sheath was simulated, as we were testing the effects of only shape on stress dissipation. The load given at the tip of each beak was 10 Newtons, taken from approximate averages of bite force of passerine taxa from Soons *et al.* (2015). Each beak was given six constraints at regular intervals at the posterior base of the model. The von Mises stress (VMS) was calculated by the FEA software, and the median VMS results were then corrected for beak surface area.

## Results

The surface area corrected median VMS of each beak was used to generate a functional landscape of beak morphology across the PC1 and PC2 axes (Figure 2). A multiple linear regression on the logarithm corrected data confirmed a significant exponential relationship between both PC axes and the ability to dissipate stress ( $F = 73.9$ ,  $p < 0.0001$ ,  $R^2 = 0.8756$ ). Long, thin beaks (low PC1, high PC2) performed significantly worse (higher stress) than short, thick ones (high PC1, low PC2).

Real taxa occupy only a proportion of total morphospace. We decided to analyse the popularity of the hypothetical morphs (*i.e.* the proportion of real taxa with a similar beak shape to each of the 25 hypothetical shapes). To achieve this, a 'popularity index' was calculated; the sum of the Euclidian distances between the PC score of each of the 227 passerine taxa and each hypothetical morph. We

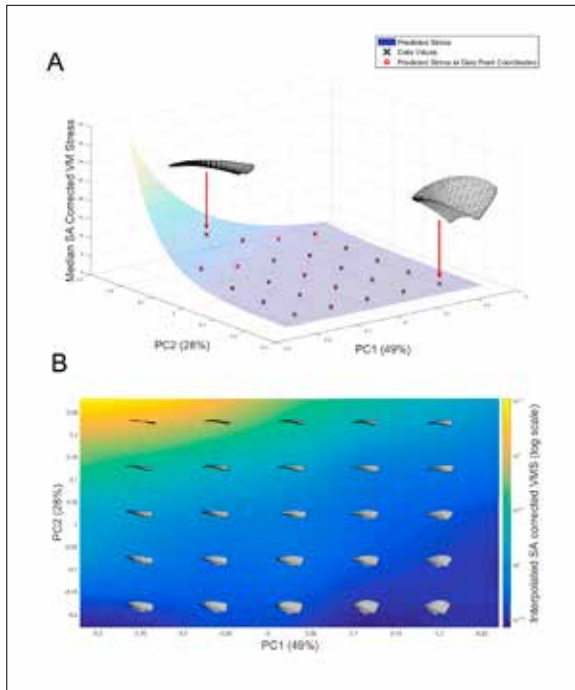


Figure 2. Surface area corrected VMS across the first two components of the beak shape morphospace of Passeriformes. (A) Fitted 3D exponential surface to the VMS data. Calculated based on a multiple linear regression of logarithm transformed data. (B) Log transformed VMS interpolated across morphospace. Theoretical beak models are overlain at their respective PC coordinates.

found that there is no significant relationship between the functional performance of a shape and its popularity amongst real taxa. Many functional shapes therefore remain unexplored in nature.

### Discussion

These results confirm that beak shape has a significant effect on mechanical performance. Beak performance does not, however, predict the popularity of a beak morph, suggesting that the most common beak shapes are not those with optimal mechanical function. It is possible that there are other constraints, such as phylogeny and braincase morphology (Bright *et al.* 2016), that influence beak morphological evolution. The reliability of this analysis is restricted due to the hypothetical nature of the beaks tested, yet this approach allows the range of comparative beak shape variation across Passeriformes to be captured. Despite a link between shape and mechanical performance, the most commonly expressed passerine beak shapes are not always optimal for stress reduction.

### Acknowledgments

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# Reconstructing food webs across the Toarcian Ocean Anoxic Event

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## Introduction

The early Toarcian extinction event was thought to have been driven by an Ocean Anoxic Event (OAE) associated with the Karoo-Ferrar Large Igneous Province (LIP) eruption (McElwain *et al.* 2005). The aim of this study is to test, through trophic network modelling, whether the early Toarcian extinction event destabilised trophic interactions of Early Jurassic ecosystems and whether the pelagic and benthic ecosystems become decoupled across the OAE (Danise *et al.* 2015).

## Methodology

The analysis was based on a field database of 38,670 macrofossil specimens, consisting of 162 different benthic and planktonic species collected from the Yorkshire Coast (Cleveland Ironstone, Whitby Mudstone and Blea Wyke Sandstone formations). Sampling was carried out at metre-scale resolution from a 150 m section, spanning the upper Pliensbachian–upper Toarcian succession by Little (1990s); Atkinson (2013); and Zarzeczny, Atkinson, Dunhill and Little (2017). Species were grouped into trophic guilds (see Table 1) based on the Bambach *et al.* (2007) ecospace model. Trophic guild assignments were inferred from modern relatives and, where possible, from palaeoecological interpretations described in literature. Trophic interaction matrices were coded for four time-bins; pre-OAE, OAE, early recovery and late recovery. Trophic networks were modelled for each time bin using *R* v.-3.4.0 and *R* packages '*igraph*', '*network*', '*MASS*', '*Matrix*', '*sna*', '*indices*' and '*tnet*' (see Dunhill *et al.* 2016 for references). Link density (LD) was used to measure the connectance



of the network whilst the degree centrality ( $C_D$ ) was calculated to measure the importance of each node within the network (Dunhill *et al.* 2016).

<b>Guild</b>	<b>Code</b>
Attached Facult. Motile Deep Infaunal Chemosymbionts	AFDC
Attached Facult. Motile Deep Infaunal Suspension Feeders	AFDS
Attached Facult. Motile Epifaunal Suspension Feeders	AFES
Attached Facult. Motile Erect Suspension Feeders	AFERS
Attached Non-Motile Epifaunal Suspension Feeders	ANES
Attached Non-Motile Semi-Infaunal Suspension Feeders	ANSES
Detritus	D
Fast Epifaunal Predator and Scavengers	FEPS
Fast Pelagic Predators	FPP
Microbenthos	M
Plankton	P
Slow Deep Infaunal Suspension Feeder	SDS
Slow Epifaunal Deposit Feeders	SED
Slow Epifaunal Grazers	SEG
Slow Epifaunal Predators	SEP
Slow Epifaunal Suspension Feeder	SES
Slow Pelagic Predators	SPP
Slow Shallow Infaunal Chemosymbionts	SSC
Slow Shallow Infaunal Miners	SSM
Slow Shallow Infaunal Predators	SSP
Slow Shallow Infaunal Suspension Feeders	SSS
Unattached Facult Motile Shallow Infaunal Miner-Suspension Feeders	UFSMS
Unattached Facult. Motile Deep Infaunal Suspension feeders	UFDS
Unattached Facult. Motile Epifaunal Suspension Feeders	UFES
Unattached Facult. Motile Shallow Infaunal Miners	UFSM
Unattached Facult. Motile Shallow Infaunal Suspension Feeders	UFSS
Unattached Non-Motile Epifaunal Suspension Feeders	UNES

**Table 1. Species grouped into trophic guilds.**



### Results

Trophic guild richness decreased from 23 in the pre-OAE, to 12 during the OAE as deep infaunal, most motile and benthic predatory guilds disappeared (Figure 1A-B). Across the OAE, the benthic community was dominated by non-motile suspension feeders. Trophic guild richness increased to 16 in the early recovery with the reappearance of some facultatively motile and slow motile benthos (Figure 1C). Trophic guild richness increased to 23 by the late recovery with the reappearance of a diverse range of motile guilds and the appearance of new epifaunal and shallow infaunal predators (Figure 1D).

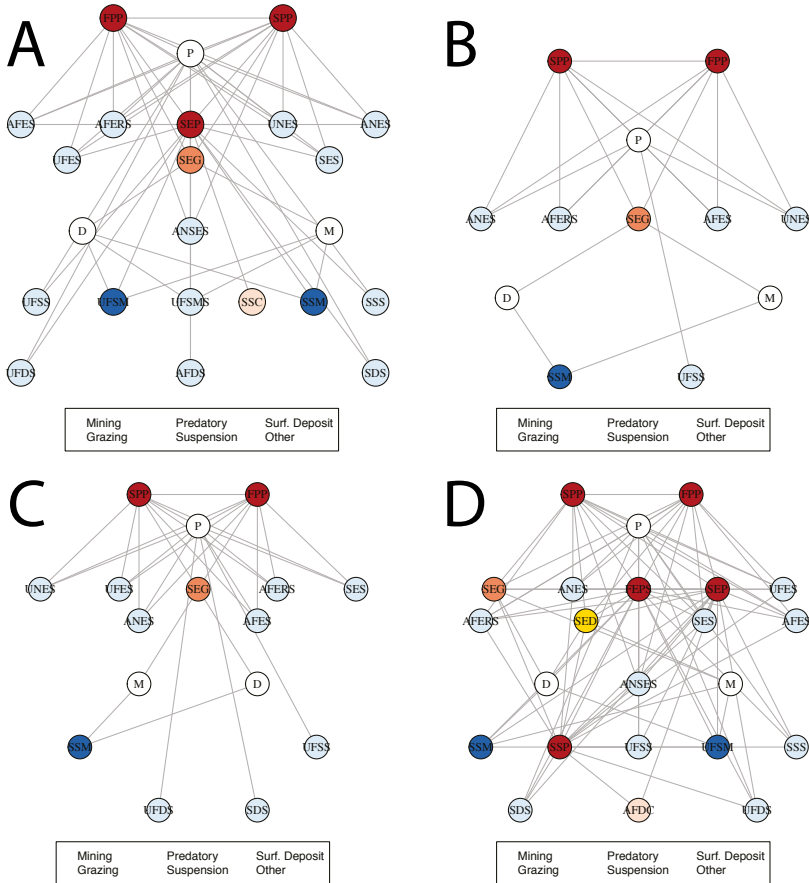


Figure 1. Trophic networks depicting trophic guild interactions of the marine macrofaunal: A, pre-OAE ( $LD = 5.130$ ); B, OAE ( $LD = 3.667$ ); C, early recovery ( $LD = 3.750$ ); and D, late recovery ( $LD = 7.739$ ). The guilds are arranged by their tiering: pelagic, epifaunal, semi-infaunal, shallow infaunal and deep infaunal (top to bottom). The guilds are as defined in Table 1.





The overall connectance of the trophic network decreases markedly during the OAE. There is a slight increase in connectance during early recovery followed by a much greater increase in the late recovery to higher levels than before the OAE. Analysis of lost and gained guilds revealed predatory guilds to have the highest connectance with  $C_D$  ranging from 17 to 19, in comparison to non-predatory guilds ranging  $C_D$  1 to 8 (excluding plankton and detritus).

### Discussion

The reduction in connectance of the trophic networks across the early Toarcian OAE indicates a reduction in ecosystem complexity. Although there is no direct evidence that pelagic and benthic ecosystems became fully decoupled, there is a major loss of benthic trophic richness. The decrease in connectance across the OAE can be explained by the loss of 11 guilds, some of which were highly connected. The loss of predatory guilds across the OAE suggests the early Toarcian extinction event was a top-down extinction, and although there is a severe reduction in guild richness and network connectance across the OAE, there is no indication of a decrease in ecosystem robustness leading to extinction cascades. This observation can be explained by metabolically demanding motile benthic guilds being more sensitive to anoxia (Vaquer-Sunyer and Duarte 2008) and thus disappearing during the OAE, unlike the less metabolically demanding non-motile guilds which were able to survive. It is likely that due to the appearance of new predatory guilds with high connectivity, the connectance of the network is greater during the late recovery (Figure 1B) than it is pre-OAE.

### Acknowledgements

Thanks to Palaeontological Association for funding this project with the Undergraduate Research Bursary PA-UB01703. Thanks to Dr Alex Dunhill for this opportunity. Thanks also to Dr Crispin Little and Jed Atkinson for guidance and continuous support throughout the project; and the rest of the postgraduate researchers in the palaeontology office who were always willing to help. Finally, thanks to Dr Andrew Beckerman for advice on network ecology.

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# Book Reviews

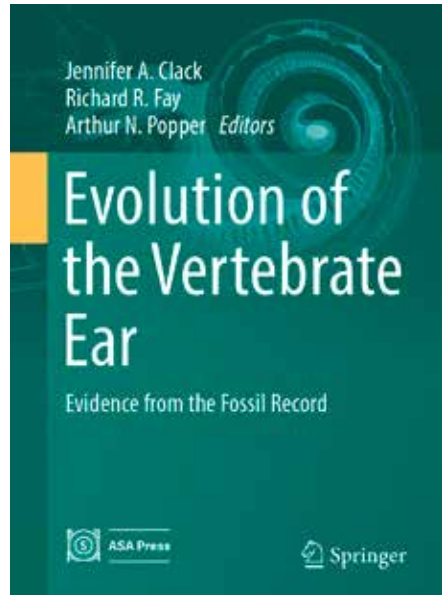
## **Evolution of the Vertebrate Ear: Evidence from the Fossil Record**

Edited by: Clack, J., Fay, R. and Popper, A., 2016. Springer / ASA Press. €114.39. ISBN 978-3-319-46659-0 (print); ISBN 978-3-319-46661-3 (e-book). 355 pages, 116 illustrations.

The book series known as the “Springer Handbook of Auditory Research” (SHAR), which recently added the Acoustical Society of America as the second publisher, has, with the present book, attained 59 volumes published since its inception in 1992. The goal of SHAR is to cover all fields of auditory research and the volume titles thus range far and wide. Although there already was a volume on the “Evolution of the vertebrate hearing system” (SHAR Vol. 22) in 2004, the emphasis of that book was clearly on the diversity known in the evolution of function, but based of course on fossil evidence. This new volume, by contrast, has an explicit subtitle “Evidence from the fossil record” and the authors have taken this seriously – perhaps, as we will see, too seriously, and have somewhat neglected function.

The eleven chapters of this book cover the fossil record in all groups of vertebrates and their corresponding skull structures involved in hearing, with a slight emphasis on mammals (three chapters). This latter emphasis is both because there is an extremely rich fossil record of mammals and their relatives, but also simply that more scientists have worked on ears of this group. I know from my own experience as editor of some volumes in this series that it can be very difficult to persuade the top researchers in any field to write a contribution to a book, but Jennifer Clack, the senior editor of this volume, has succeeded superbly in this task. The list of authors includes many top-flight palaeontologists who write with great authority.

Due to its structure, this book will appeal mainly to students of palaeontology, since it covers with a broad brush every avenue of hearing evolution that was pursued by vertebrates, both the two main lineages of fishes and the various land animal groups. Each group is described in detail and the text is accompanied by many superbly useful figures. Many of these figures were made possible by recent advances in CT-scanning of complete fossil skulls that reveal inner-ear anatomy and allow 3D reconstructions in amazing detail. Unfortunately, perhaps inevitably, those not familiar with the





terminology of palaeontology and not having at least a rough familiarity with the fossil record will struggle through this book. The latter group would have been helped by the inclusion, in Chapter 1 perhaps, of a reference collection of figures that show both the lineages of each major group and the names of all important subgroups, but also including a time scale. As it stands, the figures in most chapters show the “tree” of evolution of a particular lineage but without the important context of geologic time. Terms are encountered for particular, sometimes short, geological time periods, but the book provides no direct way to find out when that period was. Perhaps a full glossary would also have been helpful.

Although, given the functional emphasis of SHAR volume 22, it was to be expected that in the present book function would not be emphasized, the result presented is less than satisfactory. Not only is there generally very little reference to function, but functional statements are frequently made without a reference, only with reference to outdated literature, or are simply wrong. Having myself tried to cover some of the conceptual and literature gaps between the fields of palaeontology and physiology, problems on both sides were expected, but it is obvious that many palaeontologists do not know the physiological literature, just as, unfortunately, the reverse is true. In most chapters, if there are references to functional studies, they are less than 5% of the total references cited and frequently very outdated and often superseded.

An example of this is provided in Chapter 9 on lepidosaurs – a group for which I am familiar with the extant anatomy and physiology, in the form of lizards. Although the author does write (p. 259) that, “To date ... the inner ear of fossil lizards has received little attention”, the unique and enormous variations of the basilar papilla of modern lizards and their clear dependence on lizard family characteristics are not even mentioned. The references to studies of function of the middle and inner ear of lepidosaurs are all from the 1970s and thus ignore what in the meantime is a large literature on these groups. The discussion of lepidosaur ears (*e.g.* p. 274) is confined to one species described in a 1970 paper. Since work subsequently has shown, for example, that Wever’s famous 1987 book “The Reptile Ear” has a major flaw that makes all of his physiological measurements in lizards unreliable, this dearth of references to modern work is very unfortunate.

Similarly, in the chapter on archosaurs (birds, crocodylians, dinosaurs and their relatives), of the 116 references only four are related to function and the most recent reference to physiology is Wever 1978. Neither Gleich *et al.* (2005) nor Walsh *et al.* (2009) are mentioned, even though those two papers are the only serious attempts to use the physiological and anatomical studies of modern archosaurs to attempt to understand auditory function in dinosaurs and ancient birds. The profound lack of such connections to modern literature perhaps led to the extraordinary statement on p. 315 (that is not referenced): “Another feature of the inner ear observed in archosaurs in general is the elongation of the cochlea, *connected to the extension of the hearing range to lower frequencies*” (my italics). This is just wrong – if anything, the extension led to the hearing of *higher* frequencies (see Vol. 22 of the SHAR series). Also, the statement on p 316, repeated on p. 320, regarding crocodylian hearing: “Directional hearing, a consequence of pneumatization...” is at best misleading and incomplete.

It was a good move to place the chapter on amphibian hearing at the end of the book, as it runs counter to the completely false expectation that vertebrate groups form a time series (frogs-lizards-birds-mammals). Unfortunately, this chapter also contains a serious error in the statement (p. 351)



that (amphibians) "... share a second receptor, the amphibian papilla, *which perceives sounds with a different range of frequencies than the tetrapod basilar papilla*". Of course, amphibians are tetrapods and one must assume that amniotes were meant here. Of the 86 references, only two deal with ear function, perhaps explaining how such errors of understanding can creep in. The amphibian papilla, as shown by numerous studies (e.g. chapter 6 in Manley *et al.* 2004), responds well to frequencies generally below 1 kHz and thus well within the range of most tetrapod hearing organs.

The three chapters on the ears of mammals and their ancestors are perhaps together the best currently available summary of this topic. The "story" is a history lesson that can be easily followed, from the earliest amniotes that showed no specializations to a tympanic middle ear. The future stapes of early tetrapods, indeed of early amniotes including the non-mammalian ancestors of mammals such as pelycosaurs, was a bulky, structural skull support not at all adapted for hearing. Thus these animals very likely heard poorly and only low frequencies. The changes that over many tens of millions of years did lead to tympanic middle ears were in fact adaptations resulting in different or more efficient feeding. Thus in his chapter, Kemp (p. 133) speaks of serendipity underlying the availability of several small bones in the region behind the jaw joint that could form a middle ear (in mammals). In non-mammals, the stapes alone proved to be adequate in the – independent and multiple – evolution of single-ossicle middle ears. It is rather a pity that a recent paper on a gliding Jurassic mammalian species that – again independently – evolved a tympanic middle ear but with five ossicles (Han *et al.* 2017) appeared after the book's publication. This emphasizes the clear message of these chapters that the middle ear of different lineages of mammals evolved their structures independently and differently over long periods of time. The results, although very similar in most cases, are by no means always the same. As the evolutionary biologist would say, homoplasies (similarities in characteristics due to shared ancestry but parallel evolution) were frequent, both in middle- and inner-ear features. A mammal should now be defined as a species with a multi-ossicle (rather than three-ossicle) middle ear.

As described and beautifully illustrated by Luo *et al.* (Chapter 6), the evolution of middle ears then resulted in much more rapid and dramatic changes in the true mammal lineages, especially later in the cochlea, including coiling and further profound elongation. Thus hearing systems began to emerge out of the low-frequency, loud-sound mode still shown by basal therapsids (important mammal ancestors) into the world of higher-frequency, more sensitive hearing. Modern mammalian cochleae, as described in these chapters, show important differences between the subgroups, for example, in the lack of bony supports and a lack of a bony cochlear ganglion canal in egg-laying monotremes, but a homoplasy that also led to two ganglion canal systems evolving independently in different therian mammal groups, one now extinct.

Notwithstanding its shortcomings, the editors and authors of this book have done a remarkable job. It is a wonderful study resource for students of palaeontology who are interested in learning about the evolution of vertebrate ears, but also a very useful reference work for auditory anatomists and physiologists interested in the evolutionary origins of inner and middle ears, or those who simply want to find out how these amazingly sensitive and useful structures came to be.

**Geoff Manley**

*Technical University of Munich*



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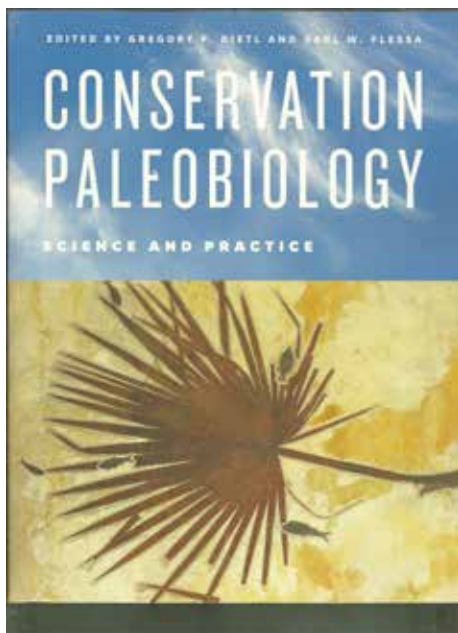
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**Conservation Paleobiology: Science and Practice**

Gregory P. Dietl and Karl W. Flessa (Editors), 2018, 336 pp., University of Chicago Press; Hardback ISBN: 9780226506722 US\$120; Paperback ISBN: 9780226506692 \$40; E-Book ISBN: 9780226506869 US\$40

While much discussion and many papers about whether or not the Earth's biota is currently experiencing a sixth mass extinction have caught the public imagination and fired public debate, conservation palaeobiology has quietly been toiling away to try to use the fossil record to understand the fate of individual species and ecosystems and, above all, to help in the conservation of extant taxa. The grim, but earnest, tagline of the field is 'putting the dead to work'.

The current volume is an expanded version of a 2010 edition produced from the materials assembled for the 2009 Paleontological Society Short Course *Conservation Paleobiology: Using the Past to Manage the Future*. The previous volume was much in demand and sold out rapidly, so I am pleased that University of Chicago Press has commissioned this new edition and made it available as an e-book, so it will remain available on demand. Clear and detailed halftone illustrations, which are 'house style' for most of the *Short Courses* volumes, are used throughout without much loss of impact and this has doubtless helped to keep the price to an affordable US\$40.





Although many of the topics share common ground with conservation biology, population biology, macroecology and some areas of actualistic taphonomy, there are only two recent single-volume treatments available, which I am aware of, that provide a comprehensive overview of the field.

The striking thing about the list of authors is that, in nearly all cases, at least one author is a leading figure in another area of palaeontology, palaeobiology, historical ecology, or conservation biology.

The introduction to the volume is brief but explains why conservation palaeobiology has coalesced into a clear field and does note that although the term was coined in 2002, there is a long history of thinking about how the past record of life might inform work on extant species and ecosystems.

Dietl and Flessa have retained the broad divisions of the earlier volume for these 15 papers: *Section One*: Conservation Paleobiology in Near Time; *Section Two*: Conservation Paleobiology in Deep Time; *Section Three*: Conservation Paleobiology at Work.

It feels a touch invidious to pick out particular contributions in what is a uniformly excellent collection but I shall make my personal picks. Kowalewski deals deftly with the multi-disciplinary aspects of using fossil shells from the Holocene deposits to extract a wide range of biological and environmental data of great significance for species conservation and tracking physical and chemical environmental variables. Jackson and McLenachan stress how far current marine ecosystems have undergone shifts in baseline parameters and present crucial historical work that establishes the 'long now' of the degradation of Caribbean reefs, stretching back to the pre-Columbian, and echoes the historical ecological work of the late Oliver Rackham on tree cover in Great Britain, which highlighted that significant deforestation activity occurred as early as the Bronze Age.

Moving on to the 'Deep Time' section, Lyons and Wagner present clear methods and several case studies that apply macroecological tools to fossil datasets. Roopnarine presents a detailed analysis of the usefulness of food web modelling in the fossil record, covering model-building in science, and provides a nuanced discussion of the limits of such models that is balanced by some shrewd insights into how to increase the value of modelling exercises. In the final chapter in this section, Allmon, also considers shifting baselines but in the context of how human activity may be cascading forward in time to change patterns of future speciation by altering key ecological variables such as biomass, productivity and abundance distributions. An insightful question this chapter raises is what are 'natural' patterns of abundance, as ecologists have developed abundance models over the last century or so based on fauna and flora which have already experienced centuries to millennia of human influence.

Both of the first two sections contain papers that are of interest to a wide Earth Science readership. I do stress this is a volume to show to your colleagues working on stable isotopes, fluvial dynamics or geostatistics, as it is highly interdisciplinary. From my own efforts to apply some of these approaches to freshwater pearl mussels in Scotland, I can attest to how quickly I found myself interacting with everyone from conservation practitioners working on rivers across the British Isles to experts in radiocarbon dating.

The final section contains only two papers, but Flessa's chapter on 'translational palaeoecology' is an eloquent summary of the particular contribution that dead individuals from extant taxa can make towards conserving populations of their living relatives and the broader habitats that these dead



individuals lived in. Such information is an incredibly important, and underexploited, evidence base, as discussions about rewilding and the reintroduction of extirpated species such as the wolf and lynx in Great Britain gain wider public and policy attention. Chapter 15 is a record of a round-table discussion among five conservation palaeobiologists whose work is informing government and non-governmental efforts to conserve a wide range of taxa, and provides a valuable insight into how the work of conservation palaeobiology can contribute to the efforts of such organizations.

Dielt and Flessa close the volume with a short epilogue on conservation palaeobiology in the Anthropocene. This tackles the difficult practical and ethical questions of attempting to maintain ecosystems on a human-dominated planet, at a time when some scientists and organizations are proposing or considering quite radical approaches to restore ecosystem functions by introducing species to fill vacant roles that have fundamentally changed since large predators or herbivores were removed.

Whatever the eventual decisions societies, land owners and managers make on these issues, the key message of the volume is that palaeontology and its allied sciences can make a difference to the future of taxa and ecosystems and provide an unexpected wealth of evidence to support decisions affecting our living biodiversity.

**Al McGowan**

*GeoBioD*



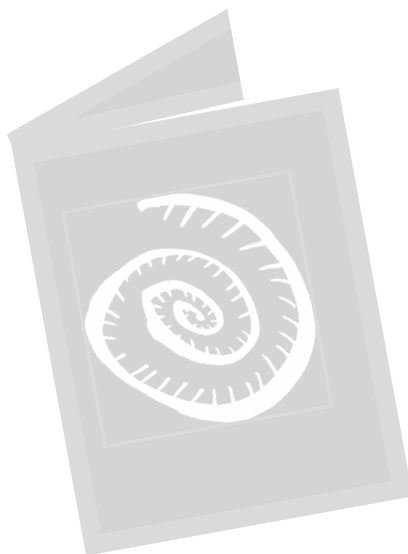
# Books available to review

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

- *The White River Badlands: Geology and Palaeontology*, by Rachel C. Benton, Dennis O. Terry Jr., Emmett Evanoff and H. Gregory McDonald.
- *Acrocanthosaurus Inside and Out*, by Kenneth Carpenter.
- *Patrons of Paleontology: How Government Support Shaped a Science*, by Jane P. Davidson.
- *Terrestrial Conservation Lagerstätten: Windows into the Evolution of Life on Land*, by Nicholas Fraser and Hans-Dieter Sues (eds).
- *The Tyrannosaur Chronicles*, by David Hone.
- *Life Through the Ages: Commemorative Edition*, by Charles R. Knight.
- *Dinosaurs: The Textbook*. (6th Edition), by Spencer G. Lucas.
- *The Princeton Field Guide to Prehistoric Animals*, by Donald R. Prothero.
- *Integrated Molecular Evolution*, by Scott. O. Rogers.
- *Die fossilen Brachiopoden der Schweiz* (2nd Edition), by Heinz Sulser.

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# Careering off course!

## *Inspirational palaeontologists*

**Cathy Whitlock, Director of the Montana State University Paleocology Lab**



Photo © Montana State University Press Office.

Cathy Whitlock is Professor of Earth Sciences, Director of the Montana State University Paleocology Lab, and Fellow and former co-Director of the Montana Institute on Ecosystems at Montana State University. Cathy is recognized nationally and internationally for her scholarly contributions and leadership activities in the area of long-term environmental and climate change. Her research on forest, fire and climate history extends from the western US to temperate regions in New Zealand, Patagonia, Australia and Europe. Over her career, Cathy has published over 190 scientific publications on this topic and trained over 30 graduate students. Following the 1988 Yellowstone fires, she helped develop analytical tools and modelling approaches to reconstruct past fires from lake-sediment charcoal; these methods are now the standard for fire-history research around the world. Yellowstone continues to be a major area for research, and Cathy and students are currently working on a project to understand the ecological consequences of past hydrothermal explosions. Cathy received her BA in Geology from Colorado College and her MS and PhD in Geological Sciences from the University of Washington, followed by a NATO Postdoctoral Fellowship at Trinity College Dublin. She was elected as Fellow of the American Association for the Advancement of Science in 2012 and Fellow of the Geological Society of America in 2017. She received the international EO Wilson Biodiversity Technology Pioneer Award in 2014 and Professional Excellence Award in Academic/Research from the Association of Women Geoscientists in 2015.

### **How did your initial interests start?**

I have always had an interest in natural science and the great outdoors. I came from a medical family and everyone thought I would follow in that direction. My father was a medical school professor and much of my childhood was spent hanging out in his research laboratory,

helping feed experimental mice and rabbits, washing glassware, and dusting skeletons. At age 14, my family moved to Colorado where I was transformed by the opportunity to hike in spectacular mountains, enjoy fields of wildflowers, and ski in deep powder. At that point, I knew that I would need to find a



career that would involve both science and the outdoors. The first class I took in college was Geology and that got me hooked.

#### **What led you to your current career path?**

At college I discovered that I wasn't so interested in deep-time geology, but I really liked the connections that geology can make to the modern environment, and this got me more into palaeoecology. I had some wonderful mentors along the way including Bill Watts from Trinity College in Dublin, and at Colorado College I had the good fortune to work with Dr Estella Leopold, the famous palaeoecologist and daughter of Aldo Leopold, who was then at the US Geological Survey in Denver. Estella was the first woman scientist that I had ever worked with, and she was so inspiring and encouraging. During my career I have worked in a botany department, a geography department, and now I'm in an Earth science department – when you work on the interface between the past and the present you can have many homes!

#### **What has been the most challenging aspect of your career?**

For much of my career, I was the only woman researcher in the unit where I worked, and the expectations on me in this token role were sometimes pretty challenging. Over the years, universities and departments have become more diversified, and it's been a great pleasure to support young women as they get started and become leaders in their field.

#### **Can you describe your current lab?**

The Palaeoecology Lab usually has a couple of postdocs, five or six masters and PhD students, as well as undergraduates. The goal is to have an array of students at different levels in their careers, and to encourage mentoring at all levels. At Montana State University, we have also invited tribal college students to join our research team, and some

of these undergraduates have continued in palaeontology and palaeoecology, which is great. We have a very active fieldwork programme, a lot of which is in the western US, including Yellowstone National Park in our backyard.

#### **How did your interest in fire-history come about?**

The 1988 Yellowstone fires were epic, about 40% of Yellowstone burnt in that year driven by very strong climate conditions. I had been working on the vegetation history of the Park for a couple of years, but hadn't really considered fires or fire history. The 1988 fires were so enormous that I realized that we were missing an important ecological process in our studies. So, we started a programme to see how we could better reconstruct fires in the past. We set up a modern monitoring project in Yellowstone, looking at how far charcoal travelled, how long it took for charcoal particles to become buried in lake sediments, and how well charcoal abundance in sediment cores reflected actual fire conditions. We developed a whole series of techniques as part of the Yellowstone programme, and those techniques are now being used around the world.

#### **What advice would you give for someone starting out on a scientific career?**

It's really important to network, get out and talk to people. Often success in academia comes from who knows you and how they value your contributions. You can't just sit in your office or lab doing good research and think that people will notice it because they probably won't. You have to get out there – give talks, introduce yourself to colleagues, and participate in scientific organizations like the Palaeontological Association.

#### **Simon Wills**

*Natural History Museum, London*

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Montana State University Paleocology Lab: <<https://sites.google.com/site/msupaleoecologylab/>>

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### ***TAXONOMY/NOMENCLATURE UPDATE***

This publication is now registered on ZooBank and is thus deemed to be valid for taxonomic/nomenclatural purposes. However we request contributors (especially those contributing grant reports) not to include names of new taxa in their reports.

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

Deadline for copy for Issue No. 98 is 4th June 2018.

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