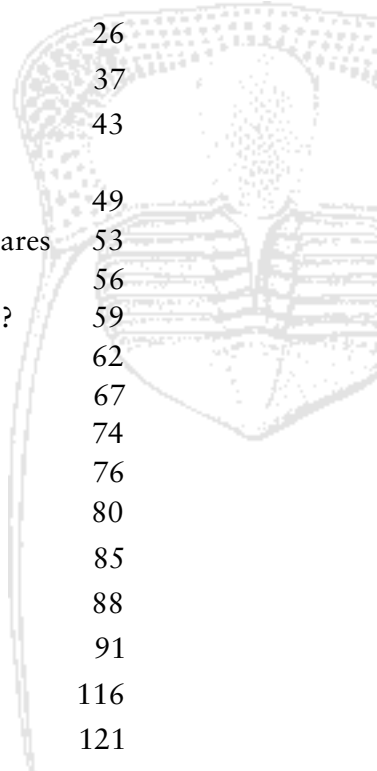


# 101

## The Palaeontology Newsletter

### Contents

Editorial	2
Association Business	3
Annual Meeting 2019	3–25
Nominations for Council	26
Association Meetings	37
News	43
From our correspondents	
A Palaeontologist Abroad	49
Legends of Rock: Asunción Linares	53
Behind the Scenes: Michigan	56
Public engagement: why bother?	59
Positively palaeontological	62
R for Palaeontologists	67
Spotlight on Diversity	74
The Brilliant Club	76
Future meetings of other bodies	80
Meeting Reports	85
Obituary: David J. Batten	88
Grant Reports	91
Book Reviews	116
Careers Q&A	121
<i>Palaeontology</i> vol. 62 parts 3 & 4	124–125
<i>Papers in Palaeontology</i> vol. 5 part 2	126



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Reminder: The deadline for copy for Issue no. 102 is 7th October 2019.

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## Editorial

Typically, the (boreal) summer issue is our thinnest, but we have bucked that trend for the current volume.

Diversity issues are again to the fore, with **Lee Hsiang Liow** contributing her perspective on being a “unique” and “lucky” scientist for the second piece in our diversity Spotlight column. **Maria McNamara** shares the details of the Association’s new Carer’s Bursary (as well as contributing another article on the many benefits of public engagement). Note that the bursary aims to support attendance at the Annual Meeting for those with caring responsibilities regardless of the specific role (*i.e.* it is not only for parents). A team of authors (comprising **José María González-Donoso**, **Dolores Linares**, **Federico Olóriz**, **Paul Palmqvist** and **José Sandoval**) produced this issue’s *Legends of Rock* piece on the pioneering Spanish palaeontologist Asunción Linares – the third woman to receive full professorship tenure in the entire country’s history.

The Careers Q and A gets a “reboot”, returning to its’ original purpose – to highlight careers outside of the traditional academic route but that still draw on skills gained in academia. The subject of this Q and A is **Betty Schirrmeister** who currently works as a Senior Data Scientist in the UK. *Behind The Scenes At The Museum* returns with a piece contributed by **Matt Friedman** highlighting the palaeontological collections at the University of Michigan in Ann Arbor (USA). This issue’s *A Palaeontologist Abroad* comprises three European-based early-career researchers, **Thomas Clements**, **Gabriel Aguirre** and **Yadong Sun**, giving their perspectives on palaeontological life in Ireland, Switzerland and Germany, respectively. **Susannah Lydon**’s news piece includes titillating details of the recent “dinosaur sex lake” controversy, and **Jan Zalasiewicz** regales us with the tale of the time Darwin met Humboldt. Bibliophiles should also check out **Tom Challands**’ *Books to Review* section that has recently gotten a major update, as well as the special offer to Association members interested in purchasing the Terrestrial Conservation Lagerstätten volume from Dunedin Academic Press. **Uwe Balthasar** shares application details for the Association’s next Exceptional Lecturer.

Finally, I want to take a moment to acknowledge **Mark Bell**’s contributions to the *Newsletter* that have spanned multiple editors and began way back in issue 85. This issue marks his last piece on using R in palaeontological analyses and focuses on a complete data analysis pipeline from one of his own publications. Mark’s contribution is, I hope, a lasting<sup>1</sup> one, in helping palaeontologists increase their computational and numerical skills, and continues the tradition laid down by the earlier contributions of Peter Forey (on cladistics) and Norm Macleod (on morphometrics)<sup>2</sup>. A fitting replacement has not yet been lined up but I am sure all my predecessors will join me in thanking him for his service to the Association.

**Graeme Lloyd**

*Newsletter Editor*

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



@ThePalAss



<<https://www.facebook.com/groups/palass/>>

<sup>1</sup> Certainly his columns will continue to be made available as a resource on the Association’s website, at: <<https://www.palass.org/publications/newsletter/r-palaeontologists>>.,

<sup>2</sup> Both of which are also available at: <<https://www.palass.org/publications/newsletter/cladistics-palaeontologists>> and <<https://www.palass.org/publications/newsletter/palaeomath-101>>, respectively.



# Association Business

## Annual Meeting 2019

### Notification is given of the 63rd Annual General Meeting

This will be held at the University of Valencia, Spain, on Thursday 19th December 2019, following the scientific sessions.

#### AGENDA

1. Apologies for absence
2. Minutes of the 62nd AGM, University of Bristol
3. Trustees Annual Report for 2018
4. Accounts and Balance Sheet for 2018
5. Election of Council and vote of thanks to retiring members
6. Report on Council Awards
7. Annual address

#### DRAFT AGM MINUTES 2018

Minutes of the Annual General Meeting held on Saturday 15th December 2018 at the University of Bristol, UK.

- 1. Apologies for absence.** None.
- 2. Minutes.** The minutes of the 2017 AGM were agreed a true record by unanimous vote.
- 3. Trustees Annual Report for 2017.** The report was agreed by unanimous vote of the meeting.
- 4. Accounts and Balance Sheet for 2017.** The accounts were agreed by unanimous vote of the meeting. The proposal to reappoint M.R. Corfield of Corfield Accountancy Ltd as Association financial examiner was also agreed by unanimous vote.
- 5. Election of Council and vote of thanks to retiring members.**

**5.1** Prof. M.P. Smith extended a vote of thanks to the following members of Council who were retiring from their positions this year: Dr A.B. Smith, Dr L.G. Herringshaw, Prof. R.J. Twichett; Council thanked Prof. M.P. Smith, who also retired following the AGM.

**5.2** The following members were elected to serve on Council: President: Prof. C.H. Wellman, Vice-Presidents: Dr C.J. Buttler and Prof. T.R.A. Vandenbroucke, Treasurer: Dr P. Winrow, Secretary: Dr C.T.S. Little; Editor-in-Chief: vacant; Editor Trustees: Dr B.H. Lomax and Prof. M.A. Purnell, Newsletter Editor: Dr G.T. Lloyd, Book Review Editor: Dr T.J. Challands, Publicity Officer: Dr S.J. Lydon, Education Officer: Dr M.E. McNamara, Outreach Officer: Dr L.M.E. McCobb, Internet Officer: Dr A.R.T. Spencer, Meetings Coordinator: Dr U. Balthasar, Diversity Officer: Dr R.C.M. Warnock, Ordinary Members: Dr D.P.G. Bond, Dr A.M. Dunhill, Prof. A.S. Gale and Ms Z.E. Hughes.



5.3 Dr C. Martínez Pérez and colleagues will organize the Annual Meeting in 2019 at the University of Valencia, Spain.

**6. Association Awards. The following awards were announced:**

6.1 The Lapworth Medal was awarded to Prof. D.J. Siveter (Oxford University Museum of Natural History).

6.2 The President's Medal was awarded to Prof. E.J. Rayfield (University of Bristol).

6.3 The Hodson Award was presented to Dr X. Ma (Natural History Museum, London).

6.4 The Mary Anning Award was presented to Mr N. Chase (Isle of Wight, UK).

6.5 The Gertrude Elles Award for public engagement was jointly presented to Ms E. Dunne, University of Birmingham, and Mr R. Barnett, University of Durham, for their efforts in the Scholars Programme of the Brilliant Club.

6.6 Research Grants were awarded to: Dr K. Agiadi, National and Kapodistrian University of Athens, *Time resolution of fish death assemblages on the Eastern Mediterranean shelf*; Dr P.E. Jardine, University of Münster, *A chemical clue to an abominable mystery? Chemotaxonomy of basal angiosperm pollen and cuticles*; and Dr I.A. Rahman, Oxford University Museum of Natural History, *Studying the soft tissues of exceptionally preserved Carboniferous crinoids with high-resolution X-ray microtomography*.

6.7 Under the Small Grants Scheme, the following awards were announced: the Whittington Award to Mr T.J. Raven, NHM, London and University of Brighton, *The evolutionary history of North American nodosaurid ankylosaurian dinosaurs*; the Callomon Award to Mr A. Elgorriaga, Universidad de Buenos Aires, *A new window on Jurassic Patagonian gymnosperm diversity: the exquisitely preserved "Pomelo" taphoflora of Chubut, Argentina*; Stan Wood awards to Ms E. Coombs, University College London, *Investigating cranial morphology in two geographically distinct groups of Oligocene cetaceans*, and Dr P. Cruzado-Caballero, Universidad Nacional de Río Negro, *Patagonian Ornithomimid dinosaurs and the conquest of Western Gondwana*; and Sylvester-Bradley awards to Mr A. Dhungana, University of Cambridge, *Ecology of Silurian deep-water coral communities*, Ms E. Long, Durham University, *Reconstructing the early development of segmented animals in 3D*, Mr N. Mongiardino Koch, Yale University, *Merging genomics and phenomics to understand macroevolution: a case study using echinoid body size*, Dr L. Pérez, Museo de La Plata, *Oligocene/Miocene Bryozoans from southern South America: a taxonomic and biogeographic perspective*, and Mr J. Prowting, University of Portsmouth, *Palaeoclimatic variation in the Adriatic Sea during the Late Pleistocene Heinrich Event 1 (18–14 Kys BP)*.

6.8 Undergraduate Research Bursaries were awarded to: Ms F. Butler, University of Birmingham, supervised by Dr T. Dunkley Jones, *The Evolution of Alkenone-producing Coccolithophore Algae*; Mr S. Cross, University of Bristol, supervised by Prof. M.J. Benton, *Reconstructing the limbs and girdles of the Ichthyosaurs of Strawberry Bank, Somerset*; Ms J. Farrant, University of Birmingham, supervised by Dr K.M. Edgar, *Biotic disturbance in the latest Eocene – impact events and climate cooling*; Ms S. Glasgow, Liverpool John Moores University, supervised by Dr P.L. Falkingham, *Regionalization of cervical vertebrae in plesiosaurs*; Mr T. Gray, University of Leicester, supervised by Prof. M.A. Purnell, *The grit problem: environmental signals in tooth microwear and implications*



for reconstructing diets of fossil mammals; Ms E. Griffiths, University of Oxford, supervised by Prof. R.B.J. Benson, *Postcranial anatomy of a new plesiosaur from the Oxford Clay*; Mr T. Henton, University of Birmingham, supervised by Dr I.J. Sansom, *The oldest urolith? Investigating a possible kidney stone from the Kimmeridgian (Jurassic) of Dorset*; Ms E. Hunt, Imperial College, London, supervised by Dr P.D. Mannion, *A new crocodylomorph from the early Late Cretaceous Kem Kem beds of Morocco*; Mr S. Webb, University of Birmingham, supervised by Prof. R.J. Butler, *Macroevolutionary patterns of tetrapod evolution during the Carboniferous–Permian transition: evidence from fossil footprints*; and Mr G. Willment, University of Oxford, supervised by Dr S. Giles, *Endocranial anatomy of a durophagous Permian actinopterygian*.

**6.9** Engagement Grants were awarded to Ms E. Panciroli for ‘Scottish fossil workshops in rural schools’, and Mr D. Marshall for the project ‘Palaeocast Gaming Network’.

**6.10** The 2018 Best Paper Awards were presented to Prof. R.B.J. Benson and colleagues for their paper entitled ‘Cope’s rule and the adaptive landscape of dinosaur body size evolution’ (*Palaeontology*), and to Drs C. Ji and H. Bucher for ‘Anisian (Middle Triassic) ammonoids from British Columbia (Canada): biochronological and palaeobiogeographical implications’ (*Papers in Palaeontology*).

**6.11** The President’s Prize was presented to Ms E. Panciroli (University of Edinburgh and National Museums Scotland).

**6.12** The Council Poster Prize was presented to Ms N.M. Murales García (University of Bristol).

**7. Annual Address.** The Annual Address entitled ‘Ice in a greenhouse world – 60 Ma and 2060’ was given by Prof. Dame Jane Francis (British Antarctic Survey).

## Trustees Annual Report 2018

The Trustees present their report with the financial statements of the charity for the year ended 31 December 2018. The Trustees have adopted the provisions of *Accounting and Reporting by Charities: Statement of Recommended Practice* applicable to charities preparing their accounts in accordance with the Financial Reporting Standard applicable in the UK and Republic of Ireland (FRS 102) (effective 1 January 2015).

### 1. OBJECTIVES AND ACTIVITIES

**1.1 Aims and objectives:** The aim of the Association is to promote research in Palaeontology and its allied sciences by (a) holding public meetings for the reading of original papers and the delivery of lectures, (b) demonstration and publication, and (c) by such other means as the Council may determine. In order to meet these objectives, the Association continues to increase its range and investment in public outreach and other charitable activities, whilst continuing to support research, publications, and student and speaker attendance at national and international meetings including our flagship Annual Meeting.

**1.2 Risk register:** In 2018 Council developed a 31-point risk register for the Association, with defined risk owners. This document will serve as a reference point for future activities of the Association.



**1.3. Finances:** At a separate awayday in October, Council discussed Association finances, based on a financial review by the Treasurer and the Executive Officer. In order to secure the Association finances for the future (in addition to the planned 2019 increase to annual subscription fees), Council agreed to the following for 2019 onwards: to ensure that all Annual Meetings are cost-neutral to the Association; to reduce overall expenditure on Research Grants, Undergraduate Research Bursaries and Grants-in-aid; to reduce the Public Engagement Group budget, including a re-balance of expenditure with a reduction in financial support to Fossil Festivals.

**1.4 Grants-in-aid for meetings and workshops:** The Association provided funds to support the following meetings and workshops: 4th International Meeting of Early-Stage Researchers in Palaeontology (4th IMERP) (Mr F. Blanco, Museum für Naturkunde, Berlin); 13th International Symposium on Fossil Cnidaria and Porifera (Prof. F. Bosellini, Università degli Studi di Modena e Reggio Emilia); Crossing the Palaeontological–Ecological Gap (Dr A.M. Dunhill, University of Leeds); The 10th European Palaeobotany and Palynology Conference (EPPC2018) (Prof. J.C. McElwain, Trinity College Dublin); Uncovering Yorkshire's Jurassic (Dr L. Herringshaw, University of Hull); Palaeontological excavations at an exceptional site: the diversity of life 125 million years ago (Dr H. Martín-Abad, Universidad Autónoma de Madrid); 1st Palaeontological Virtual Congress (Dr C. Martínez Pérez, Universitat de València); Journées de rencontre autour du patrimoine minier de la Corniche angevine (JRPM 2018) (Dr C. Strullu-Derrien, Natural History Museum, London); 18th International Bryozoology Association Conference (Dr K. Žágoršek, Technická Universita Liberec).

**1.5 Public meetings:** Two public meetings were held in 2018, and the Association extends its thanks to the organizers and host institutions of these meetings.

*62nd Annual Meeting.* The Association's Annual Meeting is its flagship meeting and this year was held on 14–17 December at the University of Bristol. Dr J. Vinther, together with local support from colleagues and PhD students, organized the meeting, which included a symposium on 'Frontiers and Advances in Dinosaur Palaeobiology' and comprised a programme of internationally recognized speakers. There were 314 attendees. The Annual Address was entitled 'Ice in a greenhouse world – 60 Ma and 2060' and was given by Prof. Dame Jane Francis (British Antarctic Survey). The President's Prize for best oral presentation by an early-career researcher was awarded to Ms E. Panciroli (University of Edinburgh and National Museums Scotland). The Council Poster Prize for best poster presentation by an early career researcher was presented to Ms N.M. Murales García (University of Bristol).

*Progressive Palaeontology.* This is an annual, open meeting for research students in palaeontology and allied sciences to present their work to an audience of their peers. The 2018 meeting was organized by Ms E. Wallace and a team of other students, and held at the University of Manchester and Manchester Metropolitan University on 7–9 June. There were 89 attendees.

**1.6 Publications:** The journals *Palaeontology* and *Papers in Palaeontology* are produced by Wiley. During 2018, the following volumes were published: *Palaeontology* volume 61, comprising six issues; and *Papers in Palaeontology* volume 4, comprising four issues. Council thanks Mr N. Stroud for assistance with the typesetting and production of the *Palaeontology Newsletter*.

**1.7 Research Grants:** A total of 20 applications for Palaeontological Association Research Grants were received. Three were recommended for funding in 2018, totalling £19,378, and were awarded to: Dr K. Agiadi, National and Kapodistrian University of Athens, 'Time resolution of fish death



assemblages on the Eastern Mediterranean shelf'; Dr P.E. Jardine, University of Münster, 'A chemical clue to an abominable mystery? Chemotaxonomy of basal angiosperm pollen and cuticles'; and Dr I.A. Rahman, Oxford University Museum of Natural History, 'Studying the soft tissues of exceptionally preserved Carboniferous crinoids with high-resolution X-ray microtomography'.

**1.8 Small Grants Scheme:** The scheme received 14 applications. Nine were recommended for funding in 2018, totalling £11,540.09. Small grants were awarded as follows: Mr T.J. Raven (NHM, London and University of Brighton) received the Whittington Award; Mr A. Elgorriaga (Universidad de Buenos Aires) received the Callomon Award; Ms E.J. Coombs (University College London) and Dr P. Cruzado-Caballero (Universidad Nacional de Río Negro) received Stan Wood awards; Mr A. Dhungana (University of Cambridge), Ms E.J. Long (Durham University), Mr N. Mongiardino Koch (Yale University), Dr L. Pérez (Museo de La Plata), and Mr J. Prowting (University of Portsmouth) received Sylvester-Bradley awards.

**1.9 Undergraduate Research Bursary Scheme:** The scheme attracted 17 applications, of which ten were recommended for funding in 2018, totalling £21,920. The awardees were as follows: Ms F. Butler, University of Birmingham, supervised by Dr T. Dunkley Jones; Mr S. Cross, University of Bristol, supervised by Prof. M.J. Benton; Ms J. Farrant, University of Birmingham, supervised by Dr K.M. Edgar; Ms S. Glasgow, Liverpool John Moores University, supervised by Dr P.L. Falkingham; Mr T. Gray, University of Leicester, supervised by Prof. M.A. Purnell; Ms E. Griffiths, University of Oxford, supervised by Prof. R.B.J. Benson; Mr T. Henton, University of Birmingham, supervised by Dr I.J. Sansom; Ms E. Hunt, Imperial College London, supervised by Dr P.D. Mannion; Mr S. Webb, University of Birmingham, supervised by Prof. R.J. Butler; and Mr G. Willment, University of Oxford, supervised by Dr S. Giles.

**1.10 Publicity, outreach and engagement:** The Association continues to promote Palaeontology and its allied sciences to the national print media, radio and television. The Association is a major financial supporter of the Lyme Regis Fossil Festival and the Yorkshire Fossil Festival (held in University of Hull in 2018, as part of the Hull Science Festival). At both festivals the Association had displays and activities for the public on the theme of fossilization, organized and staffed by members of Council, the Executive Officer and volunteers. The Public Engagement Group (PEG), consisting of the Outreach Officer, Education Officer, Publicity Officer, Executive Officer, President and Treasurer decided on expenditure of the group budget (£30,000 for 2018), supporting recurring festival activities, Engagement Grants and commissioned projects.

**1.11 Engagement Grants:** The scheme received a total of six applications in 2018, of which two were recommended for funding, totalling £3,961.88. These were awarded to Ms E. Pancirolli for 'Scottish fossil workshops in rural schools' and Mr D. Marshall for the project 'Palaeocast Gaming Network'.

**1.12 Diversity study:** In 2017 the Association commissioned a diversity study of the Association and field of palaeontology, which was undertaken by Parigen Ltd. in 2018, at a cost of £17,609. The contractors presented their findings to Council in May, and an action plan was drawn up by Council in October. The findings of the study and the action plan were presented at the 2018 AGM by the President. The action points include the following: create a new Council post of Diversity Officer with specific roles in the Diversity Group; develop programmes with disadvantaged schools/communities and investigate a school-level research placement scheme; continue to monitor the



proportion of male to female authors in Association publications and to consider actions to improve this imbalance; enhance the Association mentoring scheme and evaluate outcomes; include additional career talks at Progressive Palaeontology; introduce guidelines relating to dependent children at the Annual Meeting; introduce a Carer's Bursary scheme for the Annual Meeting; encourage Annual Meeting organizers to have diverse session chairs, including a balanced female to male ratio; establish a working group to look at the nomination and voting processes for the Association prizes and awards; and continue to monitor diversity and maintain diversity as a live project.

**1.13 Diversity Group:** In order to deliver the diversity study action points in 1.12, the Association formalized a Diversity Group that will be led by the new Diversity Officer, and comprises the President, Executive Officer, Publications Officer, and a sub-group of other Council members. The Diversity Group will work closely with the Public Engagement Group and will report to Council through the meetings, and the membership via the *Newsletter* and social media.

**1.14 Palaeontological Association Exceptional Lecturer scheme:** In order to promote palaeontology to the wider academic community and public, and to recognize excellence in research among palaeontologists, in 2018 the Association introduced a new scheme called the Innovations in Palaeontology Lecture Series, to be given by the PalAss Exceptional Lecturer, who is selected in a competitive process. The Exceptional Lecturer will give at least five lectures at five different institutions over a nine-month period. The first PalAss Exceptional Lecturer has now been selected and will give their lectures in 2019.

**1.15 Online activities:** The online activities of the Association continue to expand with greater emphasis on social media (Facebook, Twitter). The Association continues to be the sole host for the online-only journal *Palaeontologia Electronica*, as well as continuing to host websites for other societies (The Palaeontographical Society, International Organisation of Palaeobotany), palaeontological online resources (EDNA fossil insect database, the Kent Fossil Database, SPIERS Software), palaeontological networking sites (European Coalfield Conservation Opportunities) and online outreach projects (Palaeontology [Online]). The listserv PaleoNet also continues to be hosted. The Association continues to run its internet actives on cloud-based services provided by AWS located on EU-based servers. At the end of 2018 members of the PalAss Facebook group numbered 1,591 and the @ThePalAss Twitter account had 5,000 followers.

**1.16 Awards:** The Lapworth Medal, awarded to people who have made a significant contribution to the science by means of a substantial body of research, was presented to Prof. Derek J. Siveter (Oxford University Museum of Natural History). The President's Medal, awarded to a palaeontologist within 15 to 25 years of their PhD in recognition of outstanding contributions in their earlier career, coupled with an expectation that they will continue to contribute significantly to the subject in their further work, was presented to Prof. Emily J. Rayfield (University of Bristol). The Hodson Award, for a palaeontologist within ten years of award of their PhD who has made an outstanding contribution to the science through a portfolio of original published research, was awarded to Dr Xiaoya Ma (Natural History Museum, London). The Mary Anning Award, for an outstanding contribution by an amateur palaeontologist, was made to Mr Nick Chase (Isle of Wight, UK). The inaugural Gertrude Elles Award for high-quality, amateur or institutional, public engagement projects that promote palaeontology was awarded to Ms E. Dunne (University of Birmingham) and Dr R. Barnett (University





of Durham) for their efforts in the Scholars Programme of the Brilliant Club. The 2018 Best Paper Awards in *Palaeontology* and *Papers in Palaeontology* were given respectively to Prof. R.B.J. Benson and colleagues for their paper entitled 'Cope's rule and the adaptive landscape of dinosaur body size evolution', 61(1), 13–48; and Dr C. Ji and colleague for their study on 'Anisian (Middle Triassic) ammonoids from British Columbia (Canada): biochronological and palaeobiogeographical implications', 4 (4), 623–642. Council also awards undergraduate prizes to outstanding students in university departments where palaeontology is taught beyond Level 1; a total of 23 were awarded throughout the year.

**1.17 Forthcoming plans:** The Association will continue to make substantial donations from General and Designated funds to promote the charitable aims of the Association. Resources will be made available to continue a similar programme of grants, meetings, outreach and public engagement activities. As agreed at the 2017 AGM, from 2019 subscription fees will be: Ordinary Membership £40 (up from £30), Retired/Student Membership £20 (up from £15). Action points from the Diversity Study will be implemented during 2019, including a new Carer's Bursary scheme for the Annual Meeting, and the establishment of a working group to look at the nomination and voting processes for the Association prizes and awards. A small group has been set up to investigate soliciting additional legacies for the Association. The first 'Innovations in Palaeontology' lecture series will be given by the inaugural PalAss Exceptional Lecturer. The 63rd Annual Meeting will be held in December 2019 at the University of Valencia. The 2019 Progressive Palaeontology conference will be held at the University of Birmingham. The Association's website will continue to evolve in 2019, with all applications and nominations to be via online forms. Volume 62 of *Palaeontology* and volume 5 of *Papers in Palaeontology* will be published. Two additions to the *Field Guides to Fossils* series are in production and with publication expected in 2019. A book entitled *Trilobites, Dinosaurs and Mammoths* written by palaeoartist Mr J. McKay, with substantial input from Association members, will be published in 2019 and is expected to launch at the Lyme Regis Fossil Festival. The Public Engagement Group is in the process of developing initial content for a new Association YouTube channel, to be launched late in 2019. A tender process will be initiated for the filming and editing of the channel.

**1.18 Public benefit:** The Trustees confirm that they have referred to the Charity Commission's guidance on public benefit when reviewing the charity's aims and objectives, in planning future activities and setting the grant-making policy for the year.

## 2. ACHIEVEMENTS AND PERFORMANCE

**2.1 Meetings support:** During 2018, the Association agreed to support a total of nine palaeontological meetings, symposia or workshops worldwide (held in the Czech Republic, France, Ireland, Italy, Spain and the UK). In addition, our Postgraduate Travel Grant scheme supported ten postgraduate students to present their work at national and international conferences: Ms Bethany Allen (University of Leeds), Mr Yul Altolaguirre (Senckenberg Research Institute, Frankfurt), Mr Nicolas Baird (Natural History Museum, London), Mr Adam Bermingham (Northumbria University), Mr Alfio Alessandro Chiarenza (Imperial College London), Ms Paige de Polo (University of Edinburgh), Ms Karen Halsall (University of Liverpool), Ms Roxana Pirnea (University of Bucharest), Mr Omar Rafael Regalado Fernandez (University College London) and Ms Emily Roberts (University of Portsmouth). The Association also awarded £11,600 in travel grants to assist 28 student



members presenting at the 5th International Palaeontological Congress in Paris in July 2018. The Association's support enabled the worldwide dissemination of research to the benefit of the global palaeontological community.

**2.2 Publications:** During 2018, 276 papers were submitted to either *Palaeontology* or *Papers in Palaeontology*. Of these, 147 (53 %) were considered to be within scope by the Editorial Board and 90 (32 %) were subsequently accepted following peer review; a further 31 papers are still awaiting submission of a revised manuscript before a final decision is made. There was a further improvement in the impact factor of *Palaeontology*, which increased from 3.132 to 3.73. The impact factor of *Papers in Palaeontology* is now 2.156. The number of downloads of articles via Wiley Online Library was 8.7 % higher in 2018 relative to 2017 for *Palaeontology* and 122 % higher for *Papers in Palaeontology*. The Association continues to support data archiving by sponsoring Dryad data records; in the 2018 volumes 52 papers had associated data files, representing 58 % of all papers published (a similar proportion to 2017).

**2.3 Support for research:** In 2018 the Association agreed to fund the research activities of 19 early-career researchers based in three countries (Argentina, the UK and USA). Apart from directly benefitting the career development of the individuals concerned, the Association's funds continue to enable more palaeontological research to be undertaken worldwide than would otherwise be the case. Overall, the number grants funded in 2018 increased slightly from 2017 (from 19 to 22). Compared to 2017, applications for Research Grants increased substantially, from 15 to 20, and thus the success rate decreased again from 20 % to 15 %. The applications to the Small Grants Scheme decreased substantially (from 34 to 14), and the success rate consequently increased from 24 % to 64 %. Applications to the Undergraduate Research Bursary Scheme increased in 2018 compared to 2017 (from ten to 17) and the success rate decreased to 59 %.

**2.5 Mentoring scheme for early career palaeontologists:** In 2017 the Association devised a mentoring scheme for early career palaeontologists, to have a particular focus on palaeontologists at post-doctoral level in the first instance. After receiving offers from palaeontologists willing to act as mentors the scheme was publicized in the *Newsletter* and on social media in 2018. Nine postdoctoral palaeontologists applied to take part in the scheme and all have been assigned mentors. Guidelines have been developed to aid the relationships between mentors and mentees and we will consider methods to assess the scheme in 2019.

**2.6 Outreach, education and public engagement:** During 2018, the Association supported two major fossil festivals in the UK, in Lyme Regis and Hull, which attracted respectively an estimated 8,000 and 3,000 members of the general public of all ages. Workshops were delivered to around 150 primary school children by PalAss volunteers, as part of the Lyme Regis Fossil Festival schools' day, which involved scientists going out into the community. During 2018, we awarded two Engagement grants (see 1.9). Continued use of social media, in particular the Association's Twitter and Facebook accounts, has enabled the rapid and regular dissemination of research news, including of new publications, meetings and other information, to a growing audience (see section 1.15).

### 3. FINANCIAL REVIEW

**3.1 Reserves:** As of 31st December 2018, The Association holds reserves of £728,871 in General Funds, which enable the Association to generate additional revenue through investments, and



thus to keep subscriptions to individuals at a low level, whilst still permitting a full programme of meetings to be held, publications to be produced, and the award of research grants and Grants-in-aid. They also act as a buffer to enable the normal programme to be followed in years in which expenditure exceeds income, and allow new initiatives to be pursued. The Association holds £132,172 in Designated Funds, which contribute interest towards the funding of the Sylvester-Bradley, Hodson, Callomon, Whittington and Stan Wood awards and towards the Jones-Fenleigh fund. Total funds carried forward to 2019 totalled £861,043.

**3.2 Reserves policy:** The Association maintains a minimum of General Fund reserves at a level sufficient to fund at least one year's expenditure, based on a three-year average of expenditure, in addition to Designated Fund reserves. This policy is reviewed and approved annually by the Trustees.

**3.3 Summary of expenditure:** Total charitable expenditure, through grants to support research, scientific meetings and workshops in 2018 was £389,496. Governance costs were £44,557. Total resources expended were £473,733. The Association continues its membership of the International Palaeontological Association and remains a Tier 1 sponsor of *Palaeontologia Electronica*, and the *Treatise on Invertebrate Paleontology*.

#### 4. STRUCTURE, GOVERNANCE AND MANAGEMENT

**4.1 Nature of the governing document:** The Palaeontological Association was originally formed on 27th February 1957 as an unincorporated association, which was established as a registered charity (number 276369) on 21st August 1978. At an Extraordinary General Meeting on 16th March 2016, the membership voted in favour of the Association becoming a charitable incorporated organization (CIO) under the Charities Act 2011. All contracts and assets were transferred to the new organization on 1st January 2017. As a CIO the charity is an independent legal entity and, in the unlikely event of its being wound up, the members (including the Trustees) will have no liability for any outstanding contractual debts that the CIO cannot meet. However, the Trustees will continue to have the normal trustee liability for negligence or fraudulence in managing the charity's affairs. The charitable objectives of the Association remain unchanged. The change in legal status means that there has been a different registration number (1168330) and constitution since 2017. The governing document of the Palaeontological Association is the Constitution adopted at the AGM on Thursday 15th December 2016.

**4.2 Management:** The Association is managed by a Council of up to 20 Trustees, which is led by the President. The Association employs an Executive Officer and a Publications Officer who serve on Council but are not Trustees. The Trustees are elected by vote of the Membership at the Annual General Meeting, following guidelines laid down in the Constitution.

**4.3 Membership:** Membership on 31st December 2018 totalled 1,189 (1,173 at end 2017). Of these, 602 were Ordinary Members, 181 Retired Members, 20 Honorary Members, 358 Student Members and 28 Institutional Members. There were 45 institutional subscribers to *Papers in Palaeontology*. Wiley also separately manage further institutional subscribers and arrange online access to publications for them on behalf of the Association.

**4.5 Risk.** The Trustees consider that the Association is in a sound financial position. Membership numbers and revenues from publications remain strong.



A number of external websites and their associated databases are hosted on the Association's server and an Internet Hosting Service Agreement was drawn up in 2016 to minimise risk and signed by most parties during 2017. The final outstanding agreements were signed in early 2018.

## 5. REFERENCE AND ADMINISTRATION

**5.1 Name and Charity Number:** The Palaeontological Association is a Charity registered in England and Wales, Charity Number 1168330.

**5.2 Address:** The contact address of the Association is The Palaeontological Association, Alport House, 35 Old Elvet, Durham DH1 3HN, UK.

**5.3 Trustees:** The following members were elected at the AGM on 18th December 2017 to serve as Trustees in 2018:

Prof. M.P. Smith	President
Prof. R.J. Twitchett	Vice President
Dr C.J. Buttler	Vice President
Dr C.T.S. Little	Secretary
Dr P. Winrow	Treasurer
Dr A.B. Smith	Editor-in-Chief
Dr B.H. Lomax	Editor Trustee
Dr A.R.T. Spencer	Internet Officer
Dr G.T. Lloyd	Newsletter Editor
Dr T.J. Challands	Book Review Editor
Dr L.G. Herringshaw	Publicity Officer
Dr L.M.E. McCobb	Outreach Officer
Dr M. E. McNamara	Education Officer
Dr U. Balthasar	Meetings Coordinator
Dr D.P.G. Bond	Ordinary Member
Dr A.M. Dunhill	Ordinary Member
Prof. A.S. Gale	Ordinary Member
Ms Z.E. Hughes	Ordinary Member
Dr R.C.M. Warnock	Ordinary Member

**5.4 Professional services:** The Association's Bankers are NatWest, 42 High Street, Sheffield S1 2GE. The Association's Independent Examiner is Ms M.R. Corfield ACA ACMA, Corfield Accountancy Ltd., Myrick House, Hendomen, Montgomery, Powys, SY15 6EZ. The Association's investment portfolio is managed by Quilter Cheviot Investment Management, 1 Kingsway, London WC2B 6XD.

Approved by order of the Board of Trustees on 28th June 2019.



## **Independent Examiner's Report to the Trustees of The Palaeontological Association**

I report to the trustees on my examination of the accounts of the above charity for the year ended 31st December 2018 set out on pages 10 to 18.

As the charity's trustees, you are responsible for the preparation of the accounts in accordance with the requirements of the Charities Act 2011 ("the Act").

I report in respect of my examination of the charity's accounts carried out under section 145 of the 2011 Act and in carrying out my examination, I have followed all the applicable Directions given by the Charity Commission under section 145(5)(b) of the Act.

The charity's gross income exceeded £250,000 and I am qualified to undertake the examination by being a qualified member of the Institute of Chartered Accountants in England and Wales (ICAEW) and the Chartered Institute of Management Accountants (CIMA), which are two of the listed bodies.

I have completed my examination. I confirm that no material matters have come to my attention in connection with the examination which give me cause to believe that in, any material respect:

- the accounting records were not kept in accordance with section 130 of the Charities Act; or
- the accounts did not accord with the accounting records; or
- the accounts did not comply with the applicable requirements concerning the form and content of accounts set out in the Charities (Accounts and Reports) Regulations 2008 other than any requirement that the accounts give a 'true and fair' view which is not a matter considered as part of an independent examination.

I have no concerns and have come across no other matters in connection with the examination to which attention should be drawn in this report in order to enable a proper understanding of the accounts to be reached.

Ms M. R. Corfield ACA ACMA  
Corfield Accountancy Limited  
Chartered Accountants  
Myrick House  
Hendomen  
Montgomery  
Powys SY15 6EZ  
Date: 29th June 2019



## THE PALAEOLOGICAL ASSOCIATION

**Statement of Financial Activities  
for the Year Ended 31 December 2018**

	Notes	Unrestricted funds £	Designated funds £	31.12.18 Total funds £	31.12.17 Total funds £
<b>INCOME AND ENDOWMENTS FROM</b>					
Donations and legacies		59,897	2,655	62,552	56,328
<b>Charitable activities:</b>					
Public Meetings		48,536	—	48,536	37,314
Publications		318,458	—	318,458	322,556
Investment income	2	<u>12,650</u>	<u>1,975</u>	<u>14,625</u>	<u>13,978</u>
<b>Total</b>		439,541	4,630	444,171	430,176
<b>EXPENDITURE ON</b>					
Raising funds	3	39,680	—	39,680	32,164
<b>Charitable activities:</b>					
Public Meetings		72,542	—	72,542	77,950
Grants & Awards		52,390	13,476	65,866	60,126
Administration		55,756	—	55,756	44,603
Publications		195,332	—	195,332	210,681
Governance Costs	4	<u>44,557</u>	<u>—</u>	<u>44,557</u>	<u>23,093</u>
<b>Total</b>		460,257	13,476	473,733	448,617
Net gains/(losses) on investments		<u>(27,037)</u>	<u>—</u>	<u>(27,037)</u>	<u>60,340</u>
<b>NET INCOME/(EXPENDITURE)</b>		(47,753)	(8,846)	(56,599)	41,899
<b>RECONCILIATION OF FUNDS</b>					
<b>Total funds brought forward</b>		<u>776,624</u>	<u>141,018</u>	<u>917,642</u>	<u>875,743</u>
<b>TOTAL FUNDS CARRIED FORWARD</b>		<u>728,871</u>	<u>132,172</u>	<u>861,043</u>	<u>917,642</u>

**CONTINUING OPERATIONS**

All income and expenditure has arisen from continuing activities.

The notes form part of these financial statements.



THE PALAEOLOGICAL ASSOCIATION

**Balance Sheet**  
**At 31 December 2018**

	Notes	Unrestricted funds £	Designated funds £	31.12.18 Total funds £	31.12.17 Total funds £
<b>FIXED ASSETS</b>					
Investments		493,297	132,172	625,469	661,561
<b>CURRENT ASSETS</b>					
Debtors	7	189,454	—	189,454	185,839
Cash at bank		<u>91,305</u>	<u>—</u>	<u>91,305</u>	<u>105,140</u>
		280,759	—	280,759	290,979
<b>CREDITORS</b>					
Amounts falling due within one year	8	<u>(45,185)</u>	<u>—</u>	<u>(45,185)</u>	<u>(34,898)</u>
<b>NET CURRENT ASSETS</b>		<u>235,574</u>	<u>—</u>	<u>235,574</u>	<u>256,081</u>
<b>NET ASSETS</b>		<u>728,871</u>	<u>132,172</u>	<u>861,043</u>	<u>917,642</u>
<b>FUNDS</b>					
Unrestricted funds	9			<u>861,043</u>	<u>917,642</u>
<b>TOTAL FUNDS</b>				<u>861,043</u>	<u>917,642</u>

The notes form part of these financial statements.

The financial statements were approved by the Board of Trustees on 29th June 2019.



## THE PALAEOLOGICAL ASSOCIATION

# Notes to the Financial Statements for the Year Ended 31 December 2018

### 1. ACCOUNTING POLICIES

#### **Basis of preparing the financial statements**

The financial statements of the charity, which is a public benefit entity under FRS 102, have been prepared in accordance with the Charities SORP (FRS 102) 'Accounting and Reporting by Charities: Statement of Recommended Practice applicable to charities preparing their accounts in accordance with the Financial Reporting Standard applicable in the UK and Republic of Ireland (FRS 102) (effective 1 January 2015)', Financial Reporting Standard 102 'The Financial Reporting Standard applicable in the UK and Republic of Ireland' and the Charities Act 2011. The financial statements have been prepared under the historical cost convention with the exception of investments which are included at market value, as modified by the revaluation of certain assets.

#### **Income**

The charity's income principally comprises subscriptions from individuals and institutions which relate to the period under review, and sales of scientific publications.

All income is recognised in the Statement of Financial Activities once the charity has entitlement to the funds, it is probable that the income will be received and the amount can be measured reliably.

#### **Fixed assets investments**

Investments are initially recognized at their transaction value and subsequently measured at their fair value as at the balance sheet date. The statement of financial activities includes the net gains and losses arising on revaluation and disposals throughout the year.

#### **Expenditure**

Liabilities are recognised as expenditure as soon as there is a legal or constructive obligation committing the charity to that expenditure, it is probable that a transfer of economic benefits will be required in settlement and the amount of the obligation can be measured reliably. Expenditure is accounted for on an accruals basis and has been classified under headings that aggregate all cost related to the category. Where costs cannot be directly attributed to particular headings they have been allocated to activities on a basis consistent with the use of resources.

#### **Allocation and apportionment of costs**

Administrative costs have been allocated to the various cost headings based on estimates of the time and costs spent thereon.

#### **Taxation**

The charity is exempt from corporation tax on its charitable activities.

#### **Fund accounting**

General Funds are unrestricted funds which are available for use at the discretion of the Council in furtherance of the general objectives of the charity and which have not been designated for other purposes.





## THE PALAEOLOGICAL ASSOCIATION

### Notes to the Financial Statements – *continued* for the Year Ended 31 December 2018

#### 1. ACCOUNTING POLICIES – continued

Designated funds comprise unrestricted funds that have been set aside by Council for particular purposes. The aim of each designated fund is as follows:

- Sylvester-Bradley Fund: Grants made to permit palaeontological research.
- Jones-Fenleigh Fund: Grants to permit one or more delegates annually to attend the Symposium of Vertebrate Palaeontology and Comparative Anatomy (SVPCA) meeting.
- Hodson Fund: Awards made in recognition of the palaeontological achievements of a researcher within ten years of the award of their PhD.
- Callomon Fund: Grants made to permit palaeontological research with a strong fieldwork element.
- Whittington Fund: Grants made to permit palaeontological research with an element of study in museum collections.
- Stan Wood Fund: Grants in the area of vertebrate palaeontology ideally involving fieldwork, due to generous donations in memory of the Scottish fossil collector Mr Stan Wood.

#### 2. INVESTMENT INCOME

	31.12.18	31.12.17
	£	£
Deposit account interest	99	34
Investment Income	<u>14,526</u>	<u>13,944</u>
	<u>14,625</u>	<u>13,978</u>

#### 3. RAISING FUNDS

	31.12.18	31.12.17
	£	£
<b>Voluntary Income Costs: Administration</b>	<b>35,481</b>	<b>28,384</b>
<b>Investment Management Costs: Stockbroker Fees</b>	<u>4,199</u>	<u>3,780</u>
	<u>39,680</u>	<u>32,164</u>

#### 4. GOVERNANCE COSTS

During the year, a diversity study of the Association and field of palaeontology was carried out by Parigen Limited at a cost of £17,609. This was an exceptional cost in the year and formed part of the total governance costs of £44,557, the remaining costs being attributed to Trustees' expenses, administration, and Independent Examination fees.



## THE PALAEOLOGICAL ASSOCIATION

**Notes to the Financial Statements – *continued*  
for the Year Ended 31 December 2018****5. TRUSTEES' REMUNERATION AND BENEFITS**

There were no Trustees' remuneration or other benefits for the year ended 31 December 2018 nor for the year ended 31 December 2017.

**Trustees' expenses**

The total travelling expenses reimbursed to 19 Members of Council (2017:18) was £16,810 (2017: £14,983).

**6. STAFF COSTS****Analysis of Staff Costs and Remuneration**

	£ 2018	£ 2017
Salaries	81,750	80,032
Social Security Costs	5,975	5,094
Pension Costs	<u>8,175</u>	<u>7,494</u>
Total	<u>95,900</u>	<u>92,620</u>

The average monthly number of employees during the year was as follows:

	2018	2017
Publications	1	1
Administration	<u>1</u>	<u>1</u>
	<u>2</u>	<u>2</u>

No employees received emoluments in excess of £60,000.

**7. DEBTORS: AMOUNTS FALLING DUE WITHIN ONE YEAR**

	2018	2017
	£	£
Sundry Debtors	<u>189,454</u>	<u>185,839</u>

**8. CREDITORS: AMOUNTS FALLING DUE WITHIN ONE YEAR**

	31.12.18	31.12.17
	£	£
Trade creditors	27,945	18,714
Subscriptions in advance	<u>17,240</u>	<u>16,184</u>
	<u>45,185</u>	<u>34,898</u>



THE PALAEOLOGICAL ASSOCIATION

**Notes to the Financial Statements – *continued*  
for the Year Ended 31 December 2018**

**9. MOVEMENT IN FUNDS**

	At 1.1.18 £	Net movement in funds £	At 31.12.18 £
<b>Unrestricted funds</b>			
General fund	776,624	(47,753)	728,871
Sylvester-Bradley	26,394	(5,321)	21,073
Jones-Fenleigh	27,713	(210)	27,503
Hodson	1,719	(1,425)	294
Callomon	4,519	(1,151)	3,368
Whittington	13,974	(1,000)	12,974
Stan Wood	<u>66,699</u>	<u>261</u>	<u>66,960</u>
<b>TOTAL FUNDS</b>	<u>917,642</u>	<u>(56,599)</u>	<u>861,043</u>

Net movement in funds included in the above are as follows:

	Incoming resources £	Resources expended £	Gains and losses £	Movement in funds £
<b>Unrestricted funds</b>				
General fund	439,541	(460,257)	(27,037)	(47,753)
Sylvester-Bradley	652	(5,973)	—	(5,321)
Jones-Fenleigh	1,370	(1,580)	—	(210)
Hodson	1	(1,426)	—	(1,425)
Callomon	349	(1,500)	—	(1,151)
Whittington	500	(1,500)	—	(1,000)
Stan Wood	<u>1,758</u>	<u>(1,497)</u>	<u>—</u>	<u>261</u>
<b>TOTAL FUNDS</b>	<u>444,171</u>	<u>(473,733)</u>	<u>(27,037)</u>	<u>(56,599)</u>



## THE PALAEOLOGICAL ASSOCIATION

**Notes to the Financial Statements – *continued*  
for the Year Ended 31 December 2018****9. MOVEMENT IN FUNDS — *continued*...****Comparatives for movement in funds:**

	At 1.1.17 £	Net movement in funds £	At 31.12.17 £
<b>Unrestricted Funds</b>			
General fund	728,484	48,140	776,624
Sylvester-Bradley	29,665	(3,271)	26,394
Jones-Fenleigh	26,313	1,400	27,713
Hodson	3,301	(1,582)	1,719
Callomon	5,476	(957)	4,519
Whittington	14,883	(909)	13,974
Stan Wood	<u>67,621</u>	<u>(922)</u>	<u>66,699</u>
<b>TOTAL FUNDS</b>	<u>875,743</u>	<u>41,899</u>	<u>917,642</u>

Comparative net movement in funds included in the above are as follows:

	Incoming resources £	Resources expended £	Gains and losses £	Movement in funds £
<b>Unrestricted funds</b>				
General fund	422,731	(434,931)	60,340	48,140
Sylvester-Bradley	1,465	(4,736)	—	(3,271)
Jones-Fenleigh	2,836	(1,436)	—	1,400
Hodson	53	(1,635)	—	(1,582)
Callomon	543	(1,500)	—	(957)
Whittington	585	(1,494)	—	(909)
Stan Wood	<u>1,963</u>	<u>(2,885)</u>	<u>—</u>	<u>(922)</u>
<b>TOTAL FUNDS</b>	<u>430,176</u>	<u>(448,617)</u>	<u>60,340</u>	<u>41,899</u>



THE PALAEOLOGICAL ASSOCIATION

**Notes to the Financial Statements – *continued*  
for the Year Ended 31 December 2018**

**9. MOVEMENT IN FUNDS — *continued*...**

A current year 12 months and prior year 12 months combined position is as follows:

	At 1.1.17 £	Net movement in funds £	At 31.12.18 £
<b>Unrestricted funds</b>			
General fund	728,484	387	728,871
Sylvester-Bradley	29,665	(8,592)	21,073
Jones-Fenleigh	26,313	1,190	27,503
Hodson	3,301	(3,007)	294
Callomon	5,476	(2,108)	3,368
Whittington	14,883	(1,909)	12,974
Stan Wood	<u>67,621</u>	<u>(661)</u>	<u>66,960</u>
<b>TOTAL FUNDS</b>	<u>875,743</u>	<u>(14,700)</u>	<u>861,043</u>

A current year 12 months and prior year 12 months combined net movement in funds included in the above are as follows:

	Incoming resources £	Resources expended £	Gains and losses £	Movement in funds £
<b>Unrestricted funds</b>				
General fund	862,272	(895,188)	33,303	387
Sylvester-Bradley	2,117	(10,709)	—	(8,592)
Jones-Fenleigh	4,206	(3,016)	—	1,190
Hodson	54	(3,061)	—	(3,007)
Callomon	892	(3,000)	—	(2,108)
Whittington	1,085	(2,994)	—	(1,909)
Stan Wood	<u>3,721</u>	<u>(4,382)</u>	<u>—</u>	<u>(661)</u>
<b>TOTAL FUNDS</b>	<u>874,347</u>	<u>(922,350)</u>	<u>33,303</u>	<u>(14,700)</u>



## THE PALAEOLOGICAL ASSOCIATION

**Notes to the Financial Statements – *continued*  
for the Year Ended 31 December 2018****10. RELATED PARTY DISCLOSURES**

There were no related party transactions for the year ended 31 December 2018.

**11. INVESTMENT GAINS AND LOSSES**

All gains and losses are taken to the Statement of Financial Activities as they arise. Realised gains and losses on investments are calculated as the difference between sales proceeds and their opening carrying value or their purchase value if acquired subsequent to the first day of the financial year.

Unrealised gains and losses are calculated as the difference between the fair value at the year end and their carrying value. Realised and unrealised investment gains and losses are combined in the Statement of Financial Activities.

Investment Gains/Losses	31st December 2018	31st December 2017
	£	£
Realised Gain/(Loss)	(518)	4,605
Unrealised Gain/(Loss)	<u>(26,519)</u>	<u>55,735</u>
Total per Statement of Financial Activities	<u>(27,037)</u>	<u>60,340</u>

**12. INVESTMENT PORTFOLIO 2018**

See pages 24–25.



## Detailed Statement of Financial Activities for the Year Ended 31 December 2018

	31.12.18 Unrestricted funds £	31.12.17 Total funds £
<b>INCOME AND ENDOWMENTS</b>		
<b>Donations and legacies</b>		
Donations	7,462	5,732
Subscriptions	55,090	50,596
	62,552	56,328
<b>Investment income</b>		
Deposit account interest	99	34
Investment Income	<u>14,526</u>	<u>13,944</u>
	14,625	13,978
<b>Charitable activities</b>		
Scientific Journals	314,201	318,416
Special Papers	828	698
Newsletter	243	87
Field Guides	2,944	2,872
Distribution	242	483
Scientific Meetings	<u>48,536</u>	<u>37,314</u>
	<u>366,994</u>	<u>359,870</u>
<b>Total incoming resources</b>	444,171	430,176
<b>EXPENDITURE</b>		
<b>Raising donations and legacies</b>		
Administration	35,481	28,384
<b>Investment management costs</b>		
Stockbroker Fees	4,199	3,780
<b>Charitable activities</b>		
Scientific Journals	56,630	70,627
Newsletters	18,265	19,479
Marketing	632	1,193
Publication Costs	81,825	85,222
Editorial Costs	37,980	34,160
Public Meetings & Costs	72,542	77,950
Grants & Awards	53,772	41,393
Research Grants	12,094	18,733
Administration	55,756	44,603
Consultancy	<u>17,609</u>	<u>—</u>
	407,105	393,360
<b>Support costs</b>		
<b>Governance costs</b>		
Trustees' expenses	16,810	14,983
Accountancy and legal fees	595	595
Administration	<u>9,543</u>	<u>7,515</u>
	<u>26,948</u>	<u>23,093</u>
<b>Total resources expended</b>	<u>473,733</u>	<u>448,617</u>
<b>Net expenditure before gains and losses</b>	(29,562)	(18,441)
<b>Realised recognised gains and losses</b>		
Realised gains/(losses) on fixed asset investments	<u>(27,037)</u>	<u>60,340</u>
<b>Net (expenditure)/income</b>	<u><b>(56,599)</b></u>	<u><b>41,899</b></u>

This page does not form part of the statutory financial statements.



## Palaeontological Association year ended 31st December 2018.

Nominal	Holding	Cost (bought pre 2018) £	Value end 2017 £
£10,000	UK 4.5% Gilt 07/03/19 GBP 0.01	10,046.50	10,622.00
£10,000	UK 4.5% Gilt 07/03/19 GBP 0.01	10,046.50	10,622.00
£18,000	UK 4.75% Stock 07/03/20 GBP 100	18,145.87	19,955.00
49,685.81	COIF Charities Fixed Interest Fund	65,807.52	68,839.69
1,425	BP Ord 25c shares	5,047.35	7,448.00
600	Royal Dutch Shell B shares	4,422.42	15,051.00
600	BHP Billiton \$0.5 shares	4,341.48	9,135.00
180	CRH ord EUR 0.32	4,426.82	4,783.00
1,400	Smith(DS) ord GBP 0.10	4,569.69	5,693.00
500	Halma ord GBP 0.10	5,232.04	6,300.00
437	IMI Ord 25p shares	4,267.00	5,825.00
420	Experian Ord 10C	3,444.95	6,871.00
300	Diageo Ord GBP 0.28	5,826.00	8,175.00
200	Persimmon Ord 10p	2,258.00	5,476.00
70	Reckitt Benckiser Group ord GBP 0.10	5,325.75	4,843.00
300	Unilever PLC Ord GBP 0.031111	4,326.21	12,377.00
170	Astrazeneca Ord 25c	8,145.00	8,706.00
450	Glaxo Smithkline Ordinary 25p shares	7,083.98	5,951.00
300	Relx Olc GBP 0.1444	4,438.20	5,217.00
175	Carnival Plc Ord USD 1.66	3,996.49	8,561.00
1,000	BT Group Ordinary 5p shares	3,446.05	2,717.00
2,277	Vodafone Group Ord USD 0.11428571	3,434.00	5,351.00
641	National Grid Ord GBP 0.12431289	3,648.26	5,609.00
2,250	Barclays 25p Ord shares	4,867.00	4,570.00
1,465	HSBC Holdings Ordinary 0.5 US Dollar shares	4,534.00	11,235.00
982	Great Portland Estates Ord GBP0.15263157894	8,503.00	7,849.00
6,000	Mercantile Investment Tst Plc(The) ord GBP0.025	10,171.60	13,074.00
425	Findlay Park Partners US Smaller Companies	6,158.47	33,975.00
2,825	Ishares S&P 500 GBP	20,319.63	56,094.00
4250	Fidelity EUR Value Ordinary 25P shares	4,059.07	9,635.00
6,600	Fund Partners Ltd Crux European Spl Situation	7,140.00	15,358.00
30	Roche Hldgs Ag Genusscheine Nvp	3,335.33	5,620.00
9,000	Baillie Gifford & Co Japanese Income Growth W4 Dis	11,977.02	12,042.00
1,007	Eastspring Investments SICAV Japan Dynamic FGDY GBP	7,837.74	10,265.00
26	Veritas Funds Plc Veritas Asian D GBP Inc	8,182.27	16,977.00
900	JPMorgan Am UK Ltd Emerging Markets I Instl	5,043.10	8,240.00
650	RIT Capital Partners Ordinary £1 shares	4,903.90	12,753.00
800	BH Global Ltd ord GBP	10,226.25	10,912.00
4,400	Invesco Fund Managers Targeted Y Acc	9,770.33	9,914.00
37	Marshall Wace UCITS Funds Plc MW Tops UCITS G GBP	4,849.70	5,141.00
4,443	Aberdeen Investment Property Trust B	4,681.00	5,296.00
9,000	Charities Property Fund Income	11,043.28	11,393.00
1,021.54	COIF Charities Investment Fund Acc Units	59,678.69	157,089.46
	Total	399,007.45	661,560.15





Schedule of Investments (Note 12 to the Accounts).

Proceeds (sold in 2018) £	Cost (bought in 2018) £	Gain realised during 2018 £	Value end 2018 £	Gain unrealised during 2018 £
			10,210.00	-412.00
10,124.13		-497.87	19,112.00	-843.00
			66,246.09	-2,593.60
			7,067.00	-381.00
			14,040.00	-1,011.00
			9,910.00	775.00
			3,728.00	-1,055.00
	1,050.00		4,190.00	-1,503.00
			6,820.00	520.00
			4,125.00	-1,700.00
			8,001.00	1,130.00
			8,385.00	210.00
			3,860.00	-1,616.00
			4,209.00	-634.00
			12,326.00	-51.00
			9,984.00	1,278.00
			6,710.00	759.00
			4,850.00	-367.00
			6,585.00	-1,976.00
			2,381.00	-336.00
			3,482.00	-1,869.00
			4,899.00	-710.00
			3,387.00	-1,183.00
			9,477.00	-1,758.00
			6,472.00	-1,377.00
			10,530.00	-2,544.00
			35,864.00	1,889.00
			55,218.00	-876.00
			8,798.00	-837.00
			12,699.00	-2,659.00
			5,829.00	209.00
			11,052.00	-990.00
			8,854.00	-1,411.00
			14,924.00	-2,053.00
			7,313.00	-927.00
			12,415.00	-338.00
			11,860.00	948.00
			9,538.00	-376.00
			4,990.00	-151.00
			5,386.00	90.00
			11,711.00	318.00
			158,032.03	942.57
10,124.13	1,050.00	-497.87	625,469.12	-25,469.03



## Nominations for Council

At the AGM in December 2019, the following vacancies will occur on Council:

- President-elect
- Vice President
- Chair of the Editorial Board
- Editor Trustee
- Outreach Officer
- Internet Officer
- Ordinary Members (4 vacancies)

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

All potential Council Members are asked to consider the following:

'Each Council Member needs to be aware that, since the Palaeontological Association is a Registered Charity, in the eyes of the law he/she becomes a Trustee of that Charity. Under the terms of the Charities Act 1992, legal responsibility for the proper management of the Palaeontological Association lies with each Member of Council.'

Further information on the responsibilities of Trustees can be obtained by e-mailing <[secretary@palass.org](mailto:secretary@palass.org)>.

The closing date for nominations is **1st September 2019**. They should be sent to the Secretary: Dr Crispin Little, School of Earth and Environment, University of Leeds, Woodhouse Lane, Leeds LS2 9JT, UK; e-mail: <[secretary@palass.org](mailto:secretary@palass.org)>.

Nominations received thus far are as follows:

- President-elect: Prof. P.J. Orr\*
- Vice President: Dr F.L. Gill\*
- Chair of the Editorial Board: Dr B.H. Lomax\*
- Editor Trustee: Prof. N.J. Butterfield\*
- Outreach Officer: Ms Z.E. Hughes\*
- Internet Officer: Dr R. Garwood\*
- Ordinary Members (4 vacancies):

Dr S. Giles\*

Dr T.H.P. Harvey\*

\* denotes Council nominations



## *Council vacancies: 'job descriptions':*

### **President (two-year term)**

The President is usually a senior member of the palaeontological community, with wide experience of the Association, its Council and committees. The President represents the Association externally and is responsible for the overall management of Council and its many activities. The incoming President observes on Council as President-elect in the year prior to his/her term.

### **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 Trustee (three-year term; for final year becomes Chair of the Editorial Board)**

The Editor Trustees are on the Editorial Board of *Palaeontology* and *Papers in Palaeontology* but also serve on the PalAss Council. Their role is: to advise the Chair of the Editorial Board about policy issues that might arise in the running of the journals; to attend the annual review meeting with the publisher, Wiley; to advise the Chair 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.

### **Chair of the Editorial Board (one-year term for most senior Editor Trustee)**

- Oversees the production of the Association's publications and provides vision and leadership for their future development; acts as line manager for the Publications Officer and sets priorities and goals for the journals.
- Selects and invites members on to the Editorial Board to ensure gender balance, geographical coverage and disciplinary representation is achieved.
- Vets the quality of papers being accepted for publication in *Palaeontology* and *Papers in Palaeontology*; acts as a member of the Editorial Board in the preliminary sift of all papers submitted; assigns papers of suitable quality to a science editor and writes rejection letters to the rest.
- Vets the recommendations made by the Editorial Board with respect to whether papers are fit and ready for publication in light of referees' reports received. Makes final decisions.
- Firefights any issues arising from the publication process (e.g. disgruntled authors, referees or readers).

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

The Outreach Officer works with the Publicity Officer and the Education Officer in the Public Engagement Group (PEG). The PEG has responsibility for all of the Palaeontological Association outreach activities. Currently they include organizing the Association's presence at the Lyme Regis and Yorkshire fossil festivals, co-coordinating the Engagement Grants, answering relevant enquiries,



and initiating other activities that promote and develop palaeontological outreach and education for the Association. PEG members work closely together and their roles often overlap, but specific responsibilities associated with the Outreach Officer include devising and implementing new outreach activities for the Association.

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

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

### **Ordinary Members (four vacancies, all three-year terms)**

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

## **Awards and Prizes**

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

### ***Lapworth Medal***

The Lapworth Medal is 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 in choosing suitable candidates.



The candidate must be nominated by at least two members of the Association and the application must be supported by a résumé (single sheet of details) of the candidate's career, and further supported by a brief statement from each of two nominees. A list of ten principal publications must accompany the nomination. If a candidate has taken time out from their professional career for family or other purposes, this should be highlighted.

Nominations must be compiled into a PDF file of less than 10 MB and uploaded to the PalAss website. The award will be considered by Council at its May meeting and awardees will be invited to a ceremony at the Annual Meeting in December. Awards will also be announced in the *Newsletter*,



on the Association website and through social media. Council reserves the right to not make an award in any year.

Nominations are invited by **31st March** each year.

## ***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 (excluding periods of parental or other leave, but not excluding periods spent working in industry) 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 candidate must be nominated by at least two members of the Association. Nominations must include a single page that summarizes the candidate's career, further supported by a brief statement from the two nominating members. A list of ten principal publications must accompany the nomination. Letters of support by others may also be submitted. If a candidate has taken time out from their professional career for family and other purposes, this should be highlighted.

Nominations must be compiled into a PDF file of less than 10 MB and uploaded to the PalAss website. The award will be considered by Council at its May meeting and awardees will be invited to a ceremony at the Annual Meeting in December. Awards will also be announced in the *Newsletter*, on the Association website and through social media. Council reserves the right to not make an award in any year.

Nominations are invited by **31st March** each year.

## ***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, a list of principal publications, and a brief statement from each of the two nominees. If a candidate has taken time out from their professional career for family or other purposes, this should be highlighted.

Nominations must be compiled into a PDF file of less than 10 MB and uploaded to the PalAss website. Nominations will be considered by Council at its May meeting and awardees will be invited to a ceremony at the Annual Meeting in December. Awards will also be announced in the *Newsletter*, on the Association website and through social media. Council reserves the right to not make an award in any year.

Nominations are invited by **31st March** each year.



## ***Mary Anning Award***

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

The candidate must be nominated by one or more members of the Association with a short statement (up to one page of A4) outlining the candidate's principal achievements, compiled into a PDF file of less than 10 MB and uploaded to the PalAss website. Nominations will be considered by Council at its May meeting and awardees will be invited to a ceremony at the Annual Meeting in December, although the award may be presented at another time and place on request of the awardee. Awards will also be announced in the *Newsletter*, on the Association website and through social media. The Council reserves the right to not make an award in any year.

Nominations are invited by **31st March** each year.

## ***Gertrude Elles Award***

The Gertrude Elles Award is to promote high-quality public engagement in the field of palaeontology. The award is made by Council for high quality, amateur or institutional, public engagement projects that promote the discipline. Nominated projects can include museum displays and exhibitions, outreach programmes to schools and/or communities, art/science collaborations, digital initiatives, or any other programme that falls broadly under the heading of public engagement with palaeontology.

Nominations must consist of a brief supporting case and a portfolio of up to four images. The supporting case must outline:

- the aims of the project
- the nature of the target audience
- the available budget and funding sources
- visitor/audience numbers
- the results of project evaluation to demonstrate the quality and effectiveness of the project
- links to any digital components

Self-nominations are permitted, and the nominators and proposed recipients do not need to be members of the Association. Nominations will be considered relative to the scale of the institution and the available project budget.

The supporting case and the portfolio of images must be compiled into a PDF file of less than 10 MB and uploaded to the PalAss website. The award will be considered by Council at its May meeting and winners will be invited to the award ceremony at the Annual Meeting in December. Awards will also be announced in the *Newsletter*, on the Association website and through social media. Council reserves the right to not make an award in any year.

Nominations are invited by **31st March** each year.



## ***Honorary Life Membership***

Honorary Life Membership recognizes individuals whom Council deem to have been significant benefactors and/or supporters of the Association. Recipients will receive free membership for life.

Nominations from one or more members of the Association must be compiled into a PDF file of less than 10 MB and uploaded to the PalAss website. The award will be considered by Council at its May meeting and announced at the AGM. The award will also be announced in the *Newsletter*, on the Association website and through social media.

Nominations are invited by **31st March** each year.

## ***Annual Meeting President's Prize and Council Poster Prize***

These are awarded for the best talk and 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 these awards. Individuals may nominate themselves for consideration when submitting abstracts for the meeting. Each prize consists of a cash award of £200, and is announced immediately after the oral sessions at the end of the Annual Meeting.

## ***Best Paper Award***

This has been awarded since 2015 for the best papers published in *Palaeontology* and *Papers in Palaeontology* during the calendar year. Corresponding authors of winning papers are offered 'gold open access' paid for by the Association for one nominated paper submitted to *Palaeontology/ Papers in Palaeontology* within the following 18 months (and subsequently accepted). In the case of joint-authorship papers, the corresponding author can, by agreement, transfer the prize to one of the co-authors. All eligible papers are automatically considered for this award by the Editor-in-Chief and Editorial Board members, and their decision is announced at the Annual Meeting.

## ***Undergraduate Prize Scheme***

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

Departments may use any criterion for selection, though most prefer to use the scheme as an acknowledgement of best performance in a relevant exam or project. Only one nomination will be accepted from any one institution in each calendar year. The nominee must be an undergraduate student, not a postgraduate, when they are selected. Normally the award is made to a student in



their penultimate year of study, but a final-year candidate may be chosen if this is deemed more appropriate for the department in question.

Contact <[executive@palass.org](mailto:executive@palass.org)> with the nomination (name and e-mail address) and we will arrange to sign up the student as a member and send them a certificate. There is no deadline for this award.

## ***Innovations in Palaeontology Lecture Series and the PalAss Exceptional Lecturer***

The Innovations in Palaeontology Lecture Series, to be given by the **PalAss Exceptional Lecturer**, aims to promote palaeontology to the wider academic community and to recognize excellence in research among palaeontologists. The PalAss Exceptional Lecturer is selected in a competitive process.

### **This scheme aims to:**

- Improve the dissemination of cutting-edge palaeontological research to the broader academic community.
- Raise the profile of palaeontology within the Earth sciences and related fields.
- Recognize outstanding research and science communication in palaeontology among members of the Association.

### **Format of the scheme:**

- One PalAss Exceptional Lecturer will be selected each year in a competitive process.
- The PalAss Exceptional Lecturer will be expected to give five lectures at five different institutions over a nine-month period.
- The successful applicant will receive the Innovations in Palaeontology Lecture Series Grant, which will be administered by the home institution of the PalAss Exceptional Lecturer.
- The Innovations in Palaeontology Lecture Series Grant may only be used to pay the reasonable travel costs incurred by the PalAss Exceptional Lecturer to visit each of the host institutions (up to £2,000 for the total Innovations in Palaeontology Lecture Series with a maximum of £500 for any individual lecture). The host institutions will cover costs for accommodation (where necessary) and hospitality.
- Any academic institution (universities and/or museums) from any country can apply to participate in the Innovations in Palaeontology Lecture Series as a host institution.
- Any unused funds must be returned to PalAss after delivery of the final lecture. Should the PalAss Exceptional Lecturer move institutions within the timeframe of the lecture series, any unspent funds must remain available to the PalAss Exceptional Lecturer.
- Applications to be a PalAss Exceptional Lecturer will be strengthened if the applicant agrees to submit a paper as a review article for possible publication in *Palaeontology*.

### **Eligibility and selection process of the PalAss Exceptional Lecturer:**

- Eligible candidates will have a PhD in palaeontology or a related field.





- Applicants can reside in any country, but must be members of the Association.
- Candidates must self-nominate.
- To self-nominate, a two-page CV, full list of publications, and statement of motivation (max. 300 words) must be submitted via the Association's webpage as a single PDF format file (max. 8 MB). In addition, a 60 second video summary (in mp4 format; max. size: 30 MB) of a proposed seminar topic must be submitted via the Association's webpage.
- The PalAss Exceptional Lecturer will be chosen based on career track record, including research impact (relative to their career stage) and oratorical skills.

#### **Selection of host institutions:**

- Institutions interested in participating in the Innovations in Palaeontology Lecture Series should apply via the PalAss webpage and suggest a time-frame within which the lecture should be given.
- The PalAss Exceptional Lecturer will receive the list of potential host institutions after the 1st May deadline, and will choose their preferred hosts and liaise directly with them. Applications after 1st May will be considered depending on the remaining availability.

#### **Expectations for host institutions:**

- Each lecture must be widely advertised across the host institution. We particularly encourage advertisement of the Innovations in Palaeontology Lecture Series on social media.
- Host institutions are expected to pay for hospitality and offer a meal in a social environment to the PalAss Exceptional Lecturer.
- If the PalAss Exceptional Lecturer has to travel more than three hours to the host institution or cannot return home at a reasonable time, the host institution must offer at least one night of accommodation.

#### **Deadlines:**

- 1st September: Deadline for nominations for the PalAss Exceptional Lecturer.
- December: The PalAss Exceptional Lecturer will be announced at the Annual Meeting.
- March: The call for host institutions to participate in the Innovations in Palaeontology Lecture Series will be published in the *Newsletter*.
- 1st May: Deadline for applications from host institutions.
- September – May: delivery of lectures.

#### **Uwe Balthasar**

*University of Plymouth*



## 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 must be made in good time (at least nine months before the start of the event) by the scientific organizer(s) of the meeting using the online application form. Such requests will be considered by Council at the May and 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, Dr Cris Little (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 (also whether request is for a loan or a grant)
- Other sources of funding applied for
- Specific use to which requested funds will be put

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

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



## Engagement Grants

Awards are made to encourage educational outreach, public engagement and related initiatives in palaeontological themes. Normally, the budget for an individual grant would be less than £5,000. However, under exceptional circumstances, a budget of up to £10,000 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. Proposals must fit with the charitable aims of the Association. Full details of the application terms and conditions are available on the Association website.

The principal applicant must be a member of the Association. Preference will normally be given to candidates who have not previously won an award. Preference is also 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.

For more information please contact the Association's Outreach Officer, Dr Lucy McCobb (e-mail <[outreach@palass.org](mailto:outreach@palass.org)>).

The application deadline is **1st September** each year and funds will normally be available from 1st November. In rare cases where rapid access to funds is critical, applications submitted outside the normal deadlines may be considered. The awards will be announced at the following AGM.

## Small Grants Scheme

The Association offers multiple awards each year, in honour of four donors, to fund palaeontological research, travel and fieldwork; these are integrated together under the Small Grants Scheme. These grants are open to any member of the Association, although preference is given to students, early-career researchers, and members of the Association who are retired.

**Sylvester-Bradley Awards:** Multiple awards of up to £1,500 each, for palaeontological research.

**Callomon Award:** An award of up to £1,500 for a project which is normally field-based.

**Whittington Award:** An award of up to £1,500 for a project which is normally based on museum collections.

**Stan Wood Award:** An award of up to £1,500 for projects in vertebrate palaeontology, and ideally involving fieldwork and fossil collecting.

There is one application form and Council will decide on the allocation of the awards based upon the nature of the project made in the application.

Applications should be made through online submission via the appropriate page on the Association's website, and will comprise:

- An account of project aims and objectives and expected outcomes
- A breakdown and justification of the proposed expenditure
- A curriculum vitae
- Two references: one reviewing the project, and one personal reference for the applicant



- A summary suitable for the non-specialist, which will be published in the *Newsletter* when an award is made

Successful applicants will be required to produce a final project report that will be published in the *Newsletter* and are asked to consider the Association's meetings and publications as media for conveying the research results.

Further details and a full list of terms and conditions for the Small Grants Scheme can be found on the appropriate page of the Association's website. Enquiries may be made to the Secretary (e-mail <[secretary@palass.org](mailto:secretary@palass.org)>).

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

## *Undergraduate Research Bursaries*

The Palaeontological Association Undergraduate Research Bursaries are aimed at giving undergraduate students the opportunity to acquire research skills and experience that will significantly transform their academic career. The bursaries will support projects co-designed by students and their supervisor(s) that give students registered for an undergraduate degree their first experience of undertaking a palaeontological research project. The bursaries provide a stipend for the student of £287 per week for up to eight weeks. The scheme is not intended to fund students to undertake routine work for the supervisor(s) and the Association expects the supervisor(s) to provide significant personal mentoring of successful student applicants.

Applications should be made by the principal supervisor through online submission via the appropriate page on the Association's website, and will include:

- Details of the principal supervisor making the application, and other members of the supervisory team
- Details and academic track record of the named student
- An account of the project aims, methods and expected outcomes
- A project plan including details of supervision
- Ethics statement
- A referee statement in support of the named student

After completion of the work, successful **students** are required to produce a short report of the findings suitable for publication in the *Newsletter*. This report should be submitted by e-mail to <[palass@palass.org](mailto:palass@palass.org)> within eight weeks of the stated end date of the project. Successful candidates are requested to prioritize the Association's meetings and publications as media for conveying the research results.

Further details, including eligibility criteria for supervisors and students, and a full list of terms and conditions for the Undergraduate Research Bursaries scheme, can be found on the appropriate page of the Association's website. Enquiries may be made to the Secretary (e-mail <[secretary@palass.org](mailto:secretary@palass.org)>).

The deadline is **1st February** each year. Successful applicants will be notified by the end of March and funds will normally be available from 1st June. A full list of awards will be announced at the AGM.



# 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.



**63rd Annual Meeting of the Palaeontological Association**  
University of Valencia, Spain 15 – 21 December 2019

The Annual Meeting of the Palaeontological Association will be held at the University of Valencia, one of the oldest universities in Spain, founded in 1499. The organizing committee is chaired by Dr Carlos Martínez-Pérez, and consists of members of the Botany and Geology department at the University of Valencia, as well as collaborators from the University of Alicante and the Spanish Geological Survey. The e-mail address for all Meeting matters is <[annualmeeting2019@palass.org](mailto:annualmeeting2019@palass.org)>.

### Programme

The 63rd Annual Meeting will be held from 18th to 20th December 2019, with a pre-conference field-trip from 15th to 17th December, and a one-day post-conference field-trip on 21st December. All scientific sessions, workshops and the symposium will take place on the Blasco Ibañez Campus of the University of Valencia, in the Philosophy and Philology faculties. Given the volume of expected participants, several parallel sessions will be held in the main halls of these faculties, located just 100 m apart.

### Workshops and symposium

The meeting will begin with several workshops during the morning of Wednesday 18th December in the Faculty of Philology. Several workshops will be run by specialists from Transmitting Science on the application of analytical techniques for the study of fossils. In the afternoon the Annual Symposium will focus on 'Virtual Palaeontology':

- 13.30 – 13.45 Welcome
- 13.45 – 14.15 Dr Verónica Díez-Díaz (Museum für Naturkunde, Berlin)  
*Digitizing the vertebrate palaeontology collection of the Museum für Naturkunde of Berlin: preserving our natural history heritage by assessing different digitalization techniques*
- 15.15 – 14.45 Dr Peter L. Falkingham (Liverpool John Moores University) and Prof. Stephen M. Gates (Brown University)  
*Virtual footprints: simulation and digitization elucidate deep track formation*
- 14.45 – 15.15 Dr Sophie Sanchez (Uppsala University)  
*Synchrotron X-rays: new developments to reveal fossil bone microstructures in three dimensions*
- 15.15 – 16.00 Tea/coffee break
- 16.00 – 16.30 Dr Imran A. Rahman (Oxford University Museum of Natural History)  
*Computational fluid dynamics as a tool for testing functional and ecological hypotheses in fossil taxa*
- 16.30– 17.00 Dr Jen A. Bright (University of South Florida)  
*Finite elements, morphometrics, extant animals, and accuracy*
- 17.00 – 17.30 Dr Stephan Lautenschlager (University of Birmingham)  
*Multibody dynamics analysis (MDA) as a tool to reconstruct the function and palaeobiology of extinct organisms*



## Conference and Annual Address

The main Conference will begin on Thursday 19th December with a full day of talks and posters, followed by the Annual General Meeting. The Annual Address will be given by Dr Maria McNamara (University College Cork) during the afternoon, on the topic 'Not just skin deep: probing the secrets of fossil melanin using taphonomic experiments and analytical chemistry'. At the end of the day, the Annual Dinner will be held in a village on the outskirts of Valencia, at the nature reserve of La Albufera, with a live 'paella cooking show' and a disco party. The dinner and party are subsidized thanks to the generosity of our sponsors. The venue is big enough to accommodate all delegates and we would encourage everyone to attend.

Friday 20th December will be a full day of posters and talks in parallel sessions. Talks for both days will be allocated 15 minutes including time for questions. Lunch will be provided to delegates on both the 19th and 20th and are included in the registration fee.

## Field-trips

There are both pre-conference and post-conference field-trips available to delegates. A three-day pre-conference field-trip will visit the Palaeozoic series of the Iberian Range, visiting numerous palaeontological sites ranging from the Lower Cambrian to the Middle Devonian in the neighbouring provinces of Teruel and Zaragoza. This trip will depart on 15th December early in the morning from Valencia, and return on the 17th late in the afternoon, arriving in time for checking in and relaxing before the beginning of the Annual Meeting. The field-trip fees will include three days of meals, transport, the field-trip guide and accommodation for the duration (including Saturday 14th to facilitate the early departure of the group). The number of participants will be limited to 30 due to the characteristics of the outcrops.

The post-conference field-trip will entail a one-day visit on 21st December to the Miocene of the Province of Alicante, visiting the ichnological record of the Cabo de las Huertas close to Alicante, the Messinian coral reef of Santa Pola and the unique Palaeontological Museum of the province in Elche. The field-trip will be limited to 45 participants (coach capacity), departing from Valencia and returning there during the late afternoon. The price will include a meal.

## Getting to Valencia

The Conference will be held at the Blasco Ibañez Campus, where all venues are a short walk from one another. Valencia is a relatively small city; the campus is located just a 20–25 min walk from the 'old town', where abundant hotels are available. In addition, the city is well connected with public transport, including bus (EMT), tram and metro lines. There is a Metro stop just a few metres from the conference venue that connects to the centre of the city in 5–10 minutes (Line 3-Facultats).

Valencia is well connected with the rest of Spain and Europe, with its International Airport (VLC), being the destination for several Ryanair and Easyjet flights. From this airport you can easily reach the city centre by taxi or Metro (Lines 3-5). Valencia is also connected by high speed train (AVE) to Madrid, Barcelona and Alicante, and these can easily be reached from most cities within Europe, as well as non-European destinations. AVE trains arrive into Joaquín Sorolla Station, situated a ten-minute walk from the city centre.



### **Registration and booking**

Registration, booking and abstract submission are now open. Abstract submission will close in September (date to be announced) and abstracts submitted after that time will not be considered. Registration after that date will incur an additional administration charge of €50, with the final deadline for registration in November 2019, unless capacity is reached earlier. Registration and bookings will be taken on a strictly first-come, first-served basis. No refunds will be available after the final deadline.

Registration, abstract submission, booking and payment (by credit card) are available online via the Palaeontological Association website (<[www.palass.org](http://www.palass.org)>).

### **Accommodation**

Valencia has an accommodation capacity of more than 18,000 rooms in hotels and youth hostels, plus apartments and Airbnb. Accommodation is available within walking distance of the University, with plenty of options in the nearby old town, where there are numerous bars, restaurants and pubs. Accommodation should be booked separately through the usual online resources (see for example <[www.booking.com](http://www.booking.com)>), although we aim to provide a list of suggestions on the PalAss website in due course.

### **Travel grants to student members**

The Palaeontological Association runs a programme of travel grants to assist student members (doctoral and earlier) to attend the Annual Meeting, in order to present a talk or poster. For the Valencia 2019 meeting, grants of up to £100 (or the euro equivalent) will be available to student presenters who are travelling from outside Valencia. The actual amount available will depend on the number of applicants and the distance travelled. Payment of these awards is given as a disbursement at the Meeting, not as an advance payment. Students interested in applying for a PalAss travel grant should contact the Executive Officer, Dr Jo Hellawell (e-mail <[executive@palass.org](mailto:executive@palass.org)>) once the organizers have confirmed that their presentation is accepted, and before 1st December 2019. Entitle the e-mail "Travel Grant Request". No awards can be made to those who have not followed this procedure.

### **Childcare**

There are baby changing facilities on campus, and a nursing room can be made available as required. A nearby nursery can accommodate some young children (between 1 and 5 years of age) during the days of the main meeting, depending on age and demand. For details of cost and to enquire regarding availability please contact the conference organizers during the registration period.

### **Accessibility**

All buildings in the University are accessible via ramps and/or lifts.





## The city of Valencia

Valencia is located on Spain's eastern coast, on the shores of the Mediterranean Sea in the centre of the Gulf of Valencia. Its architecture dates from the first century BC to the most futuristic 21st century designs, combining history, tradition and modernity in an unusual way. Beaches bathed by the Mediterranean Sea are just 15 minutes from the city centre, near to the Marina Real Juan Carlos I, where an abundance of restaurants, pubs and music await. In addition, the city boasts wide-ranging environmental aspects due to its proximity to the Albufera nature reserve (cradle of the most famous Spanish dish, 'la paella') and more centrally its green lung, located in the old Turia riverbed that crosses the city centre from east to west. Valencia is a city experienced in accommodating all kind of events, with a reputation as one of the most complete and versatile destinations on the continent.

## Logo

The City of Arts and Sciences (CAC), designed by Santiago Calatrava, is the most iconic example of modern architecture in the city. The complex includes several fantastical buildings that house a science museum, the opera house, an IMAX cinema and an aquarium, all of them built in the old Turia riverbed surrounded by gardens and pools. Our logo was designed by Hugo Salais (HSilustration), a young scientific illustrator from Valencia, using some of these iconic buildings as a template with their reflections in the water that surrounds Valencia appearing in the shape of a nautiloid, a trilobite and the ostreid *Tridacna*.



We look forward to welcoming you to Valencia in December!

# Yorkshire FOSSIL FESTIVAL 2019



13th - 15th September  
(Schools day 13th September)

Over  
30 FREE  
events!

Science in Scarborough  
[yorkshirefossilfestival.co.uk](http://yorkshirefossilfestival.co.uk)

Rotunda Museum, Vernon Road, Scarborough YO11 2PS

**news**

## *Palaeontological Association Carer's Bursary*

Bursaries are made to support attendance at Association meetings by researchers with caring responsibilities. Normally the budget for an individual bursary will be a maximum of £250 GBP. Applications must include a supporting statement and a breakdown of anticipated expenses, supported by quotes where possible. Appropriate costs include attendance of a carer or use of local childcare facilities (for care of accompanying young children), or other caring costs at home.

Bursaries will be awarded to applications received prior to the application deadline. Applications will be assessed by the PalAss Diversity Group; if there are more than four eligible applicants, awards will be made on a first-come first-served basis. No subsequent report on expenditure is required.

Successful applicants will be invited to submit a brief statement (<60 words) describing the impact of the bursary on their career. This statement may be used in publicity for the bursary scheme and thus should not contain any confidential or sensitive information.

The principal applicant must be a member of the Association. Applications must be submitted electronically through the PalAss website. Any publicity associated with the activity must mention the support of the Association.

Successful awards will be paid retrospectively on the submission of receipts for reasonable costs (e.g. economy air fares or train tickets, accommodation, subsistence).

Deadline: **1st October** at 23:59 GMT.

Required supporting information:

- A cover letter detailing the case for support (no more than one A4 page)
- Receipts or quotations for expenses
- Details of any pending or previous applications for funds

These documents must be submitted in a single PDF file.

**Maria McNamara**

*Education Officer*

## *IPC6 (2022): call for proposals*

The International Palaeontological Congress (IPC) has been held in Sydney, Australia (2002), Beijing, China (2006), London, UK (2010), Mendoza, Argentina (2014) and Paris, France (2018). Each conference has been a great success, with rich scientific programmes of talks, posters and various pre- and post-congress field-trips, as well as enjoyable social and cultural activities. Delegates at IPC5 in Paris attended from over 60 different countries, making the congress a truly international meeting. The Council of the International Palaeontological Association (IPA) is considering potential venues for IPC6 in 2022. Proposals are welcome and should be submitted as soon as possible. For more information please see the IPA website at <[www.ipa-assoc.org](http://www.ipa-assoc.org)>.

**Sylvie Crasquin**

*President, International Palaeontological Association*



## Journal impact factors 2018

The new Impact factors for our journals have just been released and they continue to do well. *Palaeontology* now has an impact factor of 2.63, a ranking of third out of 57 journals in its field. While this is a drop from last year, when a bumper set of highly cited papers from our symposium of 2015 gave the journal an unexpected boost, *Palaeontology* remains a highly competitive journal for publishing papers that influence the subject. *Papers in Palaeontology* has also had a slight fall in impact factor, to 2.06, but has still moved up the rankings to ninth out of 57 in its field.

The top ten ranking journals covering the field of Palaeontology are as follows:

Rank	Journal	Impact Factor
1	<i>Palaeoceanography</i>	3.09
2	<i>Marine Micropalaeontology</i>	2.66
3	<i>Palaeontology</i>	2.63
4	<i>Palaeogeography, Palaeoclimatology, Palaeoecology</i>	2.62
5	<i>Vegetation History and Archaeobotany</i>	2.48
6	<i>Paleobiology</i>	2.35
7	<i>Journal of Systematic Palaeontology</i>	2.31
8	<i>Cretaceous Research</i>	2.12
9	<i>Papers in Palaeontology</i>	2.06
10	<i>Earth and Environmental Science of the Royal Society of Edinburgh</i>	1.84

**Andrew B. Smith**

*Editor-in-Chief*

## New PalAss publication

We have published a new book entitled *Trilobites, Dinosaurs and Mammoths: an introduction to the prehistory of the British Isles* by James McKay. With his colourful illustrations, palaeoartist James takes us on a whistle-stop tour through millions of years of Earth history. The British Isles are a special place for understanding the evolution of our world, as almost every time period is preserved. James uses his detailed reconstructions of rock formations and fossil



groups, accompanied by clear explanatory text, to lead us through the prehistoric changes that happened to life on these islands. The book is available to purchase from our online shop:

<<https://www.palass.org/beta/eps/shop/product/trilobites-dinosaurs-mammoths/>>.

**Sally Thomas**

*Publications Officer*



## Palaeontology in the news

Controversy is what sells newspapers (or generates clicks), so what makes the news is rarely the steady, incremental work that is the mainstay of palaeontological research. Recent fossil stories certainly fit this pattern.

The paperback edition of *Too Big to Walk: The New Science of Dinosaurs* by Brian J. Ford was published in May, and resulted in some remarkable clickbait headlines. The Daily Star ran with the arresting “Dinosaurs not killed by asteroid but by ‘shortage of SEX LAKES’”, while The Sun went with “Bonkosaurus rex”.

Ford is a prolific author of controversial popular science books. His latest offering puts a spin on ideas which were abandoned by the palaeontological community decades ago, but which play into the childhood memories that many ordinary folks have of dinosaur books showing sauro pods submerged in water. In his book he argues that non-avian dinosaurs would have required the buoyancy provided by immersion in water to be able to mate, and that the effect of tectonic changes on distribution of lakes is the true cause of their end-Cretaceous demise.



BRIAN J. FORD'S THEORIES ON DINOSAUR REPRODUCTION  
PROVED POPULAR IN SOME SPECIES

DR. JONES

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

Vertebrate palaeontologists are more or less united in their dismissal of his theories, and reviews of the book are equally scathing. My favourite on Amazon sums up Ford's ideas as “foetid dingoes' kidneys” (a fine use of the Douglas Adams quote). Unfortunately, with the release of the paperback edition, booksellers seem to be under the misapprehension that it is a serious science book, and copies sit in neat stacks in High Street bookshops next to authoritative popular science bestsellers. Another set of dinosaur misconceptions to add to the list for outreach practitioners<sup>1</sup>.

Amber from Myanmar has provided a treasure trove of new finds from around 100 million years ago, including the remains of birds and non-avian dinosaurs. However, the latest sensational fossil to hit the news was an invertebrate: a juvenile ammonite (genus *Puzosia*), studied using X-ray computed tomography and published in the *Proceedings of the National Academy of Science*. Those of us who saw the headlines and hoped to see soft-part cephalopod preservation were disappointed, but if there's one ammonite trapped in amber out there, perhaps others are waiting to be discovered. Other coverage of Burmese amber was less positive, with the journal *Science* running an article exposing the smuggling of much amber from the troubled state of Kachin in Myanmar to China, and the problematic nature of publishing research on specimens of dubious provenance.

<sup>1</sup> [Editor's note: See Maria McNamara's piece on more reasons to engage!]





Another fossil deposit in the spotlight over recent weeks has been the Foulden Maar site in Otago, New Zealand. Foulden Maar is a volcanic crater a kilometre wide, filled with Miocene sediments, including layers of economically-important diatomite. The fossil plants and animals have provided an invaluable snapshot of a temperate to subtropical rainforest ecosystem, but large-scale mining of the deposit for diatomite, used as a high-value feed additive for farming and an agricultural fertilizer, is threatened. The scientific community has called for formal protection of the site, but the tensions between local economics and scientific value have yet to play out.

With all this controversy we need a good news story to finish with. Getting palaeontology on to the fine British institution that is *Blue Peter* deserves a special mention. Congratulations to Dr Susie Maidment of the Natural History Museum, London for appearing live on the iconic children's BBC TV programme on 30th May. Inspiring the next generation with credible science has never been more important.

**Susannah Lydon**

*Publicity Officer*

## *GeoSoc medals & awards for palaeontologists*

### *Lyell Fund*

The Lyell Fund of the Geological Society of London is awarded this year to **Sam Giles** of the University of Birmingham. Sam is an outstanding palaeontologist working on the evolution of bony fishes, which are the ancestors of 99 % of all living vertebrates. In recognition of her achievements, Sam has been awarded a prestigious Royal Society Dorothy Hodgkin Research Fellowship, and two L'Oréal-UNESCO Women in Science awards, among others.



Sam completed her PhD research at the University of Oxford, working on the early origins of bony vertebrates and ray-finned fishes. Her subsequent research has explored key steps in vertebrate evolution, using state-of-the-art computed tomographic techniques to visualize and virtually dissect fossil data. Sam's work on these previously neglected taxa led to her naming a number of new species and has called for major revisions to our understanding of the origins of some of the most important and species-rich vertebrate clades.

An active teacher, Sam has developed outreach activities for primary school children, including Palaeontology Explorer backpacks aimed at increasing the profile of women in palaeontology. Sam has also given a number of popular science lectures and written an invited submission for *The Huffington Post*. Already a leading international authority in her field, Sam is a very worthy recipient of the Geological Society's Lyell Fund.

### *R H Worth Award*

The Geological Society of London's R H Worth Award celebrates the practice and encouragement of geological science by and among amateurs, and is this year awarded to the **Charmouth Heritage Coast Centre**. This charity, located on the Jurassic Coast of Dorset, brings geology to over 100,000 visitors each year and plays an essential role in the discovery, collection and curation of materials found along the actively eroding coastline. It is a model for science internationally, enabling the



discovery and preservation of finds, as well as the full engagement of the general public with the science.

The Centre receives visitors from around the world and from all walks of life, playing an important role in education by instructing over 4,000 school children annually. For many young visitors, the Charmouth Heritage Coast Centre provides their first contact with geology. The Centre's staff work with trained volunteers to organize 'fossil walks' that show off the geology of the coast and demonstrate how and where to find fossils. The Centre's volunteers have previously won the Queen's Award for Voluntary Service. 2018 was an exciting year for the Centre as it took a starring role in two BBC documentaries. It was host to the 4-metre-long ichthyosaur that was the focus of the BBC documentary *Attenborough and the Sea Dragon*, presented by Sir David Attenborough, and also featured in the BBC Four TV programme *Beach Live: Jurassic Coast Revealed*.

The Society's premier outreach award was accepted on behalf of the Charmouth Heritage Coast Centre by Phil Davidson.

#### *Biggsby Medal*

The Geological Society of London's Biggsby Medal is awarded this year to **Emily Rayfield** of the University of Bristol.

Emily is a world-leading palaeontologist who investigates skeletal mechanics and evolution. Looking at both living and extinct animals, Emily uses various methods to determine how skeletons function and to explore how this function has evolved, for example, in response to major environmental change. In particular, Emily looks at the evolution of the skull and its relation to feeding behaviour in dinosaurs, birds, crocodiles and mammals, principally during the land-to-water transition. Emily has also been involved in projects that explore the function of hard tissues in marine creatures with the aim of understanding the resilience of the skeleton in acidifying oceans.

Emily's major novel contribution is the development of the technique of finite element modelling to understand the mechanics of animal skeletons. This innovative research has been especially influential in illuminating morphological changes across major evolutionary transitions, such as the origin of birds and mammals. Emily's work has revitalized research on the feeding and behaviour of extinct animals, enabling quantitative testing of scientific hypotheses with computational methods.

Emily has served as Vice President of both the Palaeontological Association and the Society of Vertebrate Paleontology, and she is currently President of the latter. Her novel and creative approach has led the transformation of palaeontological functional morphology into a scientific discipline, and the Society has no doubt that she will continue to make seminal contributions to our understanding of the palaeobiology of ancient organisms at major evolutionary transitions.

#### **Sarah Day**

*The Geological Society of London*

(Images © The Geological Society of London.)



NEWS



## ***The Marsh Awards 2019***

Nominations are being accepted for the three Marsh Awards for 2019 in association with the Natural History Museum, London, namely, i. Palaeontology; ii. Mineralogy, and iii. Best Earth Sciences (academic) Book of the Year. The first award recognizes 'unsung heroes' who have made major contributions to promote palaeontology in the UK. The deadline for all three nominations is **1st November 2019**. Further information and the respective nomination forms can be found on the website at <<https://www.nhm.ac.uk/events/the-marsh-awards-for-palaeontology-mineralogy-earth-sciences-book.html>>.

The Marsh Christian Trust supports around 300 charities every year through the Grants Programme and gives over 80 different Awards to individuals and groups from across the charity sector, who make a difference to a cause that they believe in. We would be grateful if you could help us disseminate the information among museums, geological societies and amateur groups in your region. Help us find 'unsung heroes' among museum volunteers, scholars and people who do amazing work promoting the Earth Sciences!

**Martha Richter**

*Natural History Museum, London*

## ***Lyell Meeting 2020 open for proposals***

The Lyell Meeting is an annual flagship event for UK palaeontology and co-ordination of the meeting is open to members of the Palaeontological Association. There is now a call for proposals for the 2020 meeting, which is due to take place around March that year. Those wishing to propose a topic and convene this meeting are invited to submit developed proposals preferably by the end of August 2019. Please see the website for more information: <<https://www.geolsoc.org.uk/Events/Meeting-Proposals>>.

Our chosen theme for 2020 is the Year of Life, a fitting theme for palaeontology. We welcome submissions that are ambitious in scope and trans-disciplinary, which are more likely to attract a larger and potentially international audience. Proposed topics should appeal to a wide cross-section of the geological and palaeontological community. They should have a lead convener and one or two co-conveners. We look forward to receiving your proposals for the Lyell Meeting and we welcome proposals for other meetings in 2020 and beyond.

**Alicia Newton**

*The Geological Society of London*

## ***An apology***

We published an abridged version of an obituary of Ralph E. Chapman, kindly written for the Association by Norman MacLeod, in *Palaeontology Newsletter* 100. This version was heavily edited in a manner not approved by Norman prior to its publication. We wish to apologise unreservedly to him for the lack of editorial oversight. We would like to direct readers to the full obituary now available on our website at: <<https://www.palass.org/publications/newsletter/obituary-ralph-e-chapman>>.

**Jo Hellawell**

*Executive Officer*





## From our Correspondents

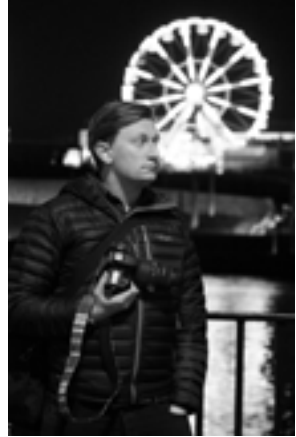
# A Palaeontologist Abroad

Highlighting early-career researchers who have taken posts outside their home country and the opportunities they used. This issue's palaeontologists are Thomas Clements, Gabriel Aguirre and Yadong Sun.

Thomas Clements is a Briton in Ireland, employed as a post-doctoral researcher at University College Cork as part of an ERC Starter Grant awarded to Maria McNamara.

### Q1: How did you end up in Ireland?

Towards the end of my PhD I had no immediate plans; my main concern was getting finished and seeing what happened next. With about three months before my hand-in date, a two-year position was advertised in UCC, Cork. I applied for the project, was successful and started about two weeks after I handed in my thesis, during the worst blizzard seen in the UK for about 50 years. I got trapped in my car overnight on the motorway during the move and the ferry over was a 'little bit' choppy!



### Q2: How is your position funded?

The position is part of a European Research Council funded project titled: 'Animal coloration through deep time: evolutionary novelty, homology and taphonomy'.

### Q3: What is your project about?

My project focuses on trying to reconstruct the colouration of fossil insects, predominantly Coleoptera (beetles). The fossilization process normally removes colour from fossils, clouding our understanding of its evolution. However, distinct chemical signals of cuticular pigments in extant insects have been identified, so we are looking at fossils of related insects from multiple Lagerstätten to see if these signals can be identified using synchrotron X-ray spectroscopy. An important part of this project is investigating whether these chemicals are altered during the fossilization process, and we will use taphonomic experiments to investigate this.

### Q4: What surprised you most about living in Ireland?

I had been to Ireland a few times before coming to live here, plus as an English-speaking country, Ireland isn't too dissimilar to home, so I didn't have a massive culture shock. The Corkonian accent can be a little impenetrable, but the people here are generally very friendly and have a great sense of humour (good craic!) and the countryside and Atlantic coastline are spectacular. I did find that the similar yet subtle differences made me initially very homesick (e.g. shopping in Tesco but not recognizing any of the products or being able to find certain staples). It's an expensive country and the housing market is an utter mess, but I have grown surprisingly fond of the place and would consider staying here.

I have learnt a lot about Ireland's history which is something I have really enjoyed, often sobering reading for an English person, and even have started to learn Irish, *i.e.* D'íth mo ochtapas mo phortán.



**Q5: Apart from friends and family what do you miss most about the UK?**

Because the two countries are so similar, it's hard to miss too much. I do miss the ease of getting around in the UK (even if it is super overpriced) as public transport is a little lacking in Ireland. I really miss high-speed, cheap, reliable internet – and my Irish partner... who lives in England.

I do NOT miss Brexit or the current state of British politics.

Thomas tweets at @thomas\_clements.

**Gabriel Aguirre is a Mexican in Switzerland, employed as a postdoctoral researcher at the Palaeontological Institute and Museum of the University of Zurich on a grant made to his PI.**



**Q1: How did you end up in Switzerland?**

While finishing my PhD in New Zealand I struggled to find a position before my visa ran out, so we (wife, one-year-old son and me) moved to Mexico for a while and eventually to Switzerland (where my wife is from). Coincidentally, the meeting of the Palaeontological Association was held that year in Zurich. I attended and managed to talk to many of the people working on palaeontology in Zurich (and abroad, of course). Some months later, I was given the chance to work on a project on some little-known dolphins from South America and to give a lecture on phylogenetic methods.

**Q2: How is your position funded?**

I currently have two part-time jobs. As a postdoc, I am employed under a grant awarded to Marcelo Sánchez-Villagra. I also work on a fixed contract as a collections assistant at the same institution.

**Q3: What is your project about?**

Most of my academic life has been devoted to describing fossil whales and dolphins. Although I continue to work on cetaceans (currently from the Molasse of Switzerland), my focus has diversified to other groups, e.g. catfish, pinnipeds and even chicken, and a wider range of analytical tools. Lately, I have been working with a very interdisciplinary group on cultural evolution. We use features on musical instruments to try to tackle questions on past human interactions.

**Q4: What surprised you most about living in Switzerland?**

The public transport system. This goes beyond the known train punctuality: there is almost no corner of the country where you could not get by using any public system means: train, tram, bus, boat, funicular, cable car, horse and carriage...

The research in Switzerland is extremely diverse thanks to the interaction of people from all over the world. The ease of access to infrastructure and the facility to travel to nearby countries allows for a very smooth flow of new information.

**Q5: Apart from friends and family what do you miss most about Mexico?**

Probably a cliché, but hard to avoid. I miss the food, there is nothing wrong with potatoes and the cheese here is very delicious, but nothing can beat a delicious taco al pastor.



You can keep up to date on Gabriel's work through his ResearchGate page here:  
<[https://www.researchgate.net/profile/Gabriel\\_Aguirre\\_Fernandez](https://www.researchgate.net/profile/Gabriel_Aguirre_Fernandez)>.



**Yadong Sun is a Chinese in Germany, employed as a Research Assistant at the GeoZentrum Nordbayern, University of Erlangen-Nuremberg on a German Science Foundation innovation research team project (DFG Forschungsgruppe).**

**Q1: How did you end up in Germany?**

It's a rather long story. I had a five-year split-site PhD programme. I started out at Wuhan (a very hot and humid city in central China) and steamed there for two and half years researching conodont taxonomy and biostratigraphy. I was awarded an exchange fellowship and spent a winter in Erlangen (Bavaria, Germany), studying stable isotopes. That winter was very white with snow reaching my knees – no biggie to a guy from North China but I

prefer my feet to be dry. I then always heard English people saying that the weather in Yorkshire was not too bad, never too hot or too cold. It seemed to be my final destination! I moved to the University of Leeds for the last two years of my PhD, learning sedimentology. But nobody told me that Yorkshire people didn't care too much about seeing the sun. I had my choices: steam house, wet feet or wet pants. After my PhD in 2013, I worked in Wuhan for a few months, got married and received a two-year fellowship from the prestigious Alexander von Humboldt Foundation to work in Germany. It seems to be a very wise decision. With the current ongoing global warming, I have never had wet feet since the winter of 2010!

My initial plan was to leave Germany after my fellowship to live in another country and then explore the world. So I didn't learn German at all. Some may say the Chinese are a very proud people, they normally don't really bother to talk to Germans. However, things did not go as planned. After my fellowship ended in 2015, I worked briefly in Wuhan for a couple of months, visited my PhD supervisor in Leeds for about a month, then moved back to Erlangen in the summer of 2016 for another contract running through to mid-2019. I was very busy with my lab work and still did not learn German but my English has improved since I left Leeds. In this summer, our project was successfully renewed. I will probably live in Germany for another three years. I do plan to learn German this time and have signed up to a programme. I am considered as a legend in our German class – the guy survived in Bavaria for five years without knowing any German! I have been very lucky in this respect and have many nice colleagues and Google to help me out with all sort of things. I became very strategic when asking for help – if anyone dared to say no, I kept nagging them until I got a yes.

**Q2: How is your position funded?**

I have been funded by the Alexander von Humboldt Foundation and the German Science Foundation (DFG, Deutsche Forschungsgemeinschaft). For young PhDs, you can apply for a fellowship or your own project from these funding bodies. Becoming a Humboldtian is a life-time honour. The foundation really takes care of every fellow. I can highly recommend PhD students apply.



**Q3: What is your project about?**

My project aims to understand the climate and oceanic conditions of the geological past. More specifically, it focuses on the Permian–Triassic transition (around 253 million years ago), when the largest mass extinction occurred. It was also a time of dramatic climate changes – the Permian was generally considered as an ice-house world while the following Triassic was a hot-house world. The Permian–Triassic boundary transition was marked by a roughly 10 °C temperature rise in about 120,000 years. The aim of the project is to understand the temperature changes in high latitudes and many other strange things that happened in this critical interval.

My main job is to extract conodonts for both biostratigraphy and oxygen isotope analysis. Conodonts are very small, typically only 200 µm long, and can be very rare. In past years, I spent a lot of time in the basement of our department, dissolving rocks and searching for conodonts. It is a very tedious job, probably why they hired a Chinese person to do it. I use diluted acetic acid for dissolving rocks. Acetic acid is the main component of vinegar and it smells. After a couple of hours working in the lab, people start to complain that I am very disturbing and smell like a Greek salad.

**Q4: What surprised you most about living in Germany?**

I am most impressed by two things: 1) world-famous German bureaucracy – and it actually works (after several years of training I believe that I am competent enough to land any UN, EU or governmental job), and 2) undergraduate students – they actually listen to me and believe what I say.

**Q5: Apart from friends and family what do you miss most about China?**

Real Chinese food. The region I have lived in for the past six years is called Franconia, which is famous for its meat- and potato-dominated cuisines and good beers. The main flavour in these cuisines is a largely salty taste while beers are considered as a daily necessity. I do enjoy the good protein-rich food here. Schnitzel and Schäufele (pig shoulder with crispy skin) are my favourite dishes. However, this diet results in a development of iconic German beer belly in me, although I haven't found enough evidence to make a further connection to losing hair amongst middle-aged men. I miss the large variety of vegetables in Chinese daily food and the diversity of tastes in my mouth. There are some Chinese restaurants in Erlangen, however they, like many restaurants in Germany, modify authentic recipes to cater for local customs. I do understand some ingredients are hard to get outside their country of origin and most Germans do not like spicy food. This kind of modification of original food is probably a really unfortunate marketing trend – I have never seen a single fortune cookie in China! I also hear similar complaints from my German colleagues who have been to China. I have been to a lot of places in China and still am very often surprised by the innovative Chinese dishes served in the Mensa (student cafeteria) of our university. Maybe there is a silver lining to this modification. Exotic Asian foods are integrated more and more to other cultures and spread rather widely to the rest of the world.

Yadong can be found on Facebook, but he is not very active there.



# Legends of Rock

**Asunción Linares**

## *Pioneering woman in Spanish palaeontology*

Asunción Linares Rodríguez was born on 12th February 1921 to a middle-class family in Pulianas, a small village close to the city of Granada, Spain, and died in Granada at 84 years of age on 21st April 2005. She went to primary school in her home town and earned her secondary-school degree at the 'Instituto Angel Ganivet' in Granada (at the time very few women completed secondary school in Spain). From 1942 to 1947 she studied Natural Sciences in the Central University of Madrid (now Universidad Complutense). In 1947 she joined the staff of the University of Granada, beginning her research career on trilobites under the direction of Professor Bermudo Meléndez. These Palaeozoic arthropods were the subject of her PhD thesis and she received the highest



*Professor Asunción Linares in her office of the Department of Palaeontology of the University of Granada in the late 1980s (J. Sandoval's personal archive).*

academic honours in 1952 for her dissertation. From 1958 to 1962 she was scientific collaborator in the 'Lucas Mallada' Institute of the Spanish National Research Council (the present CSIC). From 1957 to 1961 she undertook a number of postdoctoral stays in France (Paris, Lyon, Lille, Dijon, and Rueil-Malmaison), under the supervision of Professors Lapparent, Lys, Dubar, Fallot, Durand-Delga, Cuvillier and Mouterde, notably acquiring with Cuvillier a set of micropalaeontological skills (e.g. analysis of thin sections and microfacies) that she later introduced to Spain.

In 1961 Asunción successfully secured a permanent position as Professor (Catedrática in Spanish) of Palaeontology in the Section of Geology of the University of Granada, a section founded only three years earlier thanks to the initiative of her colleague and friend Professor José María Fontboté. She was the third woman in Spain to obtain a full-professorship tenure, the second one after the Spanish Civil War, and the first in the field of Natural Sciences – the two previous ones were Lucía de Medrano in 1522 (who succeeded Antonio de Nebrija in the Rhetoric Chair of the University of Salamanca), and Ángeles Galino Carrillo (Professor of History of Pedagogy) in 1953. She continued her work in the University of Granada during the following 26 years, where she inspired many generations of geologists and palaeontologists, and was the Head of the Department of Palaeontology from its foundation in 1964 until 1986, one year before her retirement. In the late 1960s she also started her academic administration activities, being the first woman appointed as Vice Chancellor in the University of Granada, taking the responsibility of Academic Organisation



and leading the Institute of Educational Sciences, where she oversaw new university canteens in the Assistance Programme for students, providing a significant improvement over the previous facilities. Asunción was also the first woman to be incorporated as a member of the Academy of Mathematical, Physico-Chemical and Natural Sciences of Granada. She was a member of the Geological Society of France, founding honorary member of the Spanish Palaeontological Society and of the Geological Society of Spain, and President of the Spanish Commission for Jurassic Studies. After her retirement in 1987, she continued working for 15 more years as Emeritus Professor in her department (then named the Department of Stratigraphy and Palaeontology), a position that ceased three years before her death in 2005. That year the 'Museum of Palaeontology' of the Section of Geology of the Faculty of Sciences was named in her honour.



*Asunción Linares (left) during fieldwork in Germany (1977) with three of her students (from left to right): Federico Olóriz, Pascual Rivas and Leandro Sequeiros (J. Sandoval's personal archive).*

Funding for higher education and research was very scarce in Spain during the decades between the forties and the sixties. Some universities (*e.g.* Madrid and Barcelona) had good library collections by that time, but the University of Granada (and particularly its Section of Geology) was virtually starting from scratch. In spite of this, Asunción Linares managed to set up her laboratories with palaeontological collections and research facilities that became a benchmark in Spain. Moreover, she established a palaeontological library with the most renowned books and journals of the period, as well as a huge number of palaeontological monographs (many of them classic ones) necessary for improving geological research in the Betic Cordillera. Her wide interests in palaeontology are reflected in the more than one hundred scientific papers published during her academic career, a vast number of communications and invited lectures at national and international meetings, advisor of eighteen PhD theses and of an undetermined number of



Masters theses. She participated as a member of the research team of eight research projects granted by the Ministry of Education and Science of Spain, being the principal investigator for three of them. She regularly contributed with papers to *Cuadernos de Geología* (Notebooks on Geology) of the University of Granada since its foundation in 1970, being the Editor in Chief of this journal from 1977 to 1985.

As a result of this activity, her research contributed to improving regional stratigraphy and palaeontology, while introducing many topics not investigated in depth before in Spain, including: (i) the regional geology of the Betic Cordillera; (ii) the taxonomy and biostratigraphy of planktonic and benthic foraminifera and radiolarians; (iii) the biostratigraphy and palaeobiology of the small and large mammals preserved in the Neogene-Quaternary intramontane basins of Southern Spain; and, above all, (iv) the study of ammonoid assemblages of Jurassic and Lower Cretaceous age, her group of primary interest since she returned to Granada. Thanks to these efforts, Spanish palaeontology (and particularly the study of ammonoids) experienced a great step forward to rise to a position of excellence at the European level, and many of her doctoral students are now faculty at universities across Spain (*e.g.*, Basque Country, Complutense, Córdoba, Granada, Jaén, Huelva, La Laguna, Málaga, Sevilla, Tetouan and Zaragoza) or obtained permanent research positions in the CSIC. Her generosity and dedication to her colleagues and students probably reflects the fact that Asunción Linares was fondly known among them as ‘Missy’ (she never married), a nickname that stayed with her throughout her life.

Finally, an anecdote on the vast knowledge of Asunción on nearly all palaeontological aspects: in the early 1990s she was invited to give a talk in Málaga to the students of the PhD programme in Evolutionary Biology – and spoke about mass extinction events for over three hours!

Last but not least, in spite of the impressive amount of academic work in the field of Earth sciences during her lifetime, the legacy of Asunción for the benefit of the most disadvantaged people was even greater. After her death, her dedication to charitable activities became known, having worked as volunteer in hospitals of Granada, helping homeless women, and serving as President of the Board of the Institution Pope John XXIII (an organization for the education of children in underprivileged zones). For this reason, a square in Granada is named ‘Catedrática Asunción Linares’, and a nursery school in this city and a primary school in the town Churriana de la Vega also bear her name.

**José María González-Donoso**

*Universidad de Málaga*

**Dolores Linares**

*Universidad de Málaga*

**Federico Olóriz**

*Universidad de Granada*

**Paul Palmqvist**

*Universidad de Málaga*

**José Sandoval**

*Universidad de Granada*

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# Behind the Scenes at the Museum

## *University of Michigan Museum of Paleontology and Museum of Natural History*

### **The history of palaeontological collections at University of Michigan**

The origin of natural history collections at the University of Michigan, USA is intimately tied to the 1837 statehood of Michigan. Among the first acts of the newly established state legislature was the formalization of the governance of the University. This charged the University Regents with, among other things, establishing a “Cabinet of Natural History.” In practice, this collections mission was delegated to the fledgling institution’s faculty. Palaeontology at the University began with the 1839 appointment of Douglas Houghton as State Geologist and first professor of geology at the University. Houghton’s surveys of the far northern part of Michigan yielded the first fossils added to the Cabinet, from Isle Royale in Lake Superior.



*The University of Michigan Museum of Natural History provides a public face to collections-based research at the University of Michigan. Paleontology is well represented in the Museum’s main atrium, which features the Museum of Paleontology’s visible preparation lab, and skeletal mounts of Pleistocene mastodons and Eocene whales collected or studied by Michigan faculty.*

*Image © Linda Garcia.*





The University Museum – as the Cabinet had come to be called – could claim over 100,000 specimens in 1873, outgrowing makeshift homes in existing structures. The University Museum Building was completed in 1880 to exhibit ethnological and natural history collections, but its inadequacies became clear not long after. Palaeontological and geological collections were granted their own space in the Department of Geology in 1915, and recognized as a separately funded Museum of Geology in 1926. The unit's rechristening as the Museum of Paleontology in 1928 coincided with a move to the new University Museums Building that would serve as its home for the next nine decades. It was also in the 1920s that the Museum began its own publication, *Contributions from the Museum of Paleontology*. This was joined in the 1970s by the monographic series *Papers on Paleontology*. Both remain active, with published content freely available online via the University's digital library<sup>1</sup>.

Today, the Museum of Paleontology is one of the University's research museums, alongside the Museum of Anthropological Archaeology, Museum of Zoology and Herbarium. Curatorial faculty in these museums have joint appointments with related academic departments, reflecting a distinction between curatorial and instructional roles. Collectively, the research museums contain around 20 million specimens and artifacts, ranking among the largest university collections in North America. The research museums are independent of the Museum of Natural History, but work closely with it to provide a public face to collections-based research at the University.

### Collections highlights

The Museum of Paleontology's collections are divided into separate invertebrate (an estimated two million specimens), vertebrate (100,000 catalogue numbers and perhaps as many as one million individual specimens) and palaeobotany (15,000 catalogue numbers) collections, the strengths of which reflect a combination of regional geology and the research interests of past and current researchers. The state's Lower Peninsula is centred on the Michigan Basin, apparent as a series of concentric Cambrian–Carboniferous sedimentary strata in geological maps. Marine fossils from these deposits dominate the Museum's invertebrate collections, and include trilobite specimens enlisted by Gould and Eldredge in arguments for punctuated equilibrium. The invertebrate collections in particular benefit from association with the Friends of the University of Michigan Museum of Paleontology, a group of dedicated and knowledgeable avocational palaeontologists. Many of their key discoveries from the Michigan Basin are documented in an online photographic database<sup>2</sup> and donations of individual members to the Museum include dozens of what are now holotypes. Pleistocene mammals, including mammoths and mastodons, are another area of collections strength deriving from regional finds. Beyond Michigan and the Great Lakes Region, the Museum's collections have particular strengths in Permo–Triassic terrestrial vertebrates of the southwestern United States, Cenozoic mammals from Wyoming and Eocene whales from Egypt.

### New collections space and exhibits for a third century

By the close of the 20th century, palaeontological collections had outgrown their home, spreading to separate buildings across the University's main campus. Other natural history collections experienced similar strains on space, as well as the conservation challenges posed by an older building lacking modern climate control systems. In 2001, the Herbarium was moved to the new

<sup>1</sup> See <<https://deepblue.lib.umich.edu/>>.

<sup>2</sup> See <<http://michiganbasinfossils.org/>>.



Research Museums Center, followed by the fluid collections of the Museum of Zoology in 2011–2012, and the Museum of Paleontology, Museum of Anthropological Archaeology and dry collections of the Museum of Zoology in 2016–2018. Other on-site facilities include the 130,000 volume Museums Library and specialist study and preparation labs supporting each of the research museums. At the same time as collections moved to a new facility, the University's public face of collections-based research – the Museum of Natural History – also transitioned to a new home in the Biological Sciences Building. Exhibit galleries wind through a building housing laboratories and offices for the Museum of Paleontology and departments of Ecology and Evolutionary Biology and Molecular, Cellular, and Developmental Biology. Visitors are greeted in the Museum atrium by a pair of American mastodons, one set within a cast of a trackway discovered just outside of Ann Arbor, while skeletons of the Eocene whales *Basilosaurus* and *Dorudon* are suspended overhead. Palaeontology is on show in a visible fossil preparation lab, and in *Evolution: Life through Time*, a chronological journey through Earth history as illustrated through fossils from the Museum of Paleontology. Additional palaeontological content will be displayed in November 2019 when the *Michigan* gallery opens along with other exhibits in the Museum's second phase. These new facilities place palaeontology in a secure position as the discipline at Michigan approaches its third century.



*Collections strengths of the University of Michigan Museum of Paleontology include Pleistocene megafauna of the Great Lakes region, with a particular emphasis on mastodons and mammoths. Image © Linda Garcia.*

### **Matt Friedman**

*University of Michigan*

The Museum is located at: University of Michigan Museum of Paleontology, University of Michigan Museum of Natural History, 1105 N University Avenue, Ann Arbor, MI 48109 USA and is open daily from 9am to 5pm, with extended hours until 8pm on Thursdays. Admission is free, but donations are appreciated. Tickets are required for planetarium shows.

More information can be found at the respective websites:

- UMMNH: <<https://lsa.umich.edu/ummnh/>>
- UMMP <<https://lsa.umich.edu/paleontology/>>

You can follow them on Twitter, @UMMNH and @UMichPaleo. The University of Michigan Online Repository of Fossils can be found at <<https://umorf.ummp.lsa.umich.edu/wp/>>.



# Early-career researchers and public engagement – why bother?

Early-career researchers (ECRs) operate in a world of fast-moving research and technology and dedicate much of their time to labwork, fieldwork, data analysis, writing grant applications and publications, and presenting at conferences. What's more, ECRs typically juggle these research activities with other duties, including teaching, management and administration (not to mention having a life!). Public outreach – or public engagement (the current favoured terminology) – can too easily seem like a low priority. Engaging with those outside of academia, however, can bring big benefits to our careers.

The benefits to the public are obvious: (1) they get to interact with an expert, which can have a dramatic and lasting impact, in some cases changing their lives; (2) they can learn something interesting and current (everyone wants to be up to date); and (3) they learn something accurate (combating some of the false information that can be found on the Internet).

The benefits to us as scientists, however, are not necessarily obvious nor communicated effectively, especially to ECRs, who often feel under pressure as they carve out careers and try to secure positions. At worst, public engagement can be perceived as tedious, too much hard work, irritating, a waste of time or simply 'not for me'. But communicating science to the public doesn't have to be any of these things. Moreover, it is extremely important to scientists themselves.

First of all, let's address those who feel that scientific outreach is 'not for me'. We accept that some aspects of public engagement are not suited to everyone's skillsets and interests, or require training, support and encouragement to become comfortable and proficient. Not everyone feels comfortable in a classroom of 30 boisterous five-year-olds, or in front of a TV camera, or speaking live on radio. There are, however, diverse forms of public engagement, including the digital and interpersonal, and by considering public engagement in the broadest sense, you may find an avenue that fits your skills and interests. You may actually already be engaging in scientific education and public engagement (EPE) without realizing it.

## So what is public engagement?

Various definitions of public engagement exist, but in real terms it includes activities such as:

- Working with schoolchildren, e.g. the Bristol Dinosaur Project, Beach in a Box
- Working with local adults, via lifelong learning programmes or amateur societies
- Working with local communities or groups with particular needs
- Interacting with the public at science festivals, e.g. Lyme Regis Fossil Festival, Pint of Science
- Working with university students, e.g. university society events
- Working with teachers
- Writing a blog, e.g. Palaeontology World blog (<<https://paleontologyworld.com/blog>>)
- Maintaining an active Facebook or Twitter account and posting about current research
- Writing for a popular science magazine or popular science books



- Writing for local or regional print media
- Appearing on TV or radio
- Recording a podcast, *e.g.* Palaeocast
- Recording a video for online use
- Designing or managing a website
- Designing and producing outreach materials, *e.g.* leaflets
- Designing exhibits and learning resources

### **Why should I get involved with public engagement?**

Public engagement has a number of direct and tangible benefits to researchers. Here's our list of nine reasons to participate in engaging the public with science:

#### *#1. It makes you a better communicator.*

By communicating science to the public via oral or digital avenues you will develop invaluable experience in communicating to diverse audiences, including non-scientists, scientists working outside your research area and even your scientific peers. You will learn to ditch the terminology, to succinctly and quickly describe your (and other people's) research, how to distil the key messages and how to see the bigger picture. This forces you to move out of your comfort zone and is a hugely useful skill that you may draw on later in your career, especially if you work on future projects involving diverse stakeholders, notably landowners, industry workers, policymakers and politicians. Communicating science to the public also helps you disseminate your research amongst your scientific peers by enhancing your confidence, *e.g.* presenting at conferences can be much less nerve-wracking if you've built up experience in public speaking through public engagement. Working with the public also makes you a better communicator with the professional media. Other tangible benefits to your broader communication skills include new or enhanced skills in website production and management, digital illustration/ design and data analysis.

#### *#2. It enhances your profile.*

Public engagement can greatly enhance your research impact and will develop your profile among your peers, the media and the general public. This can lead to new collaborations with other researchers and stakeholders and can feed into grant applications (*e.g.* reporting the number of visits to your website, blog *etc.*).

#### *#3. You can experience rewarding interactions with the public.*

Public engagement can be fun and very rewarding. Direct interpersonal and digital interactions can be very stimulating. Positive reflections, comments and testimonials from children, parents, students, teachers *etc.* demonstrate the powerful impact that interactions with science can have on our lives. This affirmation or public endorsement validates our efforts and confirms our value in our roles as scientists.

#### *#4. Many funders require it.*

In recent years many funding agencies in the UK, Europe and elsewhere have added discrete sections on public engagement to research grant applications; this includes NERC, the Royal Society, all EU funding programmes and NSF (to name a few). This is not the same as a typical



'dissemination plan', which focuses on how you communicate your project's results to the scientific community. The public engagement section typically requires a description of activities, a timeline, anticipated outputs, description of evaluation methods and a budget. Funders will also consider your track record in public engagement and your ability to deliver on your proposed outputs. This section of a grant proposal is often left to the last minute and can be poorly thought out. Gaining experience with public engagement activities early in your career helps you discover which activities best match your interests and skillsets and helps to create a good public engagement profile, enhancing your ability to write this part of grant proposals.

*#5. It broadens the types of funding you can apply for.*

A good track record in public engagement is essential leverage for education and engagement-specific funding. Such funding can comprise substantial pots of money (some programmes, up to €300K) and – if you plan well – can assist your research via the purchase of new equipment, analysis time, visits to collections *etc.* In this way, engagement-specific funding can contribute directly to your research agenda.

*#6. It keeps your scientific field alive.*

Many of us chose a career as a scientist in part because of positive experiences in engaging with scientists, either directly or via their written and media output. By engaging with the public, especially children, we are ensuring that our passion for the natural world is passed on, fostering positive attitudes towards science and stimulating the next generation of young scientists. Furthermore, by informing the public about your field, you are raising its profile in the public consciousness. This stimulates interest, increases scientific literacy in your research area, improves public trust in science, and reduces deficits in knowledge and misunderstandings.

*#7. It improves public trust in science.*

This leads to more indirect benefits for individual researchers but ultimately supports science as a whole. Despite the massive improvements that science has brought to civilization, both it and scientists are often portrayed negatively in the media. Public trust in science has been eroded, as illustrated by increasing public sentiment favouring sensationalized news at the expense of scientific experts. This public disillusionment with science may reflect reporting of much research as conflicting: scientists cannot 'make up their minds'. Excessive hype or 'sensationalization' is rampant, leading to *e.g.* successive supposedly science-based health crazes. Popular figures and celebrities increasingly disseminate 'scientific advice' (*e.g.* jade eggs and coffee enemas for well-being), which aside from inherent risks to public safety erodes trust in science. Above all, the real cutting-edge science itself is frequently inaccessible, either because of jargon or because of prohibitive access costs. By engaging directly with the public, we provide a critical counterbalance to these phenomena and help to foster greater understanding of science among the public.

*#8. It humanizes scientists.*

Scientists fall foul of numerous stereotypes, typically portrayed in the media as aloof, antisocial, clinical, nerdy, mad or obsessive. This is potentially a deterrent to many schoolchildren when considering future careers. When we engage with the public we humanize scientists by showing that scientists are 'real' people with normal lives and interests beyond science. We also show that scientists are diverse – we are not all white men in lab coats. By doing this we create credible role models for the next generation of scientists.



### #9. *We fulfil our civic duty.*

As scientists belonging to publicly-funded institutions, with (for many of us) much of our research income being publicly-funded, we have a civic duty to engage with wider society and pass on our research results to society at large. This is even more important where we are experts in our respective fields, *i.e.* from PhD-level onwards, and can improve public trust in science (see #6 above).

We hope that this article will encourage you to engage with the public, whether you are just starting out in your scientific career or you are already faculty. Should you have any questions about any aspect of public engagement, please get in contact with the PalAss Public Engagement Group (Outreach Officer Lucy McCobb, <[outreach@palass.org](mailto:outreach@palass.org)>; Publicity Officer Susannah Lydon, <[publicity@palass.org](mailto:publicity@palass.org)>; and Education Officer Maria McNamara, <[education@palass.org](mailto:education@palass.org)>), and we will do what we can to help.

**Maria McNamara**

*University College Cork*

## Positively palaeontological

When you finally get to meet a life-long hero and inspiration in the flesh, then the dangers of discovering feet of clay atop the pedestal are all too well known. When Charles Darwin met Alexander von Humboldt for the first and only time, in early 1842, at a gathering organized (at Humboldt's request) by Roderick Murchison<sup>1</sup>, it was the jaw of steel, though, that caused the bewilderment. That extraordinary savant-explorer, the last of the universal scientists (while being a man of the arts and humanities too, lest we forget) and celebrated in his lifetime as no other, would not stop talking, for three solid hours. Poor Darwin could not get a word in edgeways and retreated, baffled, at the end of the evening.

To Humboldt's friends, and his long-suffering brother, Wilhelm, this was nothing unusual. Humboldt lived as though he was permanently on one of those illicit substances that ramp up the metabolism to warp speed (in this case, the drug was science) and he had become used to being the centre of attention. As a font to dispense never-ending wisdom to all around him, in society he was as near a perpetual motion machine as mere biology has produced. The irony of this is that his celebrity was fully deserved, and the wisdom was real; forensic analysis of his lower limbs would reveal an absence of clay minerals, right down to the toenails. But he was not always easy company, even – and perhaps especially – on brief acquaintance, and could have a sharp and sometimes unfair tongue to boot. But many, of course, did take to this relentless polymath. Goethe, who got to know Humboldt much better, was inspired by his company, and indeed delighted in sharing this incessant hyper-activity, while the laidback and unflappable Aimé Bonpland seems to have been the perfect foil during the South American adventures.

It's a pity the conversation was so one-sided. Darwin was then in that long gestation period of the *Origin of Species* and was seeking some genuine interchange, not least regarding the geographic

<sup>1</sup> The occasion was good news for quite a few pheasants, as Murchison grumbled that it deprived him of the best part of the shooting season.



distribution of different species, about which the older man's knowledge was encyclopaedic. And Humboldt himself might well have taken positively to Darwin's dangerous idea, and perhaps discovered yet another prism to view life through, as he was preparing his own magnum opus on the world and everything on – and around – it<sup>2</sup>.

It's extraordinary that Darwin's status as icon in both scientific and popular culture – *quite* as much deserved – has risen so high, while Humboldt's fame has faded to near-obscurity – though with luck Andrea Wulf's splendid recent biography of Humboldt, *The Invention of Nature*, might enable a little re-burnishing of that once fabled reputation. Nonetheless, the *Origin* has attained a canonical status that has only grown with time, while that lyrical summation of Humboldt's thoughts, *Cosmos*, is a rare sighting even on the shelves of the most cornucopacious of charity bookshops.

My battered<sup>3</sup> 1848 copy of the first volume of *Cosmos* gives some idea of the buzz at the time. It comes from the *third* English translation, only three years after the original in German had appeared, such was the demand. The translator, the formidably erudite Elise Otté, said of the first pirated English translation, rushed out in 1845, that it 'should be passed over in silence'. Fortunately for our sense of curiosity, Ms Wulf was more outspoken ('execrable') and dug deeper, quoting Darwin's despair at its 'wretched English'. The next year a proper version, from the publishers John Murray, came out, and this second translation was deemed by Elise Otté to be 'singularly accurate and elegant', but she added a little pointedly that it omitted passages 'because they might be deemed slightly obnoxious to our national prejudices'. Now *there's* a project for an anthropologist with a yen to uncover fine examples of Victorian delicacy. It should be a simple task for one with sufficient patience as she, Miss Otté, translated the lot, and national prejudice be damned.

Obnoxiousness of another stripe might lie hidden here, as Miss Otté stated that the John Murray translation was done by one Mrs Sabine. Look at most catalogue accounts of this edition, though, and the translation is listed as by Edward Sabine (Lieut-Col.). This is encouragement enough to investigate, and it emerges that the translation was done 'under the superintendence' of the male within the Sabine ménage. Ha! – the lynx-eyed Miss Otté clearly knew who had done the work. Her own translation, for Bohn's Scientific Library, seems to have done pretty well in expressing Humboldt's high-flying ideas with appropriate Victorian sonority.

The ideas do fly high, and uncommonly wide, in a racing unbroken tide that likely is a fair mirror of the unceasing, illuminating, lyrical, meticulous, exhausting conversational flow that so took Darwin aback. With the book, though, one can retire for a cup of tea at intervals, so no wonder *Cosmos* was an instant sensation, with booksellers outdoing each other in skullduggery to get the wares out to the baying customers. And although there are no chapter breaks beyond the introduction, the thoughtful Miss Otté added simple page headers to help the reader follow Humboldt on his endless journeys through time and space.

And so we might flit past Celestial Phenomena, Planetary Systems, Comets, Aerolites, Density of the Earth, Magnetism and suchlike until we get to the realms of rocks and fossils. On this part

<sup>2</sup> Humboldt died before *The Origin of Species* was published, but Wulf suggests that he would have taken to the idea.

<sup>3</sup> A gift to Bolton Grammar School, where it clearly had been used most energetically, and perhaps even for reading.



of Humboldt's interests, the Wulf biography is perhaps a little thin – there's no mention, for instance, that Humboldt was the first to recognize the Jurassic as a separate stratigraphic unit. But in *Cosmos*, Humboldt waxes eloquent on such matters. Palaeontological investigations, he wrote, 'have imparted a vivifying breath of grace and diversity to the science of the solid structure of the earth' – a sentiment that one wishes that funding bodies today would keep in mind. The 'palaeontology' section in *Cosmos*, of 15 closely-printed pages, has his combined talents of scholarly synthesizer and crowd-pleaser well to the fore. It's something like the *Hundred Best Tunes*, transposed into the fossil key of the day, and the brio comes through even now; in the mid-19th century it must have had the readers' eyes bulging.

The saurians *sensu lato* as known then, of course, make a parade through the pages, including ichthyosaurs, plesiosaurs and pterodactyls, some of the last of these he notes with preserved wing membranes ("with impressions of curling tufts of hair, in some places a full inch in length"). There is Scheuchzer's notorious *Homo diluvii testis* ("a large salamander allied to the Axolotl, which I brought with me from the large Mexican lakes"). The mighty mastodon from Colombia's Campo de Gigantes is there too – and so also is the microfossil world revealed by 'Ehrenberg's beautiful discoveries of ... microscopic Polythalamia'. Fossil plants get quite as much attention – cycads and pine and *Araucaria* and many more, with comparisons made with the trees he observed so closely in South America, and taxonomic credit being duly given to others as appropriate – sometimes in the most surprising directions. He recounts how Christopher Columbus, that 'acute observer, whom nothing escaped', was the first to observe the difference between the conifers that we now know as the genera *Podocarpus* and *Pinus*, when he saw them growing together on the island of Cuba.

Humboldt enthusiastically recounts the kind of fossil stories that had then not yet acquired the patina of hoariness. He quotes Mary Anning discovering that the fossilized ink sacs of belemnites can yield pigment that one can still draw with. I had always wondered whether this was a romantic myth, repeated down the years by Chinese whispers. But no: there is a lovely sepia-shade drawing of an ichthyosaur skull in the Oxford Museum of Natural History, rendered by Anning's local friend and fossil fish enthusiast (and expert) Elizabeth Philpott<sup>4</sup>, and the use of belemnite ink was, of course, one of William Buckland's party tricks. More recently, Phil Wilby of the BGS has drawn a robust reconstruction of *Belemniteuthis antiquus* from the Oxford Clay, rendered in its own ink, liquefied for re-use using ammonia solution<sup>5</sup>. He said he stopped short, though, of tasting this artistic medium, even though modern squid ink is used as food colouring (I'd hazard that, with the notoriously polyphagous Buckland, belemnite ink did sometimes double as condiment). And the same kind of palaeo-drawing has been repeated, in considerable detail, on a fossil octopus from the Cretaceous of Mexico, by the artist Esther van Hulsen: the elegant result now hangs, beside the original petrification of the 93 million year-old ink-provider, in Oslo's Natural History Museum<sup>6</sup>. This is clearly a minor cottage industry within palaeontological illustration.

Humboldt, luckily, was not in a position to be tempted by that other legend of Mary Anning lore, that she had uncovered ichthyosaurs with 'saucer eyes, some of which have been found so

<sup>4</sup> <<https://morethanadodo.com/2016/10/11/tales-from-the-jurassic-coast/>>

<sup>5</sup> <<https://theparagraph.com/2009/09/jurassic-squid-drawn-in-own-ink-again/>>

<sup>6</sup> <<https://www.thisiscolossal.com/2016/05/an-octopus-painted-with-95-million-year-old-ink/>>





perfect, that the petrified lenses (the sclerotica, of which it had thirteen coats) have been split off and used as magnifiers'. This wonderfully Barnum-esque assertion is usually attributed to Charles Dickens, in an 1865 article (and so safely after the publication of *Cosmos*) on Mary Anning that appeared in *All the Year Round*, a magazine then edited by Dickens. This Dickensian production has been quite an influence in the Anning historiography, with equally oft-repeated lines such as her job being merely to provide other 'combatants with the munitions of war: now a paddle, then a jaw, then a stomach full of half-digested fish'.

Only – it probably wasn't from the pen of Dickens himself. Michael Taylor and Hugh Torrens in 2014 carried out a fine bit of detective work to show that the piece was very likely written, with much more cheerful invention (and rephrased borrowing) than historical accuracy, by a grammar school headmaster, parson and occasional jobbing author, Henry Stuart Fagan. It is, they say, simply a 'careless hack job for the mass publishing industry' – though they admit that judging this piece of hasty journalism on the standards of historical scholarship is a little like breaking a butterfly on a wheel. Nonetheless, Fagan's piece unleashed a whole shoal of red herrings to muddy the waters for those studying Mary Anning's life and times, and doubtless they will continue to swim on for a while, given how long it takes for such sober and corrective works of scholarship as that of Taylor and Torrens to penetrate the zeitgeist. The ichthyosaur eye-lens of course is bunkum from beginning to end. The 'thirteen lenses' is a muddling with the ring of bony plates around the eye, which used to be thought to be thirteen in number.

One doubts, even had this canard emerged earlier, that Humboldt – no mean practical anatomist as well as everything else – would have been taken in. And in any case, among the fossil showpieces within *Cosmos*, he had more important points to make. Better known as someone who was *prima inter pares* at connecting phenomena across geographical space, Humboldt is clearly here puzzling away at how biological phenomena connect through time – and he was doing so with a breezy confidence, as regards the evidence of petrifications, that Darwin could have used a little of.

For Humboldt, the succession of different forms of animal and plant through geological time could simply then be taken for granted. It was so for Buffon, too, of course, almost a century previously – but Buffon was ahead of his time in deducing this large idea from the little systematic data then assembled. By the time that Humboldt had swung into his synthesis, he was standing on the shoulders of Cuvier, William Smith, Agassiz, Mantell, Quenstedt, D'Orbigny, Murchison – and Mary Anning, too – and yet others<sup>7</sup>. (By the bye, the line of scholars, as Humboldt quoted, goes back further than Buffon and his prediction of the emergence of palaeontology as a science, as far back as Robert Hooke in 1688, whom he quotes as hoping that it might be possible one day to 'raise a chronology' from the study of broken and fossilized shells 'and to state the interval wherein such catastrophes and mutations have happened').

Humboldt was evidently fascinated by the 'historical phenomena of transition manifested in the organisms'. He clearly distinguished the 'geognostic' use of fossils as chronometers – with Hooke's premonition by then amply justified by the labours of subsequent scholars – from the 'purely morphological' studies aimed at 'filling up the chasms in the still living species by the fossil structures of the primitive world'. He knew there was still much to unearth about the

<sup>7</sup> Elsewhere in *Cosmos*, Humboldt made approving reference to the *Voyage of the Beagle*, which pleased Darwin no end.



successions, but the contrast with Darwin's own pessimistic writings on the fossil record in the *Origin*, more than a decade after *Cosmos*, is striking. Darwin bemoaned the imperfection of the stratal record, the gaps and the seeming absence of intermediate links between defined species, and drew little from palaeontology to support the theory that we have come to know as evolution<sup>8</sup>.

Humboldt's approach to what fossils could offer was much more upbeat, even if this new science did not (yet) provide illustrations of the finely graduated chains of fossil succession that Darwin sought. But he intuited, with gusto, where one might seek such connections. He noted the successive appearances of fish, saurians, mammals and birds. He emphasized the sheer abundance of fossils ('A single species of fossil, as Goniatites, or Trilobites, or Nummulites, sometimes constitute whole mountains'). He quoted the 1,700 fossil fish species described by Agassiz, and the lack of precise correspondence of almost all of them with modern fish. He sketched out Leopold von Buch's work on the successive 'chamber-suture' patterns of goniatites, ceratitids and ammonites, and wrote on the simple beginnings and more complex developments in fossil plants. It's broad-brush stuff, but it's all done with a positive spirit, and a sense that the fossil world could well provide clues to the 'great phenomena of the metamorphism of organic life', once properly interrogated.

Perhaps it's a double shame, therefore, that Humboldt did not pause for breath long enough, on that January evening in 1842, to allow the younger and more diffident man the space to develop a conversation. Had he done so, then Darwin would likely have been able to glean the biogeographical information he wanted (Darwin later asked Joseph Hooker to relay some of his then-unexpressed queries to Humboldt). And, just perhaps, such a start may then have led to the development of a more far-ranging discussion between them. That might – to allow our alternative history to stray into alarmingly speculative terrain – have allowed Humboldt to frame his notions of 'organic metamorphism' in less nebulous terms. And perhaps – who knows? – Darwin might have been persuaded by the old savant's enthusiasm that fossils could turn out to be useful, after all.

## Jan Zalasiewicz

University of Leicester

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<sup>8</sup> Newsletter No. 86.



# R for palaeontologists

## 8. Analysis of Phylogenetics, Part 2: A case study into modelling evolution

### Introduction

For the past five years I have been writing these articles a couple of times a year but I have recently come to the conclusion that I can no longer devote the amount of time as well as care and attention to keep these going regularly. I feel, therefore, that this is the most appropriate time to pass it over to the more capable hands of those who can devote the time required to keep this series going.

So, I want to use this last article as an opportunity to sum up everything I have discussed so far through the prism of a case study I conducted a few years ago. This will include all the necessary steps from data processing, through analysis and finally to interpretation of the results.

### Case study – body-size evolution in trilobites

In 2012, I published a study into the body-size evolution of the highly diverse Asaphidae family of trilobites (Bell and Braddy 2012), which includes several giant species as well as the largest currently known, *Isotelus rex*, at around 70cm (Rudkin *et al.* 2003).

The aim of this study was to examine, using maximum likelihood techniques, which of several evolutionary models the body-size evolution of this group conformed to. For example, were the large sizes seen in this clade achieved through a driven increase over time such as inferred by Cope's rule, or would a random-walk or Brownian motion describe the pattern better, suggesting other factors at play controlling their changes over time?

### Setting up the workspace

So let's get started. The first step as always is to set up the workspace with all the required packages and datasets. We start with setting the working directory, the location where the files we need are stored and where any resultant results files or charts will also be automatically saved (unless specified elsewhere).

```
setwd("directory address") — e.g. — setwd("/Users/markbell/Newsletter")
```

Next, we need to load in the necessary packages. In this instance we are going to use functions from three packages: *strap* (Bell and Lloyd 2015), *Geiger* (Harmon *et al.* 2008) and *dplyr* (Wickham *et al.* 2018). If you don't have these already installed then you will need to run the **install.packages** function for each individual package you are missing. Note that all of these depend on other packages to run so when installing make sure you set the dependencies argument to TRUE.

```
library(strap)
```

```
library(geiger)
```

```
library(dplyr)
```

```
library(tidyr)
```



For this analysis, we are going to need three key datasets:

- A dataset containing the tree or trees we want to analyse.
- A dataset containing the ages of all the taxa in the trees.
- A dataset containing the body size measurements of all the taxa.

The first two of these are already available inside the *strap* package so there is no need to load them. However, we will need to load in the body size data for the species we are interested in:

```
bodysize <- read.csv("sizeUntidy.csv", header=TRUE)
```

### Tidying the data

If we start by opening the raw data we can see that the information for each genus is held in a separate column and that there are 20 measurements for each genus. In a previous article I referred to data laid out in this way as untidy in that for a tidy dataset each variable should have its own column. In this case we should have a column for the genus name and another for the associated measurements.

In order to convert our untidy data into a tidy format we can use the following pipeline, using functions available in the *dplyr* package:

```
sizeTidy <- bodysize %>% tbl_df %>% gather(key=genus, value=size)
```

Now if we open our new **sizeTidy** dataset, we can see that we have a variable, called genus, for the genus name and another, called size, which contains the relevant size observations.

### Checking the assumptions

Before we conduct any analysis the first thing we want to confirm is whether the data we are using approximate a normal distribution. For this we can plot the data as a histogram to get some idea of the distribution (Figure 1).

```
hist(sizeTidy$size)
```

We can also use the *Shapiro Wilk* to determine whether the data fit a normal distribution.

```
shapiro.test(sizeTidy$size)  
data: sizeTidy$size  
W = 0.91497, p-value = <2.2e-16
```

In this case, as the p-value is lower than 0.05, we can reject the null hypothesis that the data conform to a normal distribution and as such we should log-transform our data prior to conducting the analysis.

```
sizeTidy <- sizeTidy %>% mutate(logsize=log(size, 10))
```

Whilst the data are now in a much easier format for analysis they are still not quite ready. For this analysis we want to calculate the average size for each genus. To do this we can employ a similar pipeline to above to create a new variable, called mean, which contains the average size of each genus:

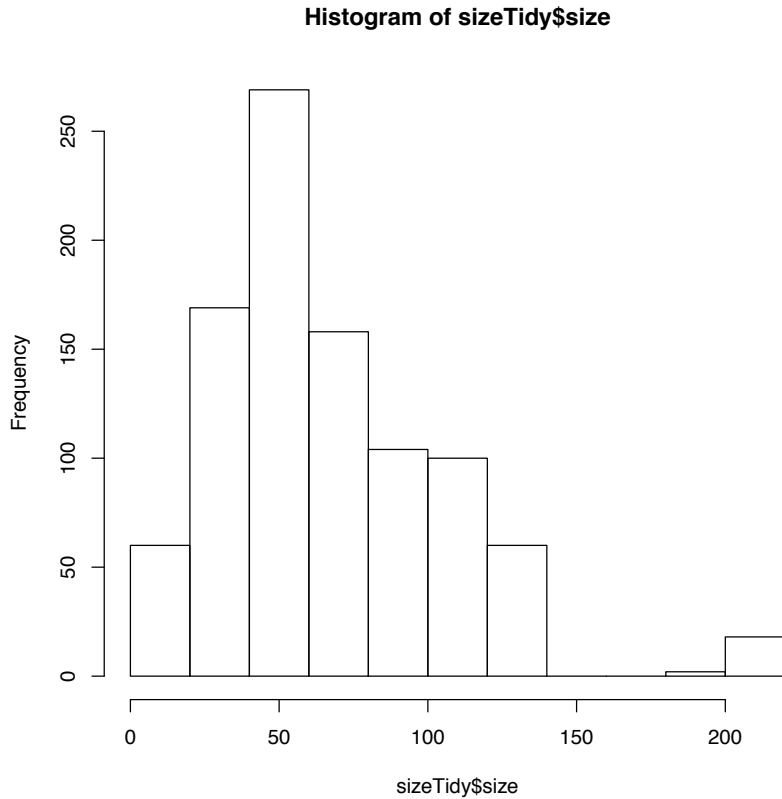


Figure 1. Histogram of Asaphidae body sizes.

```
genusMean <- sizeTidy %>% group_by(genus) %>% summarise(mean = mean(logsize))
```

A tibble: 47 x 2

genus	mean
<chr>	<dbl>
1 Anataphrus	1.49
2 Asaphellus	1.93
3 Asaphus	1.83
4 Aulacoparia	1.09
5 Basilicus	2.05

The final step is to convert this information into an array so that we can use it with our modelling functions later on:

```
sizeFinal <- genusMean$mean  
names(sizeFinal) <- genusMean$genus
```



Now we have a dataset that contains each genus we have information for, along with the mean size for each genus, we can move on to time-scaling our tree.

### Time-scaling the tree

As I covered in the last article, for this kind of analysis we need to assign branch lengths to the tree we are intending to use, which we can do using the **DatePhylo** function. In this instance, we will use the first of the 162 trees stored in the `Asaphidae$trees` object contained in the *strap* package. These data are stored as a list and as such we need to use the `[[ ]]` operator to tell R which object in the list to use.

```
tree <- DatePhylo(Asaphidae$trees[[1]], Asaphidae$ages, method="equal", rlen=1)
```

By this point we have created two data objects, a dataset containing the mean size for genera that we have been able to collect data for, and a time-scaled phylogeny that we will use to model the body sizes on. However, if we examine these individually you can see that there are more tips in the tree than we have been able to collect data for.

```
Ntip(tree)
```

```
[1] 63
```

```
nrow(genusMean)
```

```
[1] 47
```

We therefore need to remove the tips from the tree that we currently don't have any information for. The first step here is to use the `set.diff` function to determine which taxa occur in the tree but not in the body size dataset:

```
tipsNoData <- setdiff(tree$tip.label, names(sizeFinal))
```

Secondly, we can use the `drop.tip` function to remove all of these taxa from our time-scaled tree.

```
treeFinal <- drop.tip(tree, tipsNoData)
```

Now<sup>1</sup>, if we run the code as before but for the new tree we can see that both datasets contain the same number of taxa.

```
Ntip(treeFinal)
```

```
[1] 47
```

### Plotting the data

With all the above steps complete there is one final step we could do before running our analysis, and that is to plot the data. This is important as it gives us a first indication of the kinds of patterns we might expect to see and may also highlight if there are any outliers that we should examine further in case there are errors in the data. Here we will use the `geoscalePhylo` function to plot the mean size of each genus on our time-scaled tree (Figure 2).

```
sizeFinal <- sizeFinal[treeFinal$tip.label]
```

---

<sup>1</sup> [Editor's note: Users should be careful here with their own data to check that dropping tips has not altered the "root age" of the tree. To be sure, you can use the `fixRootTime` function in the *paleotree* package or the `CorrectRootTime` function in the *Claddis* package.]

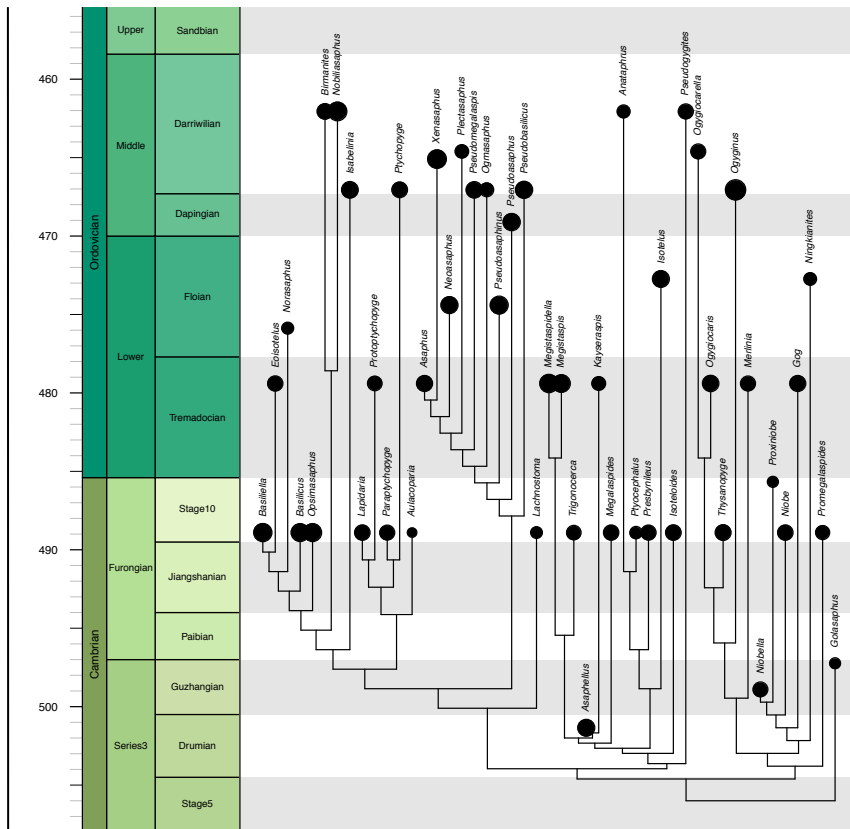


Figure 2. Phylogeny of the trilobite family Asphidae with mean genus body sizes plotted.

#NOTE: For the purposes of plotting, we need to ensure that the order of the size data is the same as the tips labels in the tree.

```
geoscalePhylo(ladderize(treeFinal), direction="upwards", cex.tip=0.5, cex.age=0.5,
cex.ts=0.5)
tiplabels(cex=sizeFinal, pch=19)
```

### Conducting the analysis

As discussed at the outset of this article, the aim here is to examine whether any one evolutionary model best explains the variation in the body size of a family of trilobites over time. Initially, we will start by fitting one model to our data using the **fitContinuous** function from the *geiger* package. For this, in addition to telling R which tree and data we want to use we also need to define which model we want to be fitted. Here we will begin with the trend model.

```
trendResult <- fitContinuous(phy=treeFinal, dat=sizeFinal, model="trend")
```



Once this has completed you will see it will print a summary of the fit of the trend model. While this provides a lot of detail it obviously only tells us about a single model. In order to answer our question, we need to gather the same information from a range of models. For this, the specific number we are interested in is the bias-corrected *Akaike Information Criterion* (AICc) which is one of the objects stored within the list and can be printed using the following:

```
trendResult$opt$aicc  
[1,] 19.56788
```

Next we need to run the same query, but employing a loop that will apply each model in turn and save the resultant AICc values for later comparison. So first, we will create an array, called `modelstorun`, that contains all the models we want to include in our analysis. Here we are just going to run three models: (i) a Brownian Motion model (BM), (ii) a trend model, and (iii) a stasis model (white). It is worth noting here that there are more models available in the `fitContinuous` function than we have used here which are detailed in the help file for this function. All you need to do to repeat this analysis for more models is to include them into `modelstorun`.

```
modelstorun <- c("BM", "white", "trend")
```

Second, we will create a dataframe, called `modelResults`, that we will use to store the information we need.

```
modelResults <- matrix(nrow=1, ncol=length(modelstorun))  
colnames(modelResults) <- modelstorun
```

Finally, we can use a loop to iteratively, run each model separately, extract the AICc number and store it in the `modelResults` dataframe.

```
for(model in 1:length(modelstorun)) {  
  modelResults[1, model] <- fitContinuous(phy=treeFinal, dat=sizeFinal, model=modelstorun[model])$opt$aicc  
}
```

Once this is done we can see that `modelResults` now contains the AICc number for each of the three models we have run.

```
      BM      white      trend  
[1,] 20.47585  9.689775 19.56788
```

### Interpreting the results

With all the models run we now need to calculate the AICc weight. Basically, this is a number which scales to one and tells us the probability of support for each model in comparison to the others examined. This allows us to assess which model is the most likely fit to our data. To do this we use the `aicw` function:





```

aicw(modelResults[1,])
      fit      delta      w
BM    20.475847  10.786072  0.004495503
white  9.689775  0.000000  0.988425996
trend  19.567878  9.878103  0.007078501

```

From this output, the value **w** is the AICc weight, and in this case shows overwhelming support for the white (or stasis) model, with the highest value, as the most likely support for our data compared with either the Brownian motion or trend models.

It is important to highlight that these numbers apply only to the comparison of these three models. If we were to add or remove any models to this analysis, then these figures would change. Therefore, the decision about what models you want to include is key to the interpretation of any results.

### Summary

In this, my last article, my intention was to reaffirm my original plan for this series: to demonstrate that learning to code, in any language, is not as difficult as it can appear from the outset. Secondly, from personal experience I can say that even learning the basics can have a huge effect on how you approach your research. When I first started the work that became the analysis I've covered above a lot of the initial data manipulation was done manually in Excel; it was only through being encouraged to learn R by those around me that I was able to automate the process and open myself up to a world of possibilities allowing me to conduct analyses that I would never have considered previously.

Finally, I hope that through these articles I have encouraged at least a small few to dip their toes into the world of R and I wish you all the best in your future endeavours. Remember, it's not as hard as it looks.

### Mark A. Bell

Scottish Government

<mark.bell521@gmail.com>

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## Spotlight on Diversity

**Highlighting different experiences in palaeontology. This issue's palaeontologist, Lee Hsiang Liow (University of Oslo), gives career advice from her perspective as a "lucky" and "unique" scientist.**

Diversity. The meaning of the word is simple enough. It means variety or the condition of having different elements. We are all different – in age, gender, age at first reproduction, age of mortality, geographic area of origin, home range – to use some typical traits studied by ecologists. Variation is the natural state of biological (and geological) systems.

We are all different. Yet, it is easy for one to associate with others with similar age, research topic, skill sets, interest, cultural background, alcohol-tolerance level *etc.* This clustering, while natural, may have (very) negative consequences for individuals and communities if unchecked.

I have always been the 'outsider', the one data point that is hard to cluster with others naturally. Most of the time, I love being different. It makes me feel unique. I was the only student from South East Asia in my Masters cohort in Sweden and also in the cohort of PhD students across all disciplines at the University of Chicago. Amongst the palaeobiology community at my alma mater I was one of the few females (and Asians and expectedly the only one from Singapore, a tiny country). When I graduated from my PhD programme, I worked as a postdoc on soft money for about ten years in a biology department in Norway. You guessed it, I stuck out like a sore thumb both among 'real biologists' and among white Europeans. I am still working in Norway and I still stick out, every single day.

Do I or did I suffer from being different? Honestly, I would say mostly not. Am I lucky for my lack of suffering as a minority race/nationality female scientist? Maybe. I have heard so many negative stories from other 'unique' people that I am forced to consider the hypothesis that I am again 'unique' in not having suffered as much.

So I should perhaps share with you why I did not suffer much. I had really good, considerate and thoughtful people around me throughout my career. Each of them positively contributed to my happiness as a female academic. I cannot name everyone who has helped me but below are some examples I think we can all learn from. And I'll name names too, because these are real people.

Grad school in Chicago was hard, also in ways that were unexpected to me. I knew that the academic work was going to be challenging and I was ready for that. What I was not ready for was living amongst Americans. I thought my time as a foreign student in Sweden prepared me and that I understood American culture from all the movies I watched. But my expectation did not match reality. This mismatch was momentous, and not in a positive way. The details of this mismatch are unimportant, but suffice to say I was lost and shocked for a couple of years. Then, Paul Harnik, now at Franklin and Marshall College, appeared in my life. Paul is one of the most thoughtful people I know. Paul challenged me to understand the diversity of American culture as it is (and not one-sidedly understood from my watching of Hollywood movies and uninformed judging of people whose behaviours do not match movie characters). We argued a lot, but our disagreements strengthened our friendship and deepened our understanding of our different cultures and genders. Because I had the support of Paul and his wife, my mental health as a



graduate student improved greatly. My advice here? Find your own Paul Harnik or be a Paul Harnik to someone and your world will be better, wherever you are and whatever career stage you are currently in. Be what Paul is to me to someone else: listen, empathize deeply and share your own understanding of the world in a constructive way.

Life after grad school can be very uncertain. Many of us may do from one to several postdocs before either giving up on academia or landing a position. I was no different and worried about my academic future, my next pay cheque, my visa or residency status in a foreign country, for what felt like the longest time. I was again incredibly lucky during this uncertain and nerve-racking period of my life. Nils Christian Stenseth was my postdoctoral mentor. Nils is a typical white male senior scientist, privileged and confident, but he was adamant in helping junior scientists, not least foreigners and women. So he did. And his mentoring style fitted me perfectly. Nils was supportive and never questioned my academic decisions or scientific authority and always pushed me beyond what I assumed was my limit. If I wanted to submit a paper to a good specialist journal, he would make me try *Science* first. And if I thought I should try a small local grant, he asked me to apply for European Research Council funding instead. Not that I always succeeded in going beyond the assumed limit, but his trust in my abilities and my science gave me mental strength. He introduced me proudly to his international colleagues in other fields, knowing that networking is key in academia. He shouted “keep up the great work Lee Hsiang!” at me in the corridor on a regular basis, even during periods of time he didn’t really know what I was working on. But the positivity is infectious and his support, priceless. My advice here? Associate with people who can give you positive energy and be that source of positive energy to your colleagues.

Most people who land permanent academic jobs will tell you that life does not get easier or more relaxing with that permanency. I agree. I often wish I was a postdoc again even with all that uncertainty of where my next meal will come from. If it was difficult for me to identify role models amongst more senior academics when I was a student, it’s even worse now. But you can build a hybrid role model from multiple people. My mentor from Singapore, Navjot Sodhi, was a wonderful (foreign) group leader; humorous, relaxed, yet firm and resolute when guiding his group’s research on tropical birds. As a foreigner in Norway I take from Navjot how to guide my group of European and mostly Norwegian scientists from backgrounds as diverse as physics, palaeontology and molecular phylogenetics, to conduct research on bryozoans.

Scott Lidgard was the best PhD supervisor I could ever have. He gave me time and attention, and demanded a tremendous amount from me that showed me that my work mattered. I take from Scott how to advise my own students and hope I can give half of what he gave me. My closest current colleagues include Russell Orr and Kjetil Voje. They are incredible scientists, but that is not what I want to emphasize here. The simplest, most powerful thing they do is to give positive support and say thank you to me and others around us, every day, not taking anything for granted. From Kjetil and Russell, I am learning to be less stingy with praise (it’s harmless!) and be more generous, in sincerely and outwardly expressing gratitude. It makes a world of difference at the work place to know one is appreciated.

And yes, you realize by now that there isn’t a single female in my narrative here. I did not do this on purpose. The fact is that there are fewer females in our field than males, especially in my generation, and I really did not have female mentors. But while we try to actively minimize



discrimination, we should also realize that mentors can be found in all genders, colours, ages and nationalities. Let's help more people who are different from us to improve the science we love.

**Lee Hsiang Liow**

*University of Oslo*

You can read more from Lee Hsiang on diversity issues in her blog piece "*Bias, Role Models and Women in STEM*", at <https://methodsblog.com/2018/02/09/women-and-girls-in-science-day/>.

## The Brilliant Club

There is an entrenched link between pupils' background and their access to higher education in the UK, and even more so at highly selective universities. The odds of a privately educated student entering Oxbridge are about 1 in 20, but for pupils from low income backgrounds they are closer to 1 in 1,500<sup>1</sup>. The Brilliant Club is an award-winning charity that exists to address this inequality. Its mission is to increase the number of pupils from under-represented backgrounds progressing to highly selective universities. The Club pursues this mission by recruiting PhD students and postdocs, giving them training in effective pedagogy, and placing them in local state-funded schools to introduce students to academically rigorous programmes. See the website [thebrilliantclub.org](http://thebrilliantclub.org) for more information.

There has been increased awareness in recent years of the lack of diversity across the palaeontological community. Results from the PalAss diversity study show a need for outreach to promote palaeontology to currently under-represented groups, particularly to those from ethnic minorities and less affluent backgrounds. In partnership with The Brilliant Club, the following five testimonies show how early-career researchers from a wide variety of topics within palaeontology are raising aspirations and promoting palaeontology directly to students from under-represented groups, showcasing the study of palaeontology as an exciting and vibrant field that is open to everyone. Currently The Brilliant Club only works with schools in the UK, but for those living elsewhere we would recommend seeking out similar programmes. One scheme linked to The Brilliant Club is the NGO AccessEd, helping to grow similar educational programmes in Botswana, Ireland, Hong Kong and South Africa; see [www.access-ed.ngo](http://www.access-ed.ngo) for more details.

Working for The Brilliant Club has been without doubt the best use I've made of my postgraduate degree. Working for a PhD is an incredible privilege, but acknowledging that privilege can be difficult when so much of university intake and faculty are mined from a very narrow socioeconomic stratum. The homogeneity means that spending time in research can quickly breed hubris, or worse, complacency. I didn't want that. I never wanted to forget my background (small-town Scottish, first in family to attain undergraduate honours) or the role that luck and happenstance have played in my academic journey. I wanted to give back. The Brilliant Club is different from many outreach charities, which often tend to focus on recruiting to just one particular university, or from particular schools. We are thankfully moving past such narrow remits, or the idea that only certain kinds of people go to university. The Brilliant Club correctly

<sup>1</sup> See The Brilliant Club's *The Path to Outcomes: Five Year Strategy, 2016 to 2021* for details: <https://thebrilliantclub.org/wp-content/uploads/2017/03/Path-to-Outcomes.pdf>.



views students from non-traditional backgrounds as a strength to be championed, and the best hope for UK universities. Everything I've seen tells me this is true.

The Brilliant Club students I had the pleasure of working with consistently blew away my expectations. In every group of 15/16-year-olds I taught there were one or two producing work that would have put many undergraduates to shame. In some cases, apart from teachers, the students had never had a chance to talk to people from similar backgrounds who had undergraduate and postgraduate degrees. The excellence of The Brilliant Club comes not just in teaching students how to study in an independent academic style, but also in giving them someone they can ask any questions of about university life: questions about money, financing, independent living and workload *etc.*

Showing students how to study independently sets them up with valuable transferrable skills. Introducing long-form marked essays and how to plan and write them takes the students on a remarkable journey from initial disbelief at their ability to ever write so much, to the confidence boost they receive when they get their marks back and can see that they had the ability all along. It really is tremendously rewarding to help prepare incredible young people for a higher education, something that should be their right. To be a small part of their adventure is the real privilege.

#### **Ross Barnett**

*Advanced Skills Tutor, The Brilliant Club*

*Joint recipient of Gertrude Elles Award 2018*

I signed up to work with The Brilliant Club in the very first week of my PhD. I knew that I wouldn't survive four intense years of researching blue skies science without having some form of outlet where I could creatively communicate my research, regularly engage with inspirational people and pick up a few new skills here and there. The Brilliant Club was exactly what I was looking for and it has been the single most rewarding experience I have ever been a part of.

Growing up in rural Ireland my only real exposure to university life was stories from some older school friends who had left the countryside to live in the 'big smoke' and who would only come back when they had a craving for mammy's cooking. When I made it there myself, what struck me hardest was the homogeneity of faces and experiences; I immediately knew that the tide was against people like me. So, working with The Brilliant Club became my way of giving back and ensuring more students feel that university *is* for them, no matter what their background is.

*Front cover of Emma's Key Stage 3-4 course (ages 11-16) "Is Palaeontology Extinct?". PhD tutors each independently design a course based on their primary research topic, which is then presented in university-style small group tutorials.*





The Brilliant Club's programme is outstanding for a plethora of reasons, but its greatest strength lies in connecting with students who you will not typically find at the usual events promoting engagement with research. Many of the students I have had the pleasure of working with had never heard of palaeontology, let alone considered a job as a researcher. Their enthusiasm for a topic and career choice I had begun to take for granted was a constant source of energy for me as I went through my PhD.

The work that my students produced would put my own undergraduate work to shame, and watching their confidence and knowledge grow as the tutorials went on was incredibly rewarding. Being part of their journey, watching their outlook on their abilities change for the better, and learning from them has been an absolute privilege. The Brilliant Club, and work like it, has the potential to transform the UK education system, and through associated initiatives The Brilliant Club's mission is spreading to places as far away as South Africa and Hong Kong. Being a part of this mission has been transformative and I'm excited to see what's in store next!

**Emma Dunne**

*Advanced Skills Tutor, The Brilliant Club*

*PhD student, University of Birmingham and joint recipient of Gertrude Elles Award 2018*

“Could we stop climate change by planting trees on satellites?”, “If the continents are moving, does that mean that Italy will soon be next to us?” and “Is the food at university always as good as during our first visit?” These are just some of the questions that came up during the last meeting with my tutorial groups, and I think they sum up nicely the aspects I like most about working with The Brilliant Club.

The Brilliant Club offers a good teaching and learning environment for tutees who have had little exposure to academic learning and tutors who want to carry their work beyond the doorsteps of university. In small groups, motivated and talented pupils and tutors come together to explore a scientific topic. It creates a safe, challenging and rewarding environment for tutees to expand their horizons – and I as a tutor gained confidence and motivation for my teaching and PhD project. Keeping up motivation during a long research project is challenging at times, and I discovered that teaching can provide the energy to keep up the morale. What could be more encouraging than witnessing how pupils develop interest in, understand new concepts of, and become able to write a detailed report on, a new topic over the course of as little as two months?

At the moment, I have two groups of Year 9 pupils (aged 13/14) with whom I learn about natural and man-made drivers of climate change, and how we know that humans have a profound impact on our planet. During our regular meetings, we help each other by extending and challenging our understanding of environmental change and our ideas about our futures. And we learn that we can find answers to complex questions and achieve big goals in life with the right mindset!

**Markus Adloff**

*New PhD Tutor, The Brilliant Club*

*PhD student, University of Bristol*



Last year I signed up to take part in The Brilliant Club's activities in secondary schools. In part this was because I was lucky enough to participate in a similar scheme run by The Open University, which gave sixth form pupils (Key Stage 5, ages 16-18) the chance to experience teaching and learning at undergraduate level. I wanted to provide similarly inspiring experiences for talented school pupils who might otherwise not have considered university education. The Brilliant Club not only gives school pupils exposure to higher level university-level education, but also the opportunity to extend, integrate and apply their knowledge of school subjects to other areas that are often not focused on as much in secondary education (such as geology and palaeontology). Palaeontology is ideal for The Brilliant Club programmes in schools, as it combines aspects of many scientific disciplines (biology, chemistry, physics, geography, computer science, *etc.*!) and applies them to the study of ancient life and environments; the appeal of dinosaurs and other mind-boggling prehistoric critters to school pupils obviously helps too! As a tutor with The Brilliant Club, I will be designing and delivering courses focused on mammalian palaeontology and dietary niche reconstruction, as well as their relevance and importance to science – areas linked to my PhD project at the University of Leicester. I hope to continue Emma's and Ross's fantastic outreach efforts bringing palaeontology into secondary schools as tutors with The Brilliant Club.

**Neil Adams**

*Incoming PhD Tutor, The Brilliant Club  
PhD student, University of Leicester*

In what some may consider a supreme effort of procrastination, or others may more charitably ascribe to improvements in my time management skills, I joined The Brilliant Club as a tutor in my final year as a PhD student. I had contemplated joining the programme before, though it was only towards the end of my PhD that I carved out the time to do it. This was actually quite a logical step that formalized and condensed my previous enthusiastic but rather disparate outreach work as a STEM Ambassador into a tractable course over which I could see my students' progress from tutorial to tutorial.

Although initially unsure of my ability (a feeling familiar to many PhD students) to produce a viable six-week course of university-level work accessible to secondary school pupils, the support and training provided by The Brilliant Club, combined with my now seven years of studying, were more than adequate to the task. The system of small-group tutorials means that we can really get to grips with the detail that underlies big concepts – in my case how the geological record of climate change can inform us about what the future may hold.

Following our penultimate tutorial, one of my Key Stage 5 pupils travelled to the Natural History Museum, London to scour their exhibits for a day to better understand some of the fossils we had been discussing in tutorials – never having previously visited the Museum. I've really benefited from the structure of The Brilliant Club programme – seeing pupils develop academically and become more confident discussing complex topics throughout a course that I designed has boosted my own confidence in my communication and teaching abilities.

**Thomas Hearing**

*Former PhD Tutor, The Brilliant Club  
Postdoctoral Researcher, Ghent University*



## >>Future Meetings of Other Bodies



**19th International Congress on the Carboniferous and Permian (XIX ICCP 2019)**  
University of Cologne, Germany 29 July – 2 August 2019

The congress, organized every four years, is the most important platform of exchange for all disciplines that deal with the geology and palaeontology of the Carboniferous and Permian periods. Four days of cutting-edge scientific sessions and a mid-congress field trip will provide a broad forum and ample time for scientific presentations and discussions, bringing together established researchers and young scientists from all over the world. Field-trips will give opportunities to explore some of classical regions of the Carboniferous, as well as the unique Rotliegend and Zechstein facies of the central European Permian, and the Pennsylvanian to Permian of the Palaeotethys realm. For more information see the first circular and website at <<https://www.socgeol.it/323n1331/19th-international-congress-on-the-carboniferous-and-permian-xix-iccp-2019.html>>.



**5th International Symposium on Palaeohistology (ISPH)**  
University of Cape Town, South Africa 31 July – 4 August 2019

The 5th International Symposium on Palaeohistology will be hosted by the Palaeobiology Research Group of the University of Cape Town. This international meeting brings together researchers at all levels investigating the histology of mineralized tissues of extant and extinct animals including microanatomy and histology of bones and teeth under the broad themes of growth and development, biomechanics, physiology, skeletochronology, pathology and diagenetic alterations. Keynote speakers are Sophie Sanchez (Uppsala University) and Shannon McFarlin (George Washington University). The conference includes a welcome reception at Iziko South African Museum and a field-trip to the West Coast Fossil Park. Registration is open at <<http://www.isph2019.co.za/>>.



**Timing, Tempo and Drivers of Biotic Evolution (Gordon Research Conference)**  
Waterville Valley, NH, USA 4 – 9 August 2019

Geochronology quantifies geological time as a means for integrating diverse geological records, establishing cause and effect, constraining the rates and durations of fundamental geological processes and phenomena, and testing time-dependent models for system evolution. The sessions explore the timing, tempo, and drivers of biotic evolution at the interface of Earth system and biological science topics, over a range of geological timescales and throughout Earth's history. The aim of this Gordon Research Conference is to foster interactions among scientists and formulate strategies for synergistically exploiting opportunities and reducing limitations of current technology, infrastructure and scientific culture. Registration is open until 7 July 2019 at <<https://www.grc.org/geochronology-conference/2019/>>.





**15th International Symposium on Early and Lower Vertebrates**  
Qijing Normal University, China 8 – 13 August 2019

The Symposia on Early and Lower vertebrates are the only recurring international meetings targeted specifically towards the Palaeozoic vertebrate research community. This meeting includes specialist sessions on the origin of jawed vertebrates, morphology and evolution of early vertebrates.

For more information see <<http://iselv.csp.escience.cn/dct/page/1>>.



**Mass extinctions, recovery and resilience**  
Utrecht University, The Netherlands 28 – 31 August 2019

This international Galileo Meeting of the European Geosciences Union will be one of the first major meetings to bring together representatives of the diverse geoscience disciplines with a focus on biotic crises since the final 'Snowbird' meeting in Vienna in 2000, and will consist of four days of extinction-themed research, conversation and debate. The meeting will examine all aspects of mass extinctions from deep time to the present day; understanding the causes of the previous five mass extinctions and other biotic crises, and the nature of ecosystem recovery and resilience to change, has never been more timely. The multidisciplinary nature will allow workers from palaeontology, volcanology, geochemistry, atmospheric science, climate modelling and geobiology to interact and share their latest findings, providing synergies for future research. A field-trip following the meeting will visit Cretaceous–Paleogene exposures near Maastricht.

For details see the website at <<https://www.egu-galileo.eu/gc5-mass/>>.



**3rd International Workshop and Field-trip of IGCP 655 Toarcian Oceanic Anoxic Event: Impact on marine organisms and ecosystems**  
Erlangen, Germany 2 – 5 September 2019

This workshop is open to all researchers focused on the study of the palaeobiological and palaeoenvironmental perturbations associated with the Pliensbachian–Toarcian boundary and the T-OAE. The main topic will be 'Impact on marine organisms and ecosystems'. The workshop is intended to promote active participation of early-career researchers and students. For that reason, a pre-conference training course is offered focusing on quantitative analysis of biological patterns. As a university city, Erlangen offers an academic and welcoming atmosphere right in the heart of the most iconic Jurassic outcrops, which will be visited during the two-day post-conference field-trip.

See the website for more information, at <<http://igcp655-toae.com>>.

**13th International Symposium on Fossil Cnidaria and Porifera**

University of Modena and Reggio Emilia, Italy 3 – 6 September 2019

The 13th International Symposium on Fossil Cnidaria and Porifera is the traditional meeting of the International Association for the Study of Fossil Cnidaria and Porifera. Symposia are organized every four years and take place around the globe. In 2019 the Symposium will be in Italy for the first time and aims to bring together participants from all over the world to discuss and share the most recent advances in studies of fossil corals and sponges, coral reefs and associated biota. The importance of the fossil archives will be highlighted with regard to understanding responses of the biosphere to long-term environmental perturbations. The Symposium will aim to promote interdisciplinary approaches from a body of interested palaeontologists and biologists, but also scholars in other disciplines.

Please see the website for more details, at <<http://www.13thfossilcnidaria.unimore.it/>>.

**67th Annual Symposium of Vertebrate Palaeontology and Comparative Anatomy (SVPCA) and 28th Meeting of the Symposium of Palaeontological Preparation and Conservation (SPPC)**

Dinosaur Isle, Isle of Wight, UK 10 – 14 September 2019

The Symposium of Vertebrate Palaeontology and Comparative Anatomy has been held in the UK, France or Ireland every year since 1953. It is open to anyone with an interest in vertebrate palaeontology or comparative anatomy and has carried on from year to year due to the willingness of members of the community to volunteer to host meetings. We are currently planning on running two field-trips, one on 10th September which will run partly in parallel with the workshop session. This trip will explore the Cretaceous sequence at Yaverland to Culver Cliff. This section will follow the sequence from the terrestrial Wessex Formation to the Late Cretaceous Chalk. The second field-trip is provisionally on 14th September and will be a visit either to the Late Eocene sections or to the west coast to look in more detail at the Wessex Formation, but tides may be challenging.

The first circular is available on the website at <[http://svpca.org/years/2019\\_isle\\_of\\_wight/](http://svpca.org/years/2019_isle_of_wight/)>.

**Annual Meeting of the Paläontologische Gesellschaft 2019**

LMU Munich, Germany 15 – 18 September 2019

The committee of the Annual Meeting of the Paläontologische Gesellschaft (PalGes) in Munich aims to organize an international meeting at which cutting-edge research in the fields of palaeontology, geobiology and palaeobiology is presented. The conference consists of symposia and workshops, plenary talks and a public evening lecture, with a pre-conference field-trip to the Miocene Molasse Basin and a post-conference field-trip to the Miocene Ries meteor crater, Nördlingen. Talks will be presented in English and in exceptional cases in German. Registration is open until 15th August.

See the website for more details, at <<https://www.en.palaeontologie.geowissenschaften.uni-muenchen.de/palges1/index.html>>.



**3rd International Conference of Continental Ichthyology (ICCI 2019)**  
Martin Luther University of Halle-Wittenberg, Halle, Germany  
23 – 29 September 2019

The 3rd International Conference of Continental Ichthyology will take place at the Central Natural Science Collections (ZNS) of the Martin-Luther-University in Halle (Saale), Germany. The conference will include all aspects of extant and fossil continental ichthyology; suggestions for possible symposia are welcome. This year is the 250th anniversary of the ZNS and will be celebrated as part of the conference. The university has a long history of palaeontological and biological research, with the well-known Eocene Geiseltal lignite fossils as only one of many significant collections. Conference field-trips will also visit a number of important trace fossil localities. Places are limited and early registration is encouraged.

The second circular can be accessed via the website at <<https://sites.google.com/view/3rd-icci-2019/>>.



**Society of Vertebrate Paleontology Annual Meeting (SVP 2019)**  
Brisbane, Australia 9 – 12 October 2019

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 79th meeting will be only the third SVP to be hosted outside of North America, and the first one in the Southern Hemisphere. The meeting is co-hosted by the University of Queensland and the Queensland Museum. The 79th SVP meeting represents a coming-of-age for Australian vertebrate palaeontology. It is the first SVP Annual Meeting to be held on a Gondwanan continent and provides a gateway to the major regions of global palaeontological significance, including other cities and regional locations around Australia, New Zealand, Antarctica and Southeast Asia.

Please see the website for more details, at  
<<http://vertpaleo.org/Annual-Meeting/Annual-Meeting-Home.aspx>>.



**International Meeting on the Ediacaran System and the Ediacaran–Cambrian Transition (IMECT 2019)**  
Guadalupe, Spain 17 – 24 October 2019

This meeting is open to presentations on all aspects of the Ediacaran System and its boundaries, including organisms and their interpretation, litho/bio/chrono/chemo- and event stratigraphy, sedimentology, geomicrobiology, (bio)geochemistry, geochronology and geodynamics. Particularly welcome are contributions dealing with the nature of the Ediacaran–Cambrian transition. Another topic of recent interest and debate is the number and nature of Ediacaran glaciations. The



registration deadline is 30th June 2019. Field-trips will provide opportunities to visit key outcrops of the Ediacaran and Ediacaran–Cambrian transition in the Central-Iberian Zone of the Iberian Massif.

See more information at <<http://www.geoparqueilluercas.es/imect2019>>.



### **Marine Reptiles Conference 2020**

The Etches Collection, Kimmeridge, UK 5–7 May 2020

All professionals, amateurs and enthusiasts of marine reptiles are invited to attend. The meeting consists of two days of oral presentations, discussions and posters plus an optional conference meal on the first day and an optional field-trip to the fossiliferous Kimmeridge Bay area on the third day. The primary focus will be on the fossil record, covering not only the marine reptiles but also the other organisms that formed part of their ecosystem. There will be a session on modern reptiles, and we welcome abstracts from researchers studying all aspects of this field.

To register your interest please visit the website: <<https://marinereptiles.org/index.php>>.



### **XV International Palynological Congress and XI International Organization of Palaeobotany Congress (XV IPC-XI IOP)**

Prague, Czech Republic 12 – 19 September 2020

This congress will celebrate 200 years of modern palaeobotany. 1820 saw the first use of binomial nomenclature for fossil plants by the Czech ‘Father of Palaeobotany’ Caspar Maria Sternberg, who published *Flora der Vorwelt* in that year. Palynology and palaeobotany have a long tradition in the Czech Republic with several eminent pioneers. The scientific programme in 2020 will cover all aspects of palaeo- and actopalynology and palaeobotany, and will be held at the Clarion Congress Hotel Prague. Several congress field-trips will be on offer around parts of Bohemia and Moravia.

Pre-registration is available at the website: <<http://www.prague2020.cz/index.php>>.

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*Please help us to help you! Add your own meeting using the link on the Association’s web page:*

<<https://www.palass.org/meetingevents/future-meetings/add-future-meeting>>.

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**Zoë Hughes**

*Ordinary Member*



# Meeting REPORT



Lyme Regis Fossil Festival

Lyme Regis, UK 3 – 5 May 2019

Every year Lyme Regis Fossil Festival is host to a variety of different exhibitions organized by geologically- or environmentally-inclined organizations from all over the UK and Ireland, ranging from the British Antarctic Survey to Dinosaur Isle. Like many years previously, the Palaeontological Association joined the festivities to bring fossil-themed fun and activities to local schools, budding palaeontologists and festival-goers from Dorset and far beyond. This year's intrepid team of PalAss palaeontologists included Jo Hellawell, Lucy McCobb, Maria McNamara, James McKay, Elspeth Wallace, Jordan Bestwick, Jack Wilkin and myself, Catherine Mascord.

The Friday saw the team bring the Fossil Festival to local schools and challenge students to the 'Fossilization Frenzy' board game, a snakes-and-ladders like activity where the children were challenged to become a fossil, navigating their chosen animal from a living creature in the prehistoric seas, through mineralization, to become a fossil in a museum, a feat that is easier said than done. This resulted in the destruction of many a potential fossil and many a frustrated child as the players' chosen animals were destroyed by scavengers, melted in the depths of the Earth and broken by careless fossil collectors.



*Elspeth spinning the Wheel of Misfortune to see whether the kids' created creatures would survive. Photo by Jo Hellawell.*

Friday also saw the successful launch of James McKay's new paleoart book, *Trilobites, Dinosaurs and Mammoths*, which takes us on a tour of the prehistory of the British Isles through millions of years of geological time. To give additional insight into his book, James gave a talk on the Saturday in the Marine Theatre on how he recreated ancient Britain. Alongside James, Maria McNamara gave a



talk on her research into the preservation of soft-tissue and determining colour in fossils during the festivities on Saturday.

As the Festival was spread all over Lyme Regis this year, for the rest of the weekend the PalAss exhibition was set up in the Town Mill Gallery running trilobite- and ancient arthropod-themed activities. The main display centred on a wonderful collection of trilobites, many of which had peculiar body plans and very specific adaptations for their environment. The collection included relatively 'normal' blind, bottom-dwelling trilobites and others with rather more extreme features such as being covered in a coat of spines, stalked eyes, or most amusingly an individual with a fork/trident-shaped growth sticking out of the front of its head. Taking inspiration from these strange products of natural selection, festivalgoers were invited to create their own 'chimera' arthropods by mix-and-matching body parts from a selection of drawings of living and extinct animals. The kids (and the occasional adult who had a go) were encouraged to think about how their creations might live if they were real. This included considering what their creepy-crawly would be able to eat or catch, where in the sea it would live and whether it swam or crawled. These chimera arthropods ranged from simple worms to bizarre (and sometimes terrifying) creatures including jellyfish monsters, six-metre-long clawed worms, poisonous hedgehog-crabs and giant blood-sucking scorpions. One creature creation was a potential B-movie monster named "Algernon", a terrifying cross between a whip scorpion, mantis shrimp and spiny trilobite, named after Gideon Algernon Mantell.



*Algernon, the crazy arthropod creature creation, painted by James McKay.*

The chimera arthropods were all pitted against the Wheel of Misfortune, a spinning wheel sporting a selection of natural disasters, including invasive species, volcanic eruptions and, most deadly of all, meteorite strikes, any of which could cause species extinction. The challenge the children faced



was to give their creature the adaptations to allow them to survive as many turns on the wheel as possible. Unfortunately, most of the creations were killed by the first or second spin, leading to the kids taking their creations back to the drawing board to 'improve' their animal. These solutions were usually practical, like being able to burrow out of a mud slide or being poisonous to survive invasive predators, however some broke the laws of physics (and the rules of the game), like animals being able to swim faster than the speed of light or being bigger than the continent of Asia!

The children could draw their creature if they wanted to, and throughout the weekend the talented James McKay, produced some fantastic life-like paintings of these chimeras based on their drawings.

This was my first time visiting Lyme Regis since early childhood, and my first time volunteering with the Paleontological Association. The experience was very memorable and educational and I particularly enjoyed the opportunity to interact and talk palaeontology with the festivalgoers and school children, who in turn taught me a thing or two. The exhibition itself was very successful with hundreds of people interacting with the team and exhibition directly. May Lyme Regis Fossil Festival 2020 be just as much of a success!

**Catherine Mascord**

*University of Hull*





## — OBITUARY —

### **David J. Batten** **1943 – 2019**

Professor David J. Batten passed away on 14th February 2019 after battling with cancer. He had for the past four years been living in a small village surrounded by the beautiful Herefordshire countryside in the south of England, and the last weeks of his life were spent at St Michael's Hospice in nearby Bartestree. David is survived by his daughter Sarah and his son Alexander and one grandchild, Adelina, who live in Canada and the USA respectively.

David was born in 1943 in Watford, UK and was brought up in Croydon, South London within easy reach of the local countryside. After his O-level exams David moved with his family and attended boarding school in Canada. He later graduated from Queen's University in Ontario with a BA in Liberal Arts in 1964 and a BSc in Geology with a minor in Biology the following year. He was awarded an MSc in Micropalaeontology from University College London in 1966, and a PhD from the University of Cambridge in 1969 for research on British Wealden (Lower Cretaceous) palynomorphs and their facies distribution, under the supervision of Norman Hughes. David remained at Cambridge for two years before taking up employment in industry (Robertson Research and BP). He moved to the University of Aberdeen as a Lecturer in 1976, relocating to the University of Wales, Aberystwyth, in 1990 where he was promoted to a personal chair in 1992. With the closure of the Geology Subdepartment there in 2002, he became affiliated with the University of Manchester.



David is best known for his contributions to Mesozoic terrestrial palynology and palynofacies analysis, his research covering a wide range of palynological and palaeobotanical topics including the Normapolles pollen group and phytogeographic provinces in the Mesozoic and Cenozoic, and Mesozoic and Tertiary megaspores. David's many publications on palynofacies, from the early 1970s onwards, were to shape the way palynologists have approached this important subject. Wealden palynology remained David's abiding passion, and his research incorporated pollen, microspores, megaspores, chlorococcalean algae, freshwater dinoflagellates, macropaleontology, and palynofacies analysis, setting new standards for rigorous documentation and thoughtful interpretation. The 780-page *English Wealden Fossils* published by the Palaeontological Association in 2011 and edited by David, with five of its 35 chapters authored or co-authored by him, has resulted in a masterly and beautifully-illustrated synthesis of the Wealden biota. Its sobriquet 'the Wealden Bible' is richly deserved.





David served as Editor-in-Chief of *Cretaceous Research* (1988–2007; 2011–2012) and Editor-in-Chief of the Palaeontological Association which included editing its flagship publication *Palaeontology* (1999–2008), responsibilities he took very seriously and which benefited enormously from his editorial vision and meticulous attention to detail. In spite of the premature curtailment of David's university career in 2002, he supervised or co-supervised eight MSc students and 14 PhD students. His publishing output included 193 refereed papers and book chapters, very many as first or sole author, along with 12 edited books, special issues and field guides. David collaborated with colleagues around the world, and is particularly fondly remembered by many friends and colleagues in China, having been appointed to a Distinguished Visiting Professorship for Senior International Scientists by the Chinese Academy of Sciences in Nanjing in 2011–2012.

Those who knew David will remember a kind, rather reserved, deeply reflective and unassuming individual who held himself always to the highest standards. As a supervisor he led by example. In recognition of an outstanding career, David was awarded the T.M. Harris Medal of the Birbal Sahni Institute of Palaeobotany, India in 1998, the Jongmans Medal of the Royal Geological and Mining Society of the Netherlands in 2006, and an Honorary Life Membership of the Palaeontological Association in 2011. He was awarded the prestigious Medal for Scientific Excellence of AASP–The Palynological Society in 2018.

A broader account of David's life and career appears in the citation for the AASP Medal for Scientific Excellence (Head 2019) followed by David's own response which includes much additional information, both appearing in the journal *Palynology*. A full list of David's publications, research students, associates and postdocs appears on the website of the International Organisation of Palaeobotany at

<<https://palaeobotany.org/index.php/2019/02/25/professor-david-j-batten-1943-2019/>>.

**Martin J. Head**  
*Brock University*

#### REFERENCE

HEAD, M. J. 2019. AASP Medal for Scientific Excellence. *Palynology*, **43**, 175–180.

**MARY ANNING ROCKS** is a campaign inspired by a fossil-mad Dorset school girl called Evie, to erect a statue to her hero Mary Anning.

We need to raise £175,000 to create this permanent artwork by renowned artist Hazel Reeves. We are planning to raise this money via **PEOPLE POWER** launching a crowdfunder page as soon as we have enough pledges.

We'd love **YOU** to be a part of this innovative way of helping us to recognise Mary Anning's remarkable achievements. Please visit **[www.maryanningrocks.co.uk](http://www.maryanningrocks.co.uk)** and pledge an amount - every penny counts, and we can't do this without you!



**THANK YOU!**

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# Engagement Grant REPORT

## *Bringing evolution to life*

**Vicky Wright**

*Making Faces Theatre, London*

### **The evolution project**

A series of animal masks were created, representing species at key evolutionary transitions along the pathway from fish to man. Inspired by Prof. Neil Shubin's "Your Inner Fish" and William K. Gregory's "Our Face from Fish to Man", mask is an innovative way to explore the changes in facial morphology and learn about evolution.

### **Background: creating the masks**

Collaborating with Prof. Christine Janis from the University of Bristol, I used scans of fossil data to make accurately proportioned masks, scaled to be worn on a human head. In theatre, the shape of a mask holds information that is only unlocked when it is worn. An early research phase exploring the movement to arise from the masks was funded by the Arts Council England. Masks were created representing the species *Eusthenopteron* (385 Ma), *Tiktaalik* (375 Ma), *Thrinaxodon* (251–245 Ma), *Morganucodon* (205 Ma), *Proconsul* (23–25 Ma), and *Australopithecus afarensis* (Lucy) (3.9–2.9 Ma).



*Species (L-R): Eusthenopteron (385 Ma), Tiktaalik (375 Ma), Thrinaxodon (251–245 Ma), Morganucodon (205 Ma), Proconsul (23–25 Ma), Australopithecus afarensis (Lucy) (3.9–2.9Ma) at Lordswood Girls School in Birmingham. Photo courtesy of Andrew Fox from the Birmingham Education Partnership.*



## School engagement programme

Combining approaches from theatre and the arts and reaching across into science opens up new and exciting ways of learning. In 2018, a series of new workshops were funded by a PalAss Engagement Grant (PA-OE201701). These workshops were developed for school children aged six to 16 years, with three levels of workshop for each of Key Stage 2, 3 and 4. I aimed to work with a diversity of pupils broadening the reach of palaeontology, and for the workshops to be a leading STEAM example by integrating arts and science to deepen learning.

Mask and animal movement requires engagement, physicality and alertness of the performer to bring the mask to life. When this happens, the audience is intrigued as the animation of the masks allows glimpses into the behaviour and movement of these prehistoric animals. Through the workshops, students learnt about species of the past, key evolutionary transitions, fossil evidence and their connection to our present day anatomy. Teaching evolution in this way gives a unique insight into the migration of movement patterns and their influence on anatomical changes. The masks provided a tool for learning across many senses (visual, kinaesthetic and spatial) supported by an atmosphere of play and improvisation.

*“Scientists have recently determined that it takes approximately 400 repetitions to create a new synapse in the brain of children – unless it is done through play, in which case, it takes between 10 and 20 repetitions.” – Dr Karyn Purvis (2016).*

### The workshops

In the movement-based workshops I led, pupils journeyed through time, starting with life in the oceans and the early sideways movement of the spine, rediscovering and recreating this in their bodies. Transitioning across into the masks, a sizeable 0.6 m *Eusthenopteron* mask (fitted with bicycle helmet inside!) gave a visually striking sense of this ancient lungfish, requiring accurate body movement to maintain the illusion. Followed by ‘First fish on land’ races, we explored limb development, the counter-torsion of reptilian motion, and shifts in anatomy from cynodonts through to early mammals, integrating palaeontological evidence and insights into the movement.

Continuing the journey up into the trees with *Proconsul*, we transitioned through to bipedalism and ended with Lucy, a popular and familiar reference point for the students.

*“I found today’s session really enjoyable because I learnt lots of new things while having fun. The facts were interesting, as I didn’t know much about evolution and I found the acting with masks useful to see what it was like. It was fun and interactive.” – Phoebe.*

Pupils got the chance to play and improvise with the masks in small groups, seeing how they could activate the movements needed to bring them to life.

*“It was really interesting to explore different forms of movement and how the ancient animals moved.” – Koran.*

The species created reference points through time for the students to spatially map out the geological timescale, providing a platform to discuss key changes of the Earth and its ecosystems. Activities included guessing the order of plate tectonic shifts and ‘how big was the animal?’, with 3D-printed skulls alongside, enabling the students to link what we were exploring to the original fossil finds.

*“It was fascinating to watch and I learnt lots about the evolution of movement as a biology teacher and so the students definitely benefited!” – Mrs Forder, Fitzharrys School.*



Tiktaalik with Vicky Wright and a pupil at Lordswood Girls School, Birmingham. Photo courtesy of Andrew Fox from the Birmingham Education Partnership.

### Outcomes

The series of workshops toured 15 primary and secondary schools across five regions (Oxfordshire, Birmingham, Bristol, Cambridgeshire and London) from November 2018 to May 2019. A total of 391 pupils participated in the workshops, alongside 25 teachers and teaching assistants. Teacher evaluation on the effectiveness of this innovative approach and its impact on student learning was an important part of the process. The teachers found that the less confident students engaged in ways they had not seen before, that classroom dynamics were shifted away from writing, and that the approach was highly effective for children with English as a second language and those with disabilities.

*“They’re going to talk about it for ages! It has massively increased the students’ confidence to try something new. I don’t think I’m exaggerating to say, you have changed some of their grades today.”*  
– Mr Boardman, Colmers School.

Following this pilot series, evolution workshops have been booked directly by schools and universities, with plans to expand the education team at Making Faces Theatre. Education partners are keen to support future grant applications to make the workshop available to disadvantaged schools, and there is future potential to integrate motion capture technology into the learning experience. Making Faces Theatre will continue to specialize in this field with future projects including the hominids (6 Ma – present) and fantastical creatures (the Cambrian explosion) on the horizon.

### Acknowledgements

Special thanks are given to the scientists and education partners: Prof. Christine Janis (University of Bristol), Dr Stephan Lautenschlager (University of Birmingham), Prof. Michel Laurin (Muséum national d’Histoire naturelle, Paris), Dr Maeva Orliac (University of Montpellier), Dr Sergi López-Torres (Polish Academy of Sciences), Prof. William Harcourt-Smith (American Museum of Natural History), Prof. Greg Wilson (University of Washington), Jeff Winterbourne, Anatol Just, Andrew Fox, Fiona MacDonald, Beatrice Madziva, Cabot Learning Federation, London Learning Authority, Birmingham Education Partnership, Festival Bridge and Science Oxford.



# Research Grant REPORTS

## *Time resolution of fish death assemblages on the Eastern Mediterranean shelf*

**Konstantina Agiadi**

*Department of Historical Geology-Palaeontology, National and Kapodistrian University  
of Athens*

Palaeoecological studies are based on the assumption that the species whose remains are found in the same sedimentary horizon are of similar age and from the same habitat, and therefore potentially interacted with one other. However, fossils preserved together within a single stratum may represent organisms that lived at vastly different times due to high degrees of time-averaging (Walker and Bambach 1971; Kowalewski 1996; Kidwell 2013). For example, quantified median ages and time-averaging of co-occurring multiple species of molluscs and brachiopods showed significant differences in median age (Kosnik *et al.* 2009, 2013; Krause *et al.* 2010; Tomašových *et al.* 2014, 2019). Different durability of skeletal parts is a major factor affecting time-averaging. For example, the median post-mortem age of mollusc shells and echinoderm tests varied by three orders of magnitude on a shallow tropical shelf (Kowalewski *et al.* 2018). In contrast, fish otoliths and mollusc shells have comparable durability, enabling testing hypotheses on the ecological and taphonomic processes behind the build-up of fossil assemblages. The aim of this project was to quantify the time-averaging of fish otoliths in surficial death assemblages using radiocarbon dating and comparing these results with those of molluscan shells in the same assemblages.

Otoliths were retrieved from grab samples collected off the Israeli coast (eastern Mediterranean) along one depth transect from 10 to 40 m (Figure 1). Dating was conducted on the native Mediterranean species *Ariosoma balearicum* Delaroché, 1809 (bandtooth conger; Congridae), *Gobius auratus* Risso, 1810 (golden goby), *Gobius cobitis* Pallas, 1814 (giant goby), *Gobius niger* Linnaeus, 1758 (black goby), *Gobius paganellus* Linnaeus, 1758 (rock goby), *Lesueurigobius friesii* Malm, 1874 (Fries's goby), and *Lesueurigobius suerii* Risso, 1810 (Lesueur's goby; Gobiidae) (Figure 2). Radiocarbon dating was implemented by accelerator mass spectrometry (AMS) with a new cost-effective procedure using powdered carbonate targets (Bush *et al.* 2013) at the University of California Irvine in collaboration with Prof. Darrell Kaufman, Northern Arizona University. Radiocarbon ages were converted to calendar ages relative to the year of sample collection including post-bomb samples using a calibration curve built on museum material from the Israeli shelf in collaboration with Dr Quan Hua (ANSTO – Australia's Nuclear Science and Technology Organisation). The molluscan shell ages used for comparison were obtained through the project *Historical ecology of Lessepsian migration* (PI: P.G. Albano, University of Vienna). Time-averaging estimations were quantified using a common non-parametric measure of dispersion, the interquartile age range (IQR).



Figure 1. Otoliths were retrieved from sediment samples collected with a grab off the Mediterranean coast of Israel (photo courtesy of P. G. Albano).

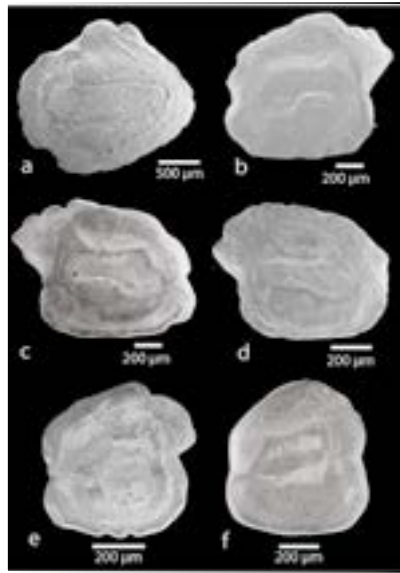


Figure 2. Fish otoliths from the surficial sediments of the Israeli shelf: *Ariosoma balearicum*, *Gobius auratus*, *Gobius cobitis*, *Gobius paganellus*, *Lesueurigobius friesii* and *Lesueurigobius suerii*.

The otolith dating gave ages within the last ~5,000 years. Therefore, these fish assemblages are Holocene and represent the native fish assemblages in the eastern Mediterranean. This basin is undergoing massive changes due to the introduction of tropical species from the Red Sea and climate warming, therefore these death assemblages represent a fundamental baseline for the pristine Mediterranean Sea. The age-frequency distributions for the otoliths at all depths show the typical right-skewed distribution of surficial death assemblages still affected by skeletal input (Tomašových *et al.* 2014, 2016). The obtained median age and time-averaging for the otoliths seem to correspond well to those for the molluscs, suggesting that molluscs and fishes responded similarly to environmental variation and that their skeletal remains followed similar taphonomic pathways.

Dating the fish otoliths in the death assemblage of the Israeli shelf provides a wealth of information on fish species life-history and production, and on otolith taphonomic processes. In the next steps, we will test the taphonomic clock of fish otoliths by comparing their preservation status to their respective post-mortem ages. Moreover, we will explore the variability in the production of the European anchovy in historical times. Finally, the ages of the otoliths of the potentially invasive species *Bregmaceros nectabanus* will confirm its status as a true invasive or establish it as a relic of the Pliocene tropical–subtropical Mediterranean Sea.

#### Acknowledgements

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## *A search for aquatic fungi: understanding the origins of mutualists and parasites*

**Christine Strullu-Derrien**

*Department of Earth Sciences, Natural History Museum, London and  
Institut de Systématique, Evolution, Muséum national d'Histoire naturelle, Paris*

Fungi have been an important part of life on land for over 400 million years, playing crucial roles as decomposers as well as forming relationships with plants and animals (Berbee *et al.* 2017). One key step in their evolution was the early transition from aquatic to land-dwelling saprotrophs, symbionts and parasites. Many fungal–plant interactions are documented from terrestrial environments (Taylor *et al.* 2015; Strullu-Derrien *et al.* 2018a) but those in aquatic and transitional environments are poorly known. The aim of this project, undertaken with Paul Kenrick and colleagues at the Natural History Museum, London, was to document the microbiota of an early freshwater environment, especially fungi and their relationships with animals and plants. The focus of the study was the Rhynie cherts (407 Ma), which are renowned as the earliest well-preserved terrestrial ecosystem. The palaeoenvironment is interpreted as an alluvial plain in which ephemeral ponds and small lakes were associated with a river system (Rice and Ashcroft 2004). Studies were performed by reinvestigation of historic thin sections housed in the collections of the Natural History Museum, London, the Hunterian Museum, Glasgow and small collections from other museums.



*Figure 1. Microbiota of a Rhynie chert freshwater environment. Illustration by Victor Leshyk (<<http://victorleshyk.com/paleo.html>>). The background shows a little pond on whose edges grew the plant *Asteroxylon mackiei*. The foreground (from left to right) shows the zoosporic fungal (*Cultoraquaticus trewini*) association with attached resting eggs, the charophycean alga *Palaeonitella*, the crustacean *Lepidocaris*, and the testate amoeba *Palaeoleptochlamys hassii* within cyanobacterial sheaths (Strullu-Derrien *et al.* 2019).*



## Early aquatic environments were more complex than suspected

While direct associations with arthropods have not been found, the functional mycocoenosis previously described (Strullu-Derrien *et al.* 2016) involving the zoosporic fungus *Cultoraquaticus trewini* appeared to be a common feature in aquatic settings. This fungus was also found in the vicinity of bacterial sheaths on which a population of organic tests was observed. We described *Palaeoleptochlamys hassii* gen. nov. sp. nov. interpreted as arcellinid amoebozoans (Strullu-Derrien *et al.* 2019), the first evidence of phagotrophic protists in the Rhynie cherts. These fossils expand the ecological dimensions of the Rhynie biota and push back the fossil record of terrestrial testate amoebae by over 200 million years.

We know from coprolites that arthropods of the Rhynie chert were able to utilize fungi as a source of food, but the limited evidence of fungal decomposition of arthropod remains as well as lignified tissues of plants remains puzzling. One source of evidence comes from the zoosporic fungi.

## Zoosporic fungi (parasites and saprotrophs) versus symbionts

Zoosporic fungi are key saprotrophs and parasites of plants, animals and other fungi, playing important roles in modern ecosystems. They comprise at least three phyla, of which two, Chytridiomycota and Blastocladiomycota, developed a range of thallus morphologies including branching hyphae. We described *Retesporangicus lyonii* gen. et sp. nov., an exceptionally well-preserved fossil, that we assigned to Blastocladiomycota, and which is the earliest known to produce multiple sporangia on an expanded hyphal network (Strullu-Derrien *et al.* 2018b). This adds to a growing body of evidence of the diversity of zoosporic fungi and their importance as decomposers in early freshwater and terrestrial systems. Chytridiomycota were abundant under wetter conditions, whereas Blastocladiomycota and symbiotic fungi favoured drier environments.

## New tools for the study of Fungi and other organisms

### *Confocal Laser scanning microscopy (CSLM) combined with methods of processing images*

CSLM is a form of optical microscopy that yields high-resolution images of minute objects. It proved to be very useful to describe both the fungus *Retesporangicus lyonii* and the testate amoebae by providing additional characters to those obtained with light microscopy. We went a step further by combining CSLM with a novel method of processing the image stacks to render surfaces and interior volumes (Spencer *et al.* 2013) and to produce high-resolution three-dimensional reconstructions. This combination was performed for the study of *R. lyonii* and enabled us to reconstruct the morphology of the sporangia and the thallus of the fungus, which would not have been resolved by observations only in traditional light microscopy.

### *X-ray microscopy (STXM) coupled with X-ray absorption near edge structure (XANES) spectroscopy*

One of the key remaining questions concerns the degradation of lignin (one of the main components of the cell wall of plant tracheids), which is mainly performed nowadays by fungi in the Agaricomycetes, a fungal group still unknown from the Rhynie chert. Our first approach was to analyse the chemistry of plant tracheid cell walls. We used the novel methods of focused ion beam-transmission electron microscopy (FIB) and synchrotron-based scanning transmission X-ray microscopy (STXM). These were coupled with X-ray absorption near edge structure (XANES) spectroscopy. FIB was unsuccessful on the Rhynie plants, which are preserved in silica, but worked well on plants preserved in pyrite. We showed that the chemical composition of



### The new fungus *Retesporangicus lyonii*

Three-dimensional reconstructions of zoosporangia (a–d) and thallus (e) of the fungus obtained by our new imaging method. Zoosporangium in light brown, spores in yellow–green inside the zoosporangium, hyphae in dark brown. In images a–d the wall of the sporangium appears in transparency (on the right) to enable observation of its content (Strullu-Derrien *et al.* 2018b).

organic residues of the cell wall in the earliest known woody plant (Strullu-Derrien *et al.* 2014) – contemporaries of the Rhynie chert plants – comprise pyrobitumen compounds, which is consistent with a lignin source (Strullu-Derrien *et al.* In press). This suggests that organisms capable of degrading lignin might have been present in the early Devonian.

### Acknowledgements

CSD gratefully acknowledges the Palaeontological Association for Research Grant PA-RG201602 that enabled this project. She thanks Paul Kenrick, Alan Spencer and Tomasz Goral for their ongoing collaboration, her co-authors, Victor Leshyk for the illustration, and Neil Clark (Hunterian Museum, Glasgow) for providing the slides for investigation. The Hunterian Museum is also acknowledged for the loan of the slides.

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# Small Grant REPORTS

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

**Keegan M. Melstrom**

*The Department of Geology and Geophysics, University of Utah*

### **Introduction**

Crocodylomorph reptiles are an extremely successful clade, having repeatedly radiated into novel ecological roles over the past 230 million years, displaying a remarkable morphological disparity throughout the Mesozoic Era, and successfully surviving two mass extinctions. The exceptional fossil record of this group presents an opportunity to study macroevolutionary patterns of ecology throughout a single clade. In particular, understanding the complex role that ecology plays in the survival and response to mass extinctions is largely an open question, especially in non-mammalian tetrapods. Previous studies of crocodylomorph taxonomic and phylogenetic diversity appear to reveal conflicting reactions to these events, with the end-Triassic mass extinction potentially acting as a trigger for an evolutionary radiation, whereas the end-Cretaceous extinction has little apparent effect on crocodylomorph diversity. Identifying the drivers behind these discordant responses may elucidate key ecological features that promote survival and success across mass extinction events.

Ecological reconstructions of extinct taxa are often generated by utilizing modern day analogues. In particular, dental morphology can provide clues regarding diet. In some cases, tooth shape, despite being unlike anything found in extant crocodylomorphs (*i.e.* crocodylians), can be compared to living squamates (Melstrom 2017), such as in the case of the unique notosuchian *Simosuchus* (Kley *et al.* 2010). However, in many other cases, Mesozoic and Cenozoic fossil crocodylomorphs possess dental forms that have no modern analogues (*e.g.* *Armadillosuchus*, *Chimaerasuchus*), are partially obscured (*e.g.* *Malawisuchus*), or teeth are not preserved (*e.g.* *Libycosuchus*). In these cases, skull shape may be able to shed light on the ecological role these taxa played in their environments.

Extinct crocodylomorphs exhibit skull morphotypes absent in living taxa (Wilberg 2017). In particular, clades such as Notosuchia and Protosuchia display an impressive range of skull shapes, potentially due to them occupying ecological roles filled by other taxa today. This range suggests the need to compare skull shapes beyond Crocodylia. Morphometrics offers a solution, allowing the direct comparison of otherwise dissimilar skull morphologies. I am applying both linear and geometric morphometrics (in lateral and dorsal view) to investigate the ecology of extinct crocodylomorphs. Data from extinct crocodylomorphs will be combined with those of a wide range of living amniotes, including mammals, squamates and crocodylians. Ultimately, I aim to reconstruct the ecology of extinct crocodylomorphs to test the hypothesis that the ecology of crocodylomorphs prior to the end-Triassic and end-Cretaceous mass extinctions played a role in their subsequent recovery from these events.



## Museum data collection

The Sylvester-Bradley Award allowed me to travel to the Staatliches Museum für Naturkunde (Stuttgart), Bayerische Staatssammlung für Paläontologie und Geologie (Munich), Museum für Naturkunde (Berlin) and the Natural History Museum (London), all of which contain large collections of fossil crocodylomorphs from regions of the world that were otherwise under-sampled in my dataset. During this research trip, I measured and photographed over 60 extinct crocodylomorph specimens and generated 3D models of many dentitions using photogrammetry. This research trip, combined with trips to nearly two dozen US and South American institutions, has allowed me to generate a dataset of nearly 120 crocodylomorph species with a worldwide distribution. These data will be combined with a dataset of approximately 150 extant amniote species that express a wide range in skull shapes and ecologies.

Data analyses are still in the early stages but have so far generated promising results. As an example, I share here a selection of 42 extant taxa comprising adult specimens, including nine mammals, 11 squamates, *Sphenodon* and 21 crocodylians, as well as six fossil crocodyliforms (Figure 1). To assess range in morphospace of extant amniotes, I employed a 2D geometric morphometric analysis in dorsal view that utilizes ten discrete homologous landmarks and four sets of semi-landmarks, which together capture much of the skull outline. Although linear and 2D geometric morphometrics do not summarize shape as comprehensively as 3D analyses (e.g. Felice and Goswami 2018; Bardua *et al.* 2019), these techniques allow for larger fossil datasets, as they are less sensitive to distortion, damage and other taphonomic processes. Position, orientation and scale were removed using a Generalized Procrustes analysis, using the `procGPA` function from the R package 'shapes' in RStudio (version 1.1.442), which also performs a principal components analysis.

The first three PC axes summarize 89.3 % of skull shape variation. Despite the inclusion of mammals and lepidosaurs (squamates + *Sphenodon*) in the dataset, these results largely confirm those of previous research, which found that extant crocodylians occupy a wide range of morphospace, from long thin snouts to short, relatively wide snouts (e.g. Pierce *et al.* 2008; Wilberg 2017). Unsurprisingly, there is a clear and significant ( $p < 0.001$ ) division between mammals, crocodylians, squamates and *Sphenodon*. Whereas there is a gradation between crocodylians and squamates, with some overlap occurring between *Paleosuchus* (dwarf caiman) and three species of *Varanus* (monitor lizards), mammals are clustered away from the two groups (Figure 1). Interestingly, the carnivorous marine mammal *Arctocephalus australis* (South American fur seal) lies between mammal and squamate morphospace, which is consistent with previous research that found an overlap between marine tetrapod groups that share similar dietary habits, despite dramatic phylogenetic distances (Kelley and Motani 2015). Within squamates, some herbivorous taxa (the iguanas *Amblyrhynchus* and *Conolophus*) tend to cluster near the centre of morphospace, but this may be due to small sample size. Finally, fossil crocodyliforms primarily cluster near the range of extant taxa (e.g. *Steneosaurus leedsii*), although the notosuchian *Libycosuchus* falls nearer to extant squamates, suggesting interesting results as the dataset continues to grow.

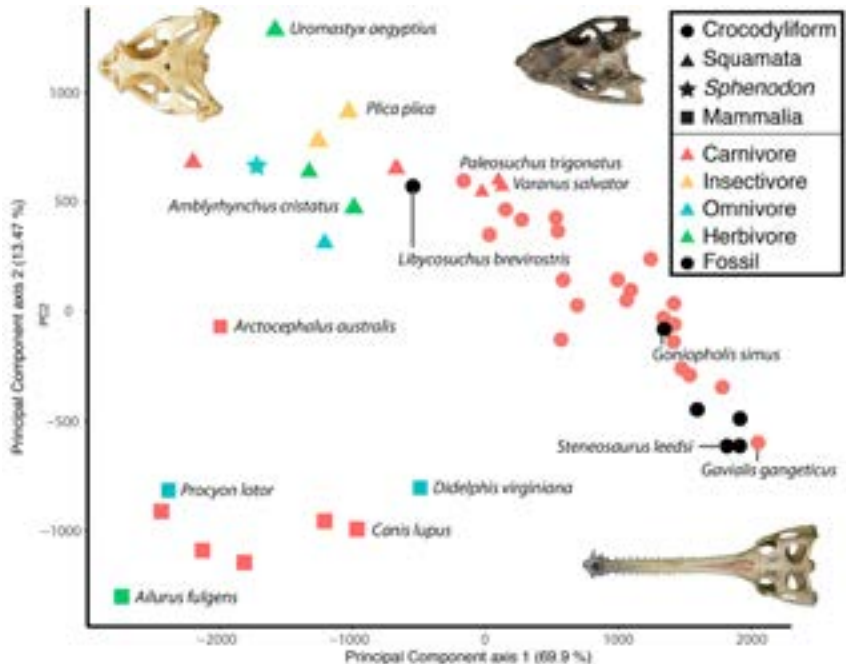


Figure 1. Comparative cranial morphospace of select extant amniotes and fossil crocodylians visualized using a principal components analysis. There is some overlap between extant crocodylians and squamates, whereas mammals are isolated. Interestingly, the fossil taxon *Libycosuchus* (BSP 1912.VIII.574; pictured upper right) is closer to some squamates than crocodylomorphs. The extant crocodylian *Gavialis gangeticus* (NHM R. Unnumbered; pictured lower right), and the extant lizard *Uromastix aegyptius* (FMNH 63961; pictured upper left) represent extremes in morphospace. Skulls are not to scale.

Future work will add over 200 extant and extinct taxa to the dataset to test if dietary ecology plays a significant role in skull shape across amniotes. Ultimately, this work will be applied to extinct crocodylomorphs to aid in ecological reconstructions with the hope of being used to evaluate if ecology played a role in the survival and success of crocodylomorphs.

**Acknowledgments**

First and foremost, thank you to the Palaeontological Association for the Sylvester-Bradley Award (PA-SB201704) that allowed me to conduct my research trip. Susannah Maidment (Natural History Museum, London), Erin Maxwell and Rainer Schoch (Staatliches Museum für Naturkunde), Oliver Rauhut (Bayerische Staatssammlung für Paläontologie und Geologie), and Daniela Schwarz and Florian Witzmann (Museum für Naturkunde, Berlin) generously provided access to collections. Thanks to B. Breeden and R. Irmis for providing valuable comments on an early draft of this report.

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## What is the Cambrian “muscle worm”?

**Allison C. Daley**

*Institute of Earth Sciences, University of Lausanne*

### Introduction

The Cambrian animal *Myoscolex ateles* is an enigmatic fossil from the Lower Cambrian (Series 2, Stage 4) Emu Bay Shale in Australia (Paterson *et al.* 2016). Specimens typically consist of an elongate body with bands of muscles preserved as highly complex bundles of phosphatic fibres (Figure 1). *Myoscolex* preserves one of the oldest examples of phosphatized muscle tissues in the fossil record; however, because previously published specimens consist almost entirely of muscles, and very little else, its affinities have been difficult to identify. *Myoscolex* was originally described as a polychaete annelid (Glaessner 1979) based on the presence of strongly mineralized rods projecting from the body, interpreted as parapodial setae. Briggs and Nedin (1997) suggested that *Myoscolex* shows evidence of paired body flaps, three eyes on the head, and a proboscis, meaning it was similar to the stem-lineage arthropod *Opabinia*. Dzik (2004) compared the shape of the body of *Myoscolex* to that of the early chordate *Pikaia*, but ultimately agreed with Glaessner (1979) that it was likely a polychaete annelid. So, the question remains – what is the affinity of the Cambrian “muscle worm”?

Previously published descriptions of *Myoscolex* were based on specimens collected from a wave-cut platform on the north coast of Kangaroo Island, South Australia, but recent excavations inland at Buck Quarry have produced hundreds of new specimens (Jago and Cooper 2011). This research project makes use of the new material to provide an updated description of the morphology of *Myoscolex*. Over 300 specimens of *Myoscolex* were examined in the collections of the South Australian Museum in August 2015. Detailed observations were made on their anatomy, including photography, *camera lucida* drawings, and SEM analyses. Measurements were made of body dimensions and muscle block sizes. This work is currently being written up as two manuscripts for publication, to be submitted later in 2019.



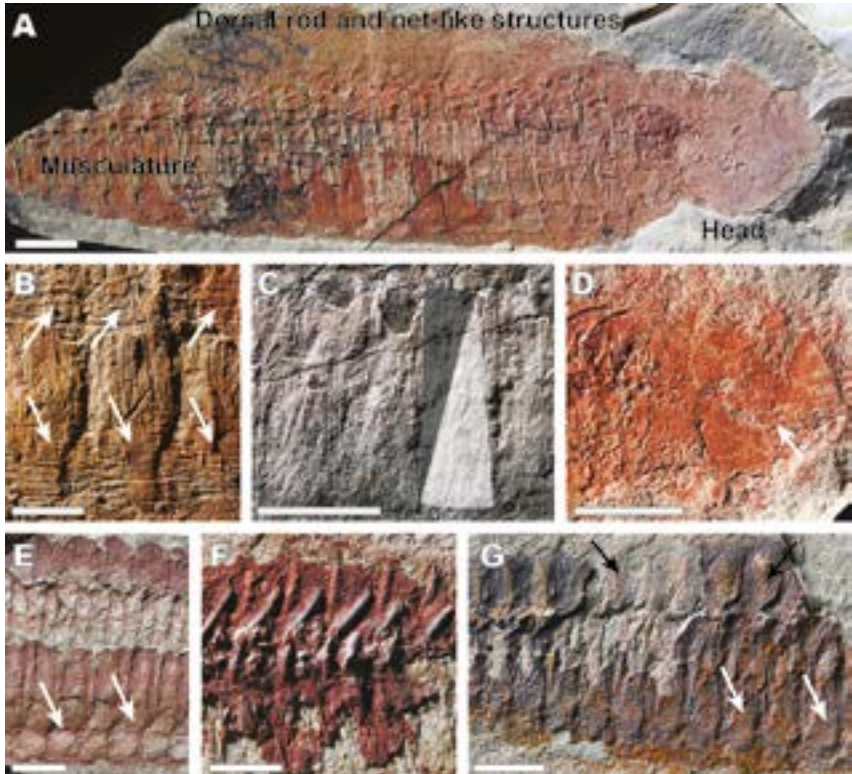


Figure 1. *Myoscolex ateles* from the lower Cambrian Emu Bay in Australia. A) nearly complete specimen, SAM P49675; B) longitudinal muscles (arrows), SAM P49018; C) dorsoventral muscles with opposing triangular blocks emphasized in white and grey shading, SAM P40816; D) head region with possible appendages (arrow), SAM P49788; E) Ventral region with plates (arrows), SAM P48977; F) dorsal region with mineralized rods and net-like structures, SAM P43545; G) body with dorsal net-like structures (black arrows) and ventral plates (white arrows), SAM P47980. Scale bars are 5 mm in A, C, D, F and 3 mm in B, E, G.

### Musculature

The most prominent feature in all specimens of *Myoscolex* are the bands of musculature that comprise much of the core of the body. These structures are confirmed to be muscles based on the morphology and size of the muscle fibres, which are indistinguishable from muscles of the crustacean arthropod *Astacus* and the polychaete annelid *Arenicola* (Figure 2). The musculature clearly defines the segmentation of the body, and is arranged in two distinct systems, which are well distinguished in the Buck Quarry specimens. Longitudinal muscles run parallel to the body axis, and are most visible in the ventral region of the body, where they are sometimes broken by body segmentation (Figure 1A, B). Dorsoventral muscles consist of repeated units of fibres orientated perpendicular to the body axis, with each body segment having a band of dorsoventral muscle that is composed of a more prominent upper region of muscle fibres that widens towards the ventral surface and a lower region that widens towards the dorsal body surface, forming two opposing tapering muscle bundles (Figure 1C).

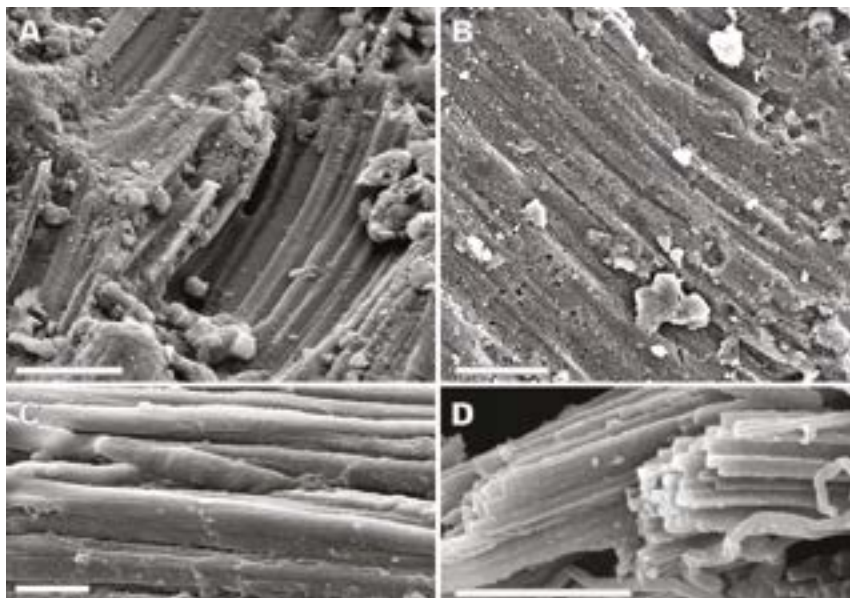


Figure 2. Scanning electron microscope images of muscle fibres: A, B) *Myoscolex* from the Emu Bay Shale; C) modern *Arenicola* (polychaete annelid); and D) modern *Astacus* (crustacean arthropod). All scale bars are 10  $\mu\text{m}$ .

### Growth

The *Myoscolex* specimens examined ranged in length from 8.2 mm to 116.2 mm (mean = 51.2 mm) and in width from 3.1 mm to 26.0 mm (mean = 10.0 mm), although numerous incomplete specimens suggest that the animal was able to attain much larger sizes. A total of 31 specimens were complete enough to include in quantitative studies, examining how length, width and segment number change during ontogeny. The strong significant positive linear correlation between body length and body width ( $r^2=0.26$ ,  $n=30$ ,  $p=0.002$ ) suggests that growth by inflation is dominant. There is also a significant correlation between body length and segment number, suggesting that segments are added during growth ( $r^2=0.88$ ,  $n=29$ ,  $p=5.37e-14$ ). Correlation plots suggest that at smaller sizes, growth is achieved by both inflation and the addition of segments, until a maximum body width is reached, after which point the body continues to increase in length by adding segments.

### New anatomical features

The Buck Quarry specimens reveal the detailed anatomy of body features other than the musculature (Figure 1). Body segmentation is well defined, and each body segment has an external cuticle ornamented with a roughly triangular plate at the ventral margin of the body (Figure 1E, G), and a pair of prominent mineralized rods with associated fan-like setose structures at the dorsal margin (Figure 1F). For each body segment, a pair of long, curved rods emerges from the dorsal surface, which tend to be preserved in 3D with phosphatization (Figure 1F). Extending from the concave margin of each of the two curved rods, there are fan-like structures adorned with a crosshatch (net-like) pattern of setae (Figure 1G). These net-like structures have a complex



morphology, with a square-shaped mesh being visible near the attachment to the rods, and a more elongated rectangular mesh being visible more distally. The ventral region of the body does not preserve obvious appendages or flaps, but has a simple scalloped margin resulting from the presence of a rounded triangular plate adorning each body segment (Figure 1E, G).

The anterior and posterior regions of the *Myoscolex* body are also revealed in the Buck Quarry specimens (Figure 1A). The posterior termination of the body has a simple tapering form, without any terminal spines or tail fan. An anterior head region can be distinguished, and consists of a rounded smooth extension that is separated from the rest of the body by a narrower neck region (Figure 1A). The head bears up to three small round or oval cephalic carapaces (Figure 1D), which have narrow reinforced rims along the margin. The faint impression of a U-shaped tube is visible in some specimens, possibly representing the anterior region of the gut. Other specimens show up to three pairs of tiny elongated structures, possibly appendages, near the base of the head (Figure 1D). No evidence for a proboscis was found in the head region.

The affinity of *Myoscolex* remains difficult to determine despite the new anatomical features described from Buck Quarry specimens. The overall body shape is similar to annelids, and the rod and fan-like setose structures could be interpreted as parapodia. However, the arrangement of the musculature and numerous features of the head suggest an arthropod affinity. Ongoing work includes examining the preservation of these specimens and the growth dynamics of the animal, in order to try to illuminate the affinity of *Myoscolex*.

### Acknowledgements

The study of *Myoscolex* material was undertaken with the University of Oxford undergraduate student Emily Tilby (now University of Cambridge). I thank Mary-Anne Binnie at the South Australian Museum for collections assistance. John Paterson (University of New England), Diego García-Bellido (University of Adelaide), Greg Edgecombe (Natural History Museum, London) and Jim Jago (University of South Australia) are acknowledged for collaborating on this research. Thank you to the Palaeontological Association, who funded this research with a Whittington Award (PA-WA201401).

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

**Nuria Melisa Morales García**

*School of Earth Sciences, University of Bristol*

For my project I am using a suite of complementary biomechanical techniques to study the functional evolution of early mammals. These techniques include finite element analysis (FEA), mechanical advantage and beam theory, which allow me to study different aspects of the jaw: its mechanical performance when biting, the efficiency of the adductor muscles, and the resistance of the jaw to torsion and bending, respectively. In order to study this, I need photographs, measurements and, in some instances, CT scan data, of complete or almost complete jaws. For this project, I needed to collect the aforementioned data on European material from the UK and Portugal. Here I present a full breakdown of the data that I originally set out to collect and its outcomes.

## **Data**

Natural History Museum, London (Purbeck Limestone Group, UK): I collected a series of photographs and measurements from the jaws of the dryolestids *Amblotherium* and *Phascolestes*, the peramuran *Peramus*, the eutriconodonts *Triconodon* and *Trioracodon*, and the spalacotheriid *Spalacotherium*.

Oxford University Museum of Natural History (Taynton Limestone Group, UK): I collected a series of photographs and measurements from the jaws of the eutriconodonts *Phascolotherium* and *Amphilestes*, as well as from the amphiteriid *Amphitherium*.

Steinmann Institut, University of Bonn (Guimarota Formation, Portugal): we (my supervisor Pam Gill and I) collected CT scan data from three specimens of the dryolestid *Dryolestes*, which have been segmented and reconstructed. These CT scan data were obtained free of charge thanks to the generosity of, and our strong working relationship with, Prof. Thomas Martin's group in Bonn.

## **Outcomes**

Extruded FEA: Using the data I collected from the aforementioned collections I have built multiple enhanced extruded models for FEA. FEA models are traditionally built using CT scan data. I have developed an alternative technique for building FE models which, instead of using expensive and sometimes inaccessible CT scan data, uses simple 2D outlines of relatively flat jaws (Morales García *et al.* in review). These outlines are then extruded to the average width value of the horizontal ramus of the jaw to form a completely flat 3D model. In a final step, the width of various structures of the ascending ramus (*e.g.* coronoid process, condyle, angular process) is fine-tuned to create a simplified 3D model of the jaw, which we call enhanced extruded FE model (Figure 1). These models will be used to assess the performance of the jaw at the moment of biting across a wide array of taxa. This represents a faster and more economic approach to the use of 3D FE models built with CT scan data. The use of these models has been validated in Early Jurassic mammaliaforms *Morganucodon* and *Kuehneotherium* (Morales García *et al.* in review).

Mechanical advantage: I am evaluating mechanical advantage data from the temporalis



and masseter using the photographs obtained in this study. Only nearly complete jaws can be considered, namely *Phascolotherium* and *Amblotherium* (Taynton Limestone Formation), *Amblotherium* and *Triconodon* (Purbeck Limestone Group), and *Dryolestes* (Guimarota Formation).

Beam theory: Second moment of area analyses are being performed in the horizontal ramii of *Phascolotherium*, *Amphitherium*, *Amblotherium*, *Trioracodon* and *Dryolestes*. This ongoing study will analyse the resistance to torsion and bending of the jaw when biting.

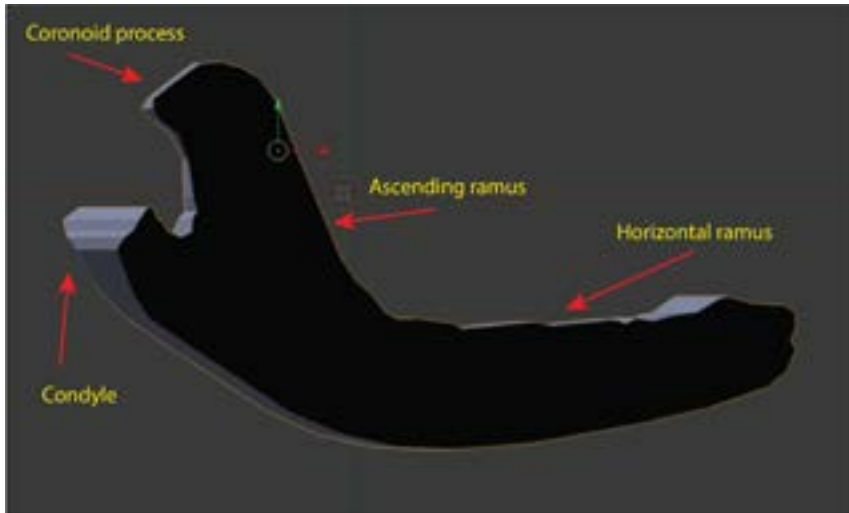


Figure 1. Enhanced extruded FE model of *Phascolotherium*, Taynton Limestone Formation, UK. Data obtained from the Oxford University Museum of Natural History, in collaboration with Dr Paul Wilson and Prof. Mark Williams (University of Warwick).

#### Additional notes

We obtained CT scan data from *Amblotherium* and *Trioracodon* from the Natural History Museum, London. These data were kindly provided free of charge to Dr Pam Gill.

We obtained CT scan data from *Phascolotherium* and *Amphitherium* from the Oxford University Museum of Natural History. These scans were obtained in collaboration with Dr Paul Wilson and Prof. Mark Williams from the University of Warwick, and scanned at the University of Warwick, at no cost. Collection of the *Amphitherium* scan data from the Oxford University Museum and Purbeck specimens from the Natural History Museum, London, meant that we did not require scanning of the more fragmentary material housed in the University Museum of Zoology, Cambridge and the Sedgwick Museum of Earth Sciences as we had originally planned.

#### Summary

I have collected photographic and tomographic data of the jaws of a number of taxa belonging to the crown group Mammalia, which span from the Middle Jurassic to the Early Cretaceous of the UK and Portugal. These data will allow us to study the functional performance of the jaws of Mesozoic mammals and will contribute to our understanding of the feeding ecology of early mammals. The study will also help us answer questions such as how jaw shape relates to function



in mammals, as well as how different Mesozoic mammalian faunas differed from each other in terms of functional diversity.

### **Acknowledgements**

I wish to thank the curators, technical staff and researchers who have assisted me in the acquisition and processing of the data. Guimarota Formation material: Prof. Thomas Martin, Dr Julia Schultz and Kai Jäger (University of Bonn); Taynton Limestone Formation material: Dr Hilary Ketchum (OUMNH), Dr Paul Wilson and Prof. Mark Williams (University of Warwick); Purbeck Limestone Group material: Dr Michael Day and Dr Vincent Fernández (NHM, London). I would also like to thank my supervisors Prof. Emily Rayfield, Dr Pamela Gill and Prof. Christine Janis for their continuous guidance and support, and Dr Jennifer J. Hill, Thomas Burgess and William Deakin for their advice on the construction of extruded FE models. The trips to NHM, London and OUMNH were funded by Palaeontological Association Stan Wood Award PA-SW201701.

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# Undergraduate Bursary REPORT

## *Small-bodied estuarine plesiosaur from the Middle Jurassic gap*

**Roxanne Armfield**

*Department of Earth Sciences, University of Cambridge*

### Introduction

Plesiosaurs are a clade of secondarily aquatic reptiles adapted to life in open water environments. They have a rich Jurassic–Cretaceous fossil record, with specimens predominantly recovered from marine deposits. A small number of plesiosaurians have also been recovered from freshwater settings, suggesting that some taxa were adapted for freshwater/estuarine environments, analogous to freshwater dolphins (Benson *et al.* 2013a). So far, all freshwater taxa are nested within a single clade, Leptocleidia (Cruickshank 1997; Benson *et al.* 2013b). Freshwater habits have been posited to have acted as a refugium allowing plesiosaurians to survive over the Jurassic–Cretaceous boundary and then re-radiate into marine ecosystems (Andrews 1922). However, freshwater taxa only occur in a narrow time interval during the Early Cretaceous and no phylogenetically informative plesiosaurian specimens have been described from the 10-million-year gap between the Early Jurassic Lias Group and the Callovian Peterborough Member of the Oxford Clay Formation. Undescribed plesiosaurian remains from the Bathonian (Middle Jurassic) of Eigg (Scotland, UK) have the potential to contribute to our understanding of the evolutionary history of freshwater plesiosaurians. The specimens co-occur with fossilized brackish-water molluscs and, combined with strontium isotope compositions, suggest a freshwater influenced depositional system (Hudson 1966).

### Methods

Much of the material is contained within weathered beach cobbles, making it difficult to physically extract the fossil material. Micro-CT scanning and subsequent segmentation (using Mimics 16.0) was carried out to produce 3D models of representative bones. The models produced were described and scored into phylogenetic analyses.

### Anatomy

The specimens include vertebral elements from all major axial regions (cervical, dorsal, sacral and caudal) and portions of the pectoral and pelvic girdles (the left coracoid and left ischium). Three cervical vertebrae were studied and are listed here in order of size: a small, anterior cervical (NHMUK R9781), a mid cervical (O2C) and a ?posterior cervical (O6C, Figure 1). In addition, a pectoral vertebra is present (O1C), identified by the position of the rib facet, which contacts the neural arch. The anterior-middle cervical centra are subcylindrical in shape, being longer anteroposteriorly than high dorsoventrally and the centra having flat ventral surfaces. A low midline ridge is present on the ventral surface of the posterior cervical centrum (O6C). A longitudinal ridge is present on the



lateral surfaces of the centrum in the anterior-middle cervicals. The pectoral vertebrae (01C) shows a ventrally convex neurocentral suture present between the centrum and the neural arch, but this suture is not visible on any other specimens. The prezygapophyseal facets face dorsomedially and the two facets contact each other along their anteroposterior length, producing a single concave trough with a thin medial ridge posteriorly separating the two facets.

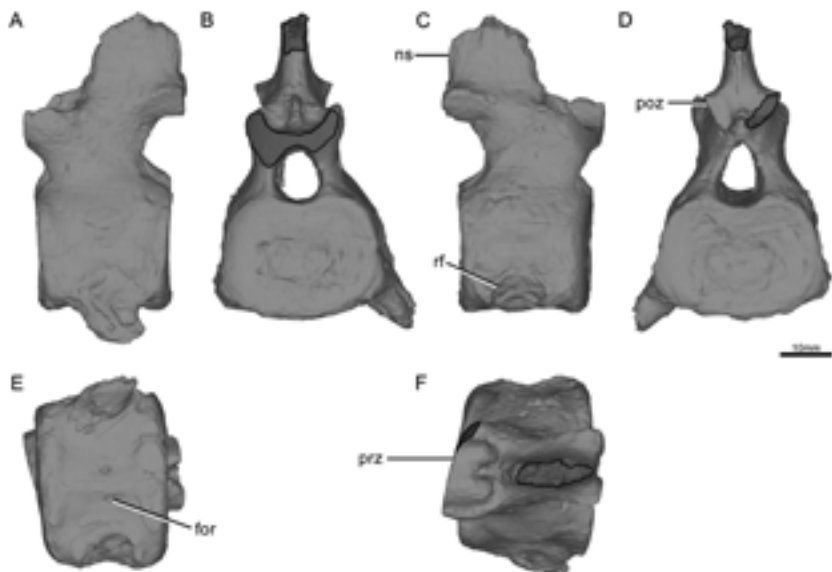


Figure 1. 3D rendering of cervical vertebrae (06C) in A, left lateral, B, anterior, C, right lateral, D, posterior, E, ventral, and F, dorsal views. Damaged regions are shaded. Abbreviations: for, subcentral foramina; ns, neural spine; prz, prezygapophysis; poz, postzygapophysis; rf, rib facet.

Two dorsal vertebrae are preserved, both with sheet-like, vertically-oriented neural spines. The neural spines are transversely narrow relative to their anteroposterior width and lack anteroposterior constriction at their bases. The neural arch peduncles are dorsoventrally short, and bear long, dorsolaterally-inclined transverse processes that arise from the level of the neural canal. The lateral ends of the transverse processes present single suboval articular facets. The prezygapophyses face dorsomedially and are separated on the midline. Each facet is slightly concave. The postzygapophyses face posterolaterally at a moderate ( $45^\circ$ ) angle.

Three sacral vertebrae were identified by the presence of rib facets that contact both the centrum and neural arch, combined with possessing widely-spaced prezygapophyses (Figure 2). The articular surfaces of the rib facets are composed of an approximately vertical ventral portion and, a ventrolaterally-facing dorsal portion that together produce a single suboval shaped facet. The prezygapophyseal facets face dorsomedially. They have planar surfaces, unlike the mediolaterally concave surfaces of dorsal and cervical zygapophyses. They are narrower mediolaterally than the width of the centrum and do not contact each other medially. The postzygapophyseal facets are also flat, and face posteroventrally. NHMUK R9774 has an almost complete neural spine, which is mediolaterally narrow, sheet-like, and taller dorsoventrally than its antero-posterior length.



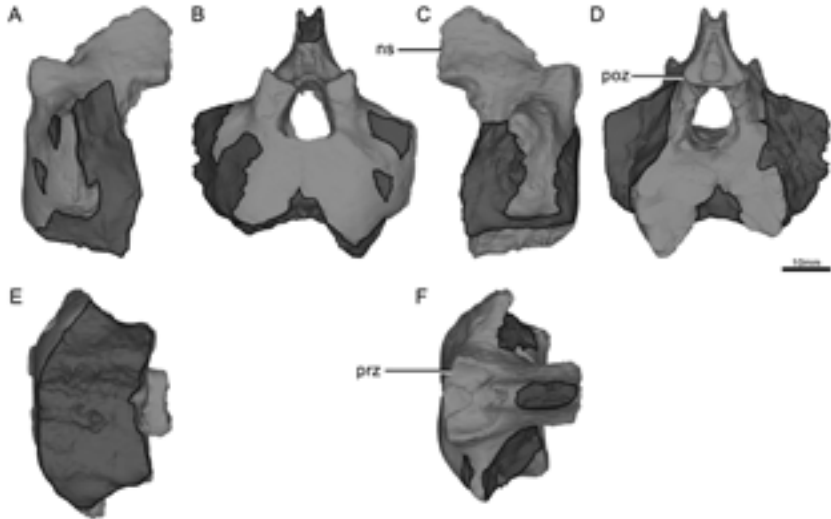


Figure 2. 3D rendering of sacral vertebrae (O55) in A, left lateral, B, anterior, C, right lateral, D, posterior, E, ventral, and F, dorsal views. Damaged regions are shaded. Abbreviations: ns, neural spine; prz, prezygapophysis; poz, postzygapophysis.

Two caudal vertebrae are present, with the smaller of the two (NHMUK R9792) preserving caudal ribs co-ossified to the rib facets. Ventrally, both vertebrae possess anterior and posterior chevron facets. These are approximately equal in size, with the posterior facets projecting ventrally from the centrum.

### Preliminary phylogenetic analysis

With this material we were able to score for 42 anatomical characters within the Serratos *et al.* (2017) data matrix. The dataset was analysed using TNT v1.5 using the New Technology Search. This taxon was always recovered as a basal member of Elasmosauridae. Taxa within Elasmosauridae tend to show plesiosauromorph body proportions (with short heads and long necks) and are characterized as possessing cervical vertebrae with centra longer anteroposteriorly than they are tall dorsoventrally (Serratos *et al.* 2017). This result dates the evolution of freshwater habits in plesiosaurians to at least the Middle Jurassic and suggests this either occurred once, in the common ancestor of Leptocleidia and Elasmosauridae, or that a freshwater ecology has been independently acquired multiple times in plesiosaurian evolution. However, recent analyses only assign Cretaceous taxa to Elasmosauridae (Serratos *et al.* 2017). Further investigation is required into the phylogenetic position of this taxon, particularly as the repeated evolution of pliosauromorph and plesiosauromorph body forms within Plesiosauria has obstructed inference of their phylogeny and evolutionary history, resulting in uncertainty of the relationships among major clades (Ketchum and Benson 2010).



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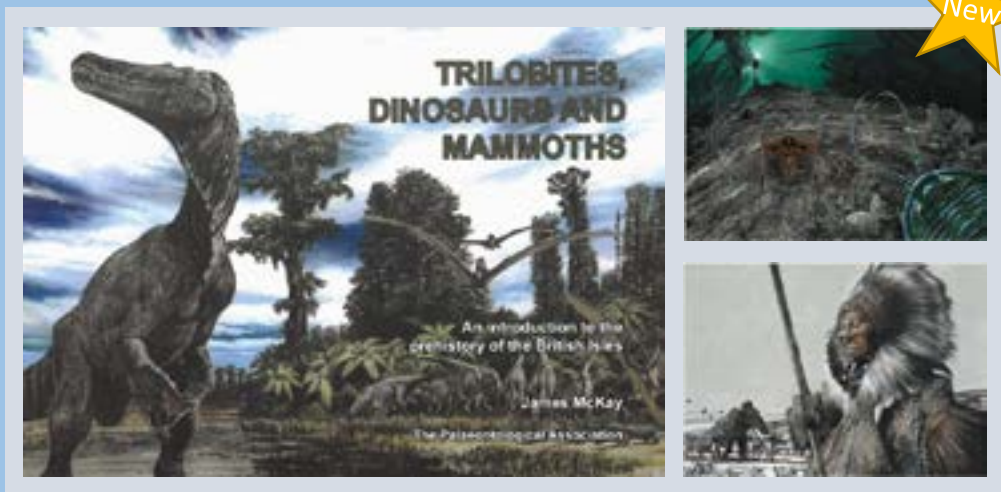
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# Trilobites, Dinosaurs & Mammoths

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# Book Reviews

## Terrestrial Conservation Lagerstätten: Windows into the Evolution of Life on Land

Nicholas Fraser and Hans-Dieter Sues 2017. Dunedin Academic Press. 450 pages £165.00 (hardcover) ISBN:9781780460147.

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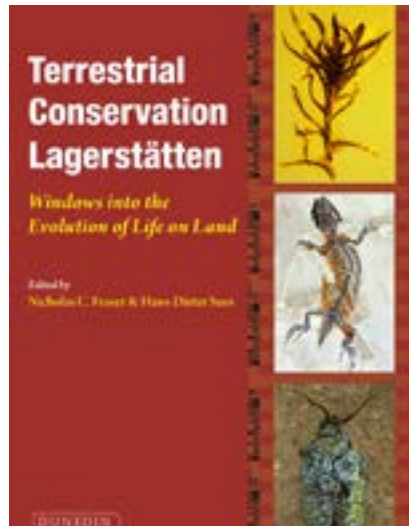
As clearly recognized by the production of this volume, terrestrial biotas are often rarely considered when thinking about Lagerstätten and their role in unravelling not only the evolution of individual taxa but also as a window to past worlds. This volume is therefore a welcome addition to the literature, but while there are many positive aspects to consider about the volume there are also disappointments.

The volume has nine chapters dealing with assemblages that range in age from Devonian to Eocene and is illustrated by a large number of full colour plates and the large format certainly helps illustrate the remarkable animals and plants. Each chapter discusses the history of the deposit and its' study together with a description of the geological setting before a description of the biota and what makes it special is supplied. It is worth mentioning here that there is no explanation as to why some important Lagerstätten have not been included, nor is there an overarching concept to the volume. Equally there is, as is often the case, less emphasis on plants and more on animals, and in many cases some of the most exciting new areas of the study of some Lagerstätten have been missed. A longer introductory chapter would have been very useful, putting the Lagerstätten into a broader context rather than the very short introduction of just over two pages.

The book begins with what is clearly the most important early terrestrial Lagerstätte: the Rhynie chert from the Early Devonian of Scotland. The two authors have been at the forefront of the new research of the assemblages. The late Nigel Trewin through his efforts and insights brought this remarkable Lagerstätte to a whole new audience, making many important discoveries, and Hans Kerp has continued the descriptions and been involved in many new discoveries of the plants, algae and fungi. This chapter is both a delight but also a disappointment, as there are a number of illustrations, particularly concerning the ecology, that could have been used but weren't, and a depiction of the potential food chains that have been unravelled is also absent. Little is mentioned about more recent palynological research. The table at the end of the chapter is particularly useful, however.



The Carboniferous is represented by the East Kirkton biota. As you would expect from the author (Jennifer Clack) the strengths of the chapter are in the descriptions and illustrations of the vertebrates. However, I found some aspects a little disappointing. I would have liked to have seen more on the geological setting of the site including maps and logs, much like those seen in the Rhynie chapter. The major problem I have is with the description and illustration of the plants. This is one site where there are a range of preservation states of plants providing in some cases a link between plant compressions and plant permineralizations (see Scott *et al.* 1994; Brown *et al.* 1994; Galter *et al.* 1998). The literature here is not complete in this regard either. The stem shown in Fig 3A is in fact beautifully anatomically preserved but not shown (see Rolfe *et al.* 1990, their Fig 4e). Despite the fact that *Stanwoodia* is mentioned it is not illustrated, nor are any of the anatomically preserved plants. The compression illustrations are poor as they were not photographed correctly, and some of these are also anatomically preserved but this is not discussed. There are no illustrations of charcoalfied plants. This is especially a pity as nowhere in the volume are charcoalfied floras mentioned and many assemblages are now recognized as Lagerstätten (see for example Glasspool *et al.* 2006). A new reconstruction of the environment and biota would have been very useful, as well as a discussion of the role of wildfire (see Scott 2018 for discussion).



Surprisingly, other Carboniferous Lagerstätten are not included but perhaps this is because plants dominate the biota and these are not considered 'sexy'.

With the Triassic I was surprised again at the omissions. The late Triassic Madygen biota is an interesting choice. Here the geological setting is well described. I particularly liked the ecosystem reconstruction. It is a pity that the structure of this chapter could not have been used as a template for all the chapters.

Surprisingly there is a second Triassic chapter (on the Solite Quarry) but this is one that is perhaps less well known to many. Despite the fact that the plants are the most abundant fossils, the deposit to have only half a page of illustrations of them (with four specimens) is disappointing. By contrast the diverse insect fauna receive 48 illustrations. The tetrapods are both illustrated and reconstructed here, but again there are no ecosystem reconstructions, which I think is a shame, as this would have helped in the visualization of the habitats and biotas. I also wondered why there was nothing on the Triassic Molteno of South Africa.

The next two Mesozoic examples are from China. The relatively unknown assemblage, at least in western literature, is the Yanliao biota of mid-late Triassic age. It is the animals that again take centre stage, including the earliest known feathered dinosaurs. Here, instead of a single quarry the biota of a large region is illustrated. I would particularly have liked to see some reconstructions of the individual animals and plants as well as an ecosystem reconstruction. Again, I think that this

The next two Mesozoic examples are from China. The relatively unknown assemblage, at least in western literature, is the Yanliao biota of mid-late Triassic age. It is the animals that again take centre stage, including the earliest known feathered dinosaurs. Here, instead of a single quarry the biota of a large region is illustrated. I would particularly have liked to see some reconstructions of the individual animals and plants as well as an ecosystem reconstruction. Again, I think that this



was an opportunity missed. The discussion of the claim of early angiosperms (Fig 5A and 5B) is poor, considering their potential importance if this identification is correct. It is a pity that some of the information and reconstruction shown in Yang *et al.* (2019) was too late to be included in the chapter.

The early Cretaceous Jehol biota is much better known to those interested in the evolution and ecology of terrestrial ecosystems. The illustrations of the sites are especially welcome but maps and sections of the localities would have been preferable. It is not clear where the fossils in the illustrations are from, nor where they are now – this would have been really useful information. There has been much research on the identification of colour in feathers and insects yet this is not considered in any depth (see Zhang *et al.* 2010; McNamara *et al.* 2018; Wang *et al.* 2019). Useful papers are also missing from the reference list (*e.g.* Leng *et al.* 2003), and for example the stratigraphic figure of Zhou *et al.* (2003; their Fig 2) would have been useful. I am sure that this chapter will be one reason palaeontologists will want to buy the book, but more exciting illustrations could have been included.

The mid-Cretaceous Santana Formation is in some ways a strange choice as many of the animals illustrated are fishes. I wonder how this is considered a terrestrial Lagerstätte.

The Eocene Messel biota is the only Cenozoic Lagerstätte to be considered. It is written by one of the experts (Stephan Schaal) and attempts to include the diverse range of animals and plants that occur in the site. There is an excellent geological introduction and the taphonomy is well described. The biodiversity is covered well and I especially liked the images of the colour of the insect fossils. I would have liked much more on the recent work to explain the occurrence of colour in the fossils (*e.g.* McNamara *et al.* 2011; Vitek *et al.* 2013). Some of the pictures are unnecessarily large and I would have liked to see many more examples as this is an especially exciting deposit. Why no ecological reconstructions or indeed reconstructions of food webs? There is some exciting research on the bats and their role in the ecosystem and I was left a little disappointed as what would have been an exceptional chapter is just good.

Strangely out of stratigraphical sequence is the Cretaceous amber chapter. This is beautifully illustrated with emphasis on the insects preserved in the Burmese deposits in particular. The lack of geological maps, sections *etc.* is a regret. Much more could have been included in the new research on amber fossils, especially in the use of synchrotron radiation X-ray tomography and on the formation of amber as a whole (see for example Seyfullah *et al.* 2018). There has been some exciting research in this area and we only have one figure with CT imaging. Here again the plants are poorly represented. The study of plants in amber is one that has been progressing rapidly in recent years but is not represented in this volume.

Again I was left wondering why there was nothing on the Cenozoic Princeton Chert for example (see Archibald *et al.* 2012; Stockey 2000). A lack of detailed introduction or conclusion makes the choices made seem, at least in some cases, quite strange.

There is no conclusion chapter – nothing on the way ahead and new ways of studying the biotas. The index is good. Overall this is an interesting volume that I would hope all geological libraries would purchase but the price and shortcomings may make an individual purchase difficult to justify.

**Andrew C. Scott**

*Royal Holloway, University of London*



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# Books available to review

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

- *The Dinosaurs Rediscovered: How A Scientific Revolution Is Rewriting Their Story*, by Michael Benton.
- *Fossils Of The Milwaukee Formation: A Diverse Middle Devonian Biota From Wisconsin, USA*, by Kenneth C. Gass, Joanne Kluessendorf, Donald G. Mikulic and Carlton E. Brett.
- *Beyond Extinction: The Eternal Ocean. Climate Change & the Continuity of Life*, by Wolfgang Grulke.
- *Across the Bridge*, by Henry Gee.
- *Fossil Frogs and Toads of North America*, by J. Alan Holman.
- *Trilobites of the British Isles*, by Robert Kennedy and Sinclair Stammers.
- *Fossilien im Alpstein: Kreide und Eozän der Nordostschweiz*, by Peter Kürsteiner and Christian Klug.
- *William Smith's Fossils Reunited*, by Peter Wigley (editor) with Jill Darrell, Diana Clements and Hugh Torrens.
- *Extinction: A Very Short Introduction*, by Paul Wignall.
- *The Palaeoartist's Handbook: Recreating Prehistoric Animals in Art*, by Mark P. Witton.

## Dr Tom Challands

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







## Careers Q & A

### *Professional palaeontologists in the wider world*



After working as a post-doctoral research fellow in Palaeontology at the University of Bristol (2012–2016), Betty Schirrmeister now works as a senior data scientist at Royal Mail's Group Business Intelligence (2016 – present).

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**Q1: When you were a child, what did you want to be when you grew up?**

Originally, I dreamt of becoming the next Indiana Jones, but I shifted towards conservation biology working with apes during my final years at school. After I finished my MSc in biology in 2006 I even worked for five months on a research project about behaviour in chimpanzees at a field site in Uganda. Although this was an exceptional experience, I decided to move back to the computer and lab, working on my PhD in Evolutionary Genetics.

**Q2: How did you first get interested in palaeontology?**

I thought palaeontology interesting for a long time and subscribed to palaeontology courses during my undergraduate studies in biology. However, it was only following my PhD that I switched full time to palaeontology. In order to improve the dating of my molecular trees, I needed to understand the bacterial fossil record better – allowing me to determine for myself the validity of certain fossils or geological events.

**Q3: What is your favourite fossil and why?**

Stromatolites, e.g. in Shark Bay, Western Australia. Not only are stromatolites living fossils, but also present some of the earliest evidence of life on Earth.

**Q4: What made you pursue your current job?**

One of the things I enjoyed most as part of my research (aside from the fun conferences), was working with data, building models in order to find answers to exciting questions on the early evolution of life. In fact, I started to enjoy all the programming that comes with it and after my fellowship in Bristol ended, I had to make a decision whether to continue in academia or switch to something non-academic, such as data science. I have to admit that other factors that influenced my choice were, job security, better salary, being able to choose which city I wanted to work and live in and generally an improved work-life balance. Royal Mail as a company turned out to be a great employer, providing a fantastic work-life balance and the opportunity to work in a growing data science



team on some great challenges. However, I do miss my research from time to time!

**Q5: What are the main responsibilities of your job?**

I am leading and supporting several of Royal Mail's data science projects; this includes parcel time predictions, revenue and delivery forecasts, as well as network optimizations for our delivery routes. As a project lead I take care of communication and management of stakeholders (senior managers from the business with a specific interest in the project), timely delivery of solutions, starting with an "MVP" (a minimal viable product) and making sure end-to-end solutions work (getting the correct data, running the model pipeline, implementing the results in a dashboard or some other form of delivery accessible to the end-user).

**Q6: What gives you the most satisfaction in your job?**

The modelling and programming part of the job. Finding a new solution to a problem or overcoming a challenge is a very satisfying part of the job. We work mostly in Python or R and have a lot of paired – sometimes group – programming sessions, which are not only enjoyable, but are also great ways to improve coding skills and learn new ways of solving problems. Additionally, we are encouraged to always learn new techniques and improve our skillset, which, if not possible, I would have missed coming from academia.

**Q7: What are the worst things about your job?**

Being dragged into meetings where you are not really needed or of any help. Luckily, we established ways of working as a team, where we can push back meeting requests if we feel our input is not required. That has proven to be very helpful.

**Q8: What has been the best career advice you have received?**

Somebody recommended a "science to data science" bootcamp following my postdoc. While many bootcamps can be expensive and not lead anywhere, this one was not only a great price,

but also worked as a recruitment initiative. I worked on a project for Royal Mail and got a data science role with them afterwards. It definitely worked for me.

**Q9: What skills does it take to be successful in your job?**

These fall into two camps: non-technical skills and technical skills.

The non-technical aspects include, good problem-solving skills (finding a solution, even if it is not perfect), project management skills (being able to see a project through from end to end) and excellent communication skills (particularly being able to talk to business and non-technical people). The latter might have been acquired during an M.Sc., most certainly during a PhD. However, some people have these skills naturally and might have proven so in positions other than a degree (my personal recommendation).

The technical aspects include, knowledge of a coding language that you are comfortable with (focus on one at the beginning – in data science the two most used are Python and R), some mathematical or statistical knowledge, a general idea about techniques that can be applied in data science, and some example projects to present during an interview (in case you have no real business projects, it can be another data science project with a hypothetical link to a business context).

**Q10: Do you have any tips for students who would like to take a similar career path?**

Practise your coding skills (e.g. on coding sites like <https://exercism.io/>), <https://www.codewars.com/>), go to some data science meet-ups to build a network (e.g. <https://www.meetup.com/Bristol-Data-Scientists/>), <https://pydata.org/london2019/>), show some online presence (participate in Kaggle-competitions, <https://www.kaggle.com/competitions>), get a github account, <https://github.com/>, and fill it with some awesome projects that you can show off during an interview).



It is generally important that you enjoy coding and be happy to pursue some small projects in your free-time (there are plenty of ideas on Kaggle or Exercism). Don't be scared to get into coding. There are plenty of free online courses to get you started (e.g. <https://eu.udacity.com/course/introduction-to-python--ud1110>), <https://eu.udacity.com/course/data-analysis-with-r--ud651>).

**Q11: Are there any major obstacles to being successful in a career like yours?**

Finding the right company can be challenging, particularly when you are new to the field. Many companies claim they are using data science, but in the end you might find yourself simply doing visualisations and writing reports. Make sure there is an established data science team present in the company before you start. I wrote a blog related to this: <https://www.linkedin.com/pulse/hype-surrounding-data-science-how-avoid-hangover-betty-schirrmeister/>.

---

*Find out more about Betty through her personal website: <https://schirrmeister.wordpress.com/>, or LinkedIn: <https://www.linkedin.com/in/bettinaschirrmeister/> or GitHub: <https://github.com/BettyES>.*

---

**Q12: What's the best thing about your job?**

The variety of projects I am working on. Constantly discovering different solutions ensures that it never gets boring. It is also nice to see some of these projects being implemented and actually used (the project life cycle is much shorter than in academia). We have a great data science team at Royal Mail (most of us come from academia), so working on projects in teams can also be great fun.

**Q13: What are your future ambitions?**

Leading my own data science team. I got promoted to a senior role recently, so I am looking forward to getting a lot of experience in my new role. However, in the long run taking on more responsibilities within a business in regards to delivering data science would be fantastic.



## Palaeontology

VOLUME 62 • PART 3

### CONTENTS

#### Symposium

- REvoSim: organism-level simulation of macro and microevolution 339  
RUSSELL J. GARWOOD, ALAN R. T. SPENCER *and* MARK D. SUTTON  
<<https://doi.org/10.1111/pala.12420>>

#### Original Articles

- Phylogeny and evolutionary history of diplobathrid crinoids (Echinodermata) 357  
SELINA R. COLE  
<<https://doi.org/10.1111/pala.12401>>
- The early composition and evolution of the turtle shell (Reptilia, Testudinata) 375  
TOMASZ SZCZYGIELSKI *and* TOMASZ SULEJ  
<<https://doi.org/10.1111/pala.12403>>
- Phylogeny, ecology and deep time: 2D outline analysis of anuran skulls from the Early Cretaceous to the Recent 417  
CARLA BARDUA, SUSAN E. EVANS *and* ANJALI GOSWAMI  
<<https://doi.org/10.1111/pala.12405>>
- Skeletal microstructure of *Stenopterygius quadriscissus* (Reptilia, Ichthyosauria) from the Posidonienschiefer (Posidonia Shale, Lower Jurassic) of Germany 433  
KATHERINE L. ANDERSON, PATRICK S. DRUCKENMILLER, GREGORY M. ERICKSON *and* ERIN E. MAXWELL  
<<https://doi.org/10.1111/pala.12408>>
- First record of Mesozoic scroll coprolites: classification, characteristics, elemental composition and probable producers 451  
NIBEDITA RAKSHIT, MOHD SHAFI BHAT, DEBARATI MUKHERJEE *and* SANGHAMITRA RAY  
<<https://doi.org/10.1111/pala.12409>>
- Increases in sampling support the southern Gondwanan hypothesis for the origin of dinosaurs 473  
JÚ LIO C. A. MARSOLA, GABRIEL S. FERREIRA, MAX C. LANGER, DAVID J. BUTTON *and* RICHARD J. BUTLER  
<<https://doi.org/10.1111/pala.12411>>
- Ecological stasis in Spinicaudata (Crustacea, Branchiopoda)? Early Cretaceous clam shrimp of the Yixian Formation of north-east China occupied a broader realized ecological niche than extant members of the group 483  
MANJA HETHKE, FRANZ T. FÜRSICH, BAOYU JIANG, BO WANG, PATRICK CHELLOUCHE *and* STEPHEN C. WEEKS  
<<https://doi.org/10.1111/pala.12412>>



# Palaeontology

VOLUME 62 • PART 4

## CONTENTS

### Original Articles

- Homologous shell microstructures in Cambrian hyoliths and molluscs 515  
 LUOYANG LI, XINGLIANG ZHANG, CHRISTIAN B. SKOVSTED, HAO YUN, BING PAN *and* GUOXIANG LI  
 <<https://doi.org/10.1111/pala.12406>>
- A gravid fossil turtle from the Early Cretaceous reveals a different egg development strategy to that of extant marine turtles 533  
 EDWIN-ALBERTO CADENA, MARY L. PARRA-RUGE, JUAN DE D. PARRA-RUGE *and* SANTIAGO PADILLA-BERNAL  
 <<https://doi.org/10.1111/pala.12413>>
- The hatching mechanism of 130-million-year-old insects: an association of neonates, egg shells and egg bursters in Lebanese amber 547  
 RICARDO PÉREZ-DE LA FUENTE, MICHAEL S. ENGEL, DANY AZAR *and* ENRIQUE PEÑALVER  
 <<https://doi.org/10.1111/pala.12414>>
- Body size changes in bivalves of the family Limidae in the aftermath of the end-Triassic mass extinction: the Brobdingnag effect 561  
 JED W. ATKINSON, PAUL B. WIGNALL, JACOB D. MORTON *and* TRACY AZE  
 <<https://doi.org/10.1111/pala.12415>>
- Evidence for seasonal variation in  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  profiles of Baculites and implications for growth rate 583  
 NICHOLAS M. ELLIS *and* THOMAS S. TOBIN  
 <<https://doi.org/10.1111/pala.12416>>
- Coralline red algae from the Silurian of Gotland indicate that the order Corallinales (Corallinophycidae, Rhodophyta) is much older than previously thought 599  
 SEBASTIAN TEICHERT, WILLIAM WOELKERLING *and* AXEL MUNNECKE  
 <<https://doi.org/10.1111/pala.12418>>
- Spatiotemporal sampling patterns in the 230 million year fossil record of terrestrial crocodylomorphs and their impact on diversity 615  
 PHILIP D. MANNION, ALFIO ALESSANDRO CHIARENZA, PEDRO L. GODOY *and* YUNG NAM CHEAH  
 <<https://doi.org/10.1111/pala.12419>>
- Tooth microwear and occlusal modes of euharamiyidans from the Jurassic Yanliao Biota reveal mosaic tooth evolution in Mesozoic allotherian mammals 639  
 FANGYUAN MAO *and* JIN MENG  
 <<https://doi.org/10.1111/pala.12421>>
- Systematics and macroevolution of extant and fossil scalopine moles (Mammalia, Talpidae) 661  
 ACHIM H. SCHWERMANN, KAI HE, BENJAMIN J. PETERS, THORSTEN PLOGSCHTIES *and* GABRIELE SANSALONE  
 <<https://doi.org/10.1111/pala.12422>>
- Diversity patterns in upper Cambrian to Lower Ordovician trilobite communities of north-western Argentina 677  
 FERNANDA SERRA, DIEGO BALSEIRO *and* BEATRIZ G. WAISFELD  
 <<https://doi.org/10.1111/pala.12424>>
- Life-history strategies indicate live-bearing in Nothosaurus (Sauropterygia) 697  
 EVA M. GRIEBELER *and* NICOLE KLEIN  
 <<https://doi.org/10.1111/pala.12425>>



## Papers in Palaeontology

VOLUME 5 | PART 2

### CONTENTS

- A redescription of *Orovenator mayorum* (Sauropsida, Diapsida) using high-resolution  $\mu$ CT, and the consequences for early amniote phylogeny 197  
DAVID P. FORD *and* ROGER B. J. BENSON  
<<https://doi.org/10.1002/spp2.1236>>
- New armoured scalidophorans (Ecdysozoa, Cycloneuralia) from the Cambrian Fortunian Zhangjiagou Lagerstätte, South China 241  
YUNHUAN LIU, JIACHEN QIN, QI WANG, ANDREAS MAAS, BAICHUAN DUAN, YANAN ZHANG, HU ZHANG, TIEQUAN SHAO *and* HUAQIAO ZHANG  
<<https://doi.org/10.1002/spp2.1239>>
- Newly recognized Famennian lungfishes from East Greenland reveal tooth plate diversity and blur the Devonian–Carboniferous boundary 261  
JENNIFER A. CLACK, THOMAS J. CHALLANDS, TIMOTHY R. SMITHSON *and* KETURAH Z. SMITHSON  
<<https://doi.org/10.1002/spp2.1242>>
- The oldest members of Porcellioidea (Gastropoda): a new link between Baltica and Perunica 281  
JIRÍ FRÝDA, JAN OVE R. EBBESTAD *and* BARBORA FRÝDOVÁ  
<<https://doi.org/10.1002/spp2.1241>>
- Cambrian trilobites from the Huérmeda Formation (Iberian Chains, north-east Spain) and the inadequacy of the Marianian Stage 299  
J. JAVIER ÁLVARO, JORGE ESTEVE, FERNANDO GRACIA *and* SAMUEL ZAMORA  
<<https://doi.org/10.1002/spp2.1237>>
- First monodontid cetacean (Odontoceti, Delphinoidea) from the early Pliocene of the north-western Pacific Ocean 323  
HIROTO ICHISHIMA, HITOSHI FURUSAWA, MAKINO TACHIBANA *and* MASAICHI KIMURA  
<<https://doi.org/10.1002/spp2.1244>>
- A new actinopterygian from the Late Devonian Gogo Formation, Western Australia 343  
BRIAN CHOO, JING LU, SAM GILES, KATE TRINAJSTIC *and* JOHN A. LONG  
<<https://doi.org/10.1002/spp2.1243>>



## *Overseas Representatives*

- Argentina: DR M. O. MANCENÍDO, Division Paleozoología invertebrados, Facultad de Ciencias Naturales y Museo, Paseo del Bosque, 1900 La Plata, Argentina.
- Australia: DR RUDY LEROSEY-AUBRIL, School of Environmental & Rural Science, University of New England, Armidale NSW 2351, Australia.
- China: DR Z. ZHONGE, Institute of Vertebrate Palaeontology and Palaeoanthropology, Academia Sinica, P.O. Box 643, Beijing 100044.
- France: DR J. VANNIER, Centre des Sciences de la Terre, Université Claude Bernard Lyon 1, 43 Blvd du 11 Novembre 1918, 69622 Villeurbanne, France.
- Germany: PROFESSOR F. T. FÜRSICH, GeoZentrum Nordbayern, Fachgruppe Paläoumwelt, Universität Erlangen-Nürnberg, Loewenichstrasse 28, D-91054 Erlangen, Germany.
- New Zealand: DR R. A. COOPER, GNS Science, P.O. 30368, Lower Hutt, New Zealand.
- USA: PROFESSOR P. SELDEN, The Paleontological Institute, University of Kansas, Lawrence, Kansas, 66045, USA.  
PROFESSOR N. M. SAVAGE, Department of Geology, University of Oregon, Eugene, Oregon 97403, USA.  
PROFESSOR M. A. WILSON, Department of Geology, College of Wooster, Wooster, Ohio 44961, USA.

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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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