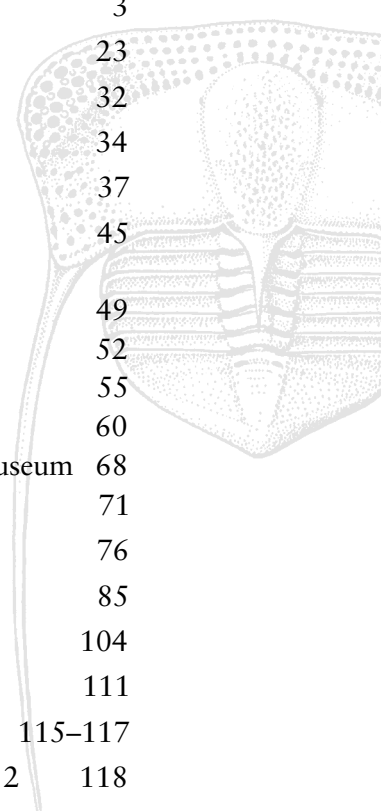


The Palaeontology Newsletter

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Reminder: The deadline for copy for Issue no. 99 is 8th October 2018.

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Editorial

The (boreal) summer issue of the Newsletter is traditionally the slimmest, but what it may lack in quantity it certainly makes up for elsewhere. **Uwe Balthasar** introduces the Association's new **Innovations in Palaeontology Lecture Series**, which will be delivered by the Palaeontological Association's Exceptional Lecturer (see his piece for application details). And Council has replaced the Golden Trilobite with the broader scope **Gertrude Elles Award for Public Engagement**, this year with a late September deadline.

Mark Bell's R column returns and pivots into new more specific territory with the first in a series focusing on manipulating and exploring phylogenetic data. **Jan Zalasiewicz's** piece touches on the fascinating story of Jeanne Villepreux-Power, widely considered the inventor of the aquarium. **Zoë Hughes** now helms the Future Meetings of Other Bodies section, which contains perhaps the first virtual palaeontology meeting, a sign of things to come? (NB: To add your own meeting please use the link on the Association's web page:

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

This issue also introduces a new feature – **A Palaeontologist Abroad** – which is intended to give some exposure to early career researchers who have swapped countries in pursuit of palaeontology. Hopefully this will highlight opportunities for others and give a sense of whether the emigration route is for you. Three researchers – **Briony Mamo**, **Liz Martin-Silverstone** and **Colin VanBuren** – give their perspectives on life in Hong Kong, the United Kingdom and Australia, respectively. This issue's Careers Q and A was conducted by **Laura Soul** and features the fascinating story of **Kay Behrensmeyer**. She shares a great career tip along the way: "My advice would be to have enough areas of expertise that you can go in different directions depending on the availability of jobs". Finally, for those looking for a more personal mentoring experience I would point you to **Caroline Buttler's** update on the Association's mentoring scheme, where applications to be mentees are now open.

Graeme Lloyd

Newsletter Editor

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Association Business

Annual Meeting 2018

Notification of the 62nd Annual General Meeting

This will be held at the University of Bristol, UK, on Saturday 15th December 2018, following the scientific sessions.

AGENDA

1. Apologies for absence
2. Minutes of the 61st AGM, Imperial College London
3. Trustees Annual Report for 2017
4. Accounts and Balance Sheet for 2017
5. Election of Council and vote of thanks to retiring members
6. Report on Council Awards
7. Annual Address

DRAFT AGM MINUTES 2017

Minutes of the Annual General Meeting held on Monday 18th December 2017 at Imperial College London, UK.

- 1. Apologies for absence.** None.
- 2. Minutes.** The minutes of the 2016 AGM were agreed a true record by unanimous vote.
- 3. Trustees Annual Report for 2016.** The report was agreed by unanimous vote of the meeting.
- 4. Accounts and Balance Sheet for 2016.** The accounts were agreed by unanimous vote of the meeting.
- 5. Discussion of membership fees.** Council proposed an increase in membership fees to rebalance the funding streams of the Association and to better secure the financial future of the Association. The proposed fees from 2019 are: Ordinary Membership fee £40 (up from £30), Retired/Student Membership fee £20 (up from £15). This proposal to raise fees was agreed by unanimous vote of the meeting.
- 6. Election of Council and vote of thanks to retiring members.**
 - 6.1 Prof. M.P. Smith extended a vote of thanks to the following members of Council who were retiring from their positions this year: Prof. E.J. Rayfield, Dr M. Ruta; Dr M.E. McNamara; Dr C.J. Buttler; Dr T.R.A. Vandenbroucke; Dr I.A. Rahman.
 - 6.2 The following members were elected to serve on Council: President: Prof. M.P. Smith; Vice-Presidents: Dr C.J. Buttler and Prof. R.J. Twitchett; Treasurer: Dr P. Winrow; Secretary: Dr



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

6.3 Dr J. Vinther and colleagues will organize the Annual Meeting in 2018 at the University of Bristol, UK.

7. Association Awards. The following awards were announced:

7.1 The Lapworth Medal was awarded to Prof. S. Bengtson (Naturhistoriska riksmuseet, Sweden).

7.2 The President's Medal was awarded to Prof. J.C. McElwain (Trinity College Dublin, Ireland).

7.3 The Hodson Award was presented to Dr S.L. Brusatte (University of Edinburgh, UK).

7.4 The Mary Anning award was presented to Mr M. Ben Moula (Taichoute, Morocco).

7.5 Research Grants were awarded to: Dr J. Lozano-Fernandez, University of Bristol, *A molecular palaeobiological approach to understand Onychophora terrestrialization: assessing the impact of fossils*; Dr B.J. Slater, University of Uppsala, *Opening a new window onto the Cambrian Explosion of animal life*; Dr E.F. Smith, Johns Hopkins University, *Pyritization of soft tissue at the Precambrian–Cambrian boundary in the southwest USA*.

7.6 Under the Small Grants Scheme, the following awards were announced: Sylvester-Bradley Awards to Mr J. Bestwick, University of Leicester, *Reconstructing diets of non-mammalian fossil taxa from the Solnhofen archipelago*; Mr T.H. Boag, Stanford University, *Investigating the role of oxygen and silica in deep-water first appearances of the Ediacara Biota*; Dr I.S. Fenton, Imperial College London and NHM, *Function, form and foraminifera: a community perspective on macroevolution*; Mr K. Melstrom, University of Utah, *The ecological response of crocodylomorphs to mass extinctions*; Mr M.F.G. Weinkauf, University of Geneva, *The influence of shell calcification rate on stable oxygen isotope composition in planktonic foraminifera*; the Whittington Award to Dr D.A. Legg, University of Manchester, *Patterns and processes in early arthropod evolution revealed by new animals from the Lower Cambrian of southwest China*; the Callomon Award to Mr A.P. Shillito, University of Cambridge, *Trace fossil insights into Early Devonian terrestrial ecosystems – a case study from Gaspé, Quebec*; and Stan Wood Awards to Ms N.M. Morales García, University of Bristol, *A biomechanical study on the feeding ecology of Mesozoic mammalian faunas of the United Kingdom and Portugal*; Mr J.P. Rio, Imperial College London, *The Evolutionary History of mekosuchine crocodylians from the Cenozoic of Australia*.

7.7 Undergraduate Research Bursaries were awarded to: Ms S. Chambi-Trowell, University of Bristol, supervised by Prof. P.J.C. Donoghue, *An enigmatic early diapsid from the Late Triassic of England*; Mr P.G. Choate, University of Manchester, supervised by Dr R. Sansom, *Meta-analysis of phylogenetic data*; Mr W. Deakin, University of Bristol, supervised by Prof. E.J. Rayfield, *Functional drivers of the evolution of beak shape in birds*; Ms A. Nadhira, Imperial College London, supervised by Dr M.D. Sutton, *Reconstruction and analysis of a 3-D Silurian fossil sponge*; Mr W. Richardson, University of Brighton, supervised by Dr S.C.R. Maidment, *Does a taxonomic identification bias affect diversity analyses on dinosaurs?*; Mr S. Walker, Edge Hill University, supervised by Dr B.A. MacGabhann, *Taxonomy and taphonomy of 'sparkly worm tubes' from the Tafelberg Lagerstätte*,



Ordovician, Morocco; Ms S. Wright, University of Oxford, supervised by Dr R.J. Benson, *Morphometric data from a new Paleocene dermochelyid may help clarify comparative rates of evolution in marine turtles*; and Ms K. Zarzyczny, University of Leeds, supervised by Dr A.M. Dunhill, *Reconstructing food webs across the Toarcian Ocean Anoxic Event*.

7.8 An Engagement Grant was awarded to Ms V. Wright, Making Faces Theatre, Bringing Evolution to Life.

7.9 The 2016 Best Paper Awards were presented to Dr L.C. Soul and Prof. M. Friedman for their paper entitled 'Bias in phylogenetic measurements of extinction and a case study of end-Permian tetrapods' (*Palaeontology*) and to Dr L. Leuzinger and colleagues for 'A new chondrichthyan fauna from the Late Jurassic of the Swiss Jura (Kimmeridgian) dominated by hybodonts, chimaeroids and guitarfishes' (*Papers in Palaeontology*).

7.10 The President's Prize was presented to Dr R.P. Anderson (University of Oxford) and Mr J. Bestwick (University of Leicester).

7.11 The Council Poster Prize was presented to Mr C. Nedza (University of Leicester).

8. Annual Address. The Annual Address entitled "101 uses for a dead fish. Experimental decay, exceptional preservation, and fossils of soft bodied organisms" was given by Prof. M.A. Purnell (University of Leicester).

Trustees Annual Report 2017

The Trustees present their report with the financial statements of the charity for the year ended 31 December 2017. 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 Objectives: The objects of the Association are to advance education for the public benefit in Palaeontology and its allied sciences by (a) promoting research and publishing the useful results thereof, (b) holding public meetings for the reading of original papers and the delivery of lectures, (c) extending knowledge of the science through demonstration and publication, (d) awarding grants and bursaries and (e) by such other means as the Council may determine. In order to meet these objectives, the Association continues to increase its range of and investment in public engagement 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 Grants-in-aid for meetings and workshops: The Association provided funds to support the following meetings and workshops: 'Mass Extinctions: Past, Present and Future, GSA 2017' (Dr D.P.G. Bond, University of Hull); '65th Symposium on Vertebrate Palaeontology & Comparative Anatomy' (Prof. R.J. Butler, University of Birmingham); '15th Larwood Bryozoan Conference' (Dr C.J. Buttler, National Museum Wales); 'Advances in palaeobiological modelling, EGU 2018' (Dr A.M. Dunhill, University of Leeds); 'The Old Red: Hugh Miller's Geological Legacy' (Mr M. Gostwick, The Friends of Hugh Miller); 'Second International Meeting of Early Stage Researchers in Palaeontology' (Dr G.



Iliopoulos, University of Patras); 'FORAMS2018' (Dr E. Lo Giudice Cappelli, University of St Andrews); 'Geochemical-Palaeobiological Interactions Throughout Earth History, EGU2018' (Dr J.J. Matthews, Memorial University of Newfoundland); 'International Workshop on Konservat-Lagerstätten' (Dr M.E. McNamara, University College Cork); '6th International Conference on Trilobites and their Relatives' (Dr H. Parnaste, Tallinn University of Technology); '26th International Workshop on Plant Taphonomy' (Dr L.J. Seyfullah, University of Göttingen); 'The Early Tetrapod World: laying the foundations of the modern vertebrate fauna' (Dr T.R. Smithson, University of Cambridge); 'Evolution in the dark: unifying our understanding of eye loss' (Dr L.H. Sumner-Rooney, Museum für Naturkunde, Berlin); 'VIIIth Workshop on Non-Pollen Palynomorphs' (Dr E.N. van Asperen, Durham University); 'Advances in Computational Paleobiology, GSA 2017' (Dr R.C.M. Warnock, ETH Zurich).

1.3 Public meetings: Three public meetings were held in 2017, and the Association extends its thanks to the organizers and host institutions of these meetings.

61st Annual Meeting. The Association's Annual Meeting is its flagship meeting and this year was held on 17–19 December at Imperial College London. Dr M.D. Sutton, Dr P.D. Mannion and Dr A.R.T. Spencer, together with local support from colleagues and PhD students, organized the meeting, which included a symposium on 'Evolutionary modelling in palaeontology' and comprised a programme of internationally-recognized speakers. There were 326 attendees. The Annual Address was entitled '101 uses for a dead fish. Experimental decay, exceptional preservation, and fossils of soft bodied organisms' and was given by Prof. M.A. Purnell (University of Leicester). The President's Prize for best oral presentation by an early career researcher was awarded jointly to Dr R.P. Anderson (University of Oxford) and Mr J. Bestwick (University of Leicester). The Council Poster Prize for best poster presentation by an early career researcher was presented to Mr C. Nedza (University of Leicester).

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 2017 meeting was organized by Mr J. Bestwick and a team of other students, and was held at the University of Leicester on 1–3 June. There were 99 attendees, of which eight were non-UK based (8%).

British Science Festival. This is an annual forum for presentations to the public and general scientists. The Association sponsored its 2016 President's Prize winner, Dr J.N. Keating (University of Manchester), to give a public talk on 'Your 500 million year Family Tree' at the 2017 Festival in Brighton, which drew a large audience.

1.4 Publications: The journals *Palaeontology* and *Papers in Palaeontology* are produced by Wiley. During 2017, the following volumes were published: *Palaeontology* volume 60, comprising six issues; and *Papers in Palaeontology* volume 3, comprising four issues. Council thanks Mr N. Stroud for assistance with the typesetting and production of the *Palaeontology Newsletter*.

1.5 Research Grants: A total of 15 applications for Palaeontological Association Research Grants were received. Three were recommended for funding in 2017, totalling £18,733, and were awarded to: Dr J. Lozano-Fernandez, University of Bristol, 'A molecular palaeobiological approach to understand Onychophora terrestrialization'; Dr B.J. Slater, University of Uppsala, 'Opening a new window onto the Cambrian Explosion of animal life: assessing the impact of fossils'; and Dr E.F. Smith, Smithsonian Institution, 'Ediacaran pyritized fossils from the USA'.



1.6 Small Grants Scheme: The scheme received 34 applications. Eight were recommended for funding in 2017, totalling £11,957.50. Small grants were awarded as follows: Dr D.A. Legg (University of Manchester) received the Whittington Award; Mr A.P. Shillito (University of Cambridge) received the Callomon Award; Ms N.M. Morales García (University of Bristol) and Mr J.P. Rio (Imperial College London) received Stan Wood awards; Mr J. Bestwick (University of Leicester), Mr T.H. Boag (Stanford University), Mr K.M. Melstrom (University of Utah) and Mr M.F.G. Weinkauff (University of Geneva) received Sylvester-Bradley awards.

1.7 Undergraduate Research Bursary Scheme: The scheme attracted ten applications. Eight were recommended for funding in 2017, totalling £15,750, as follows: Ms S. Chambi-Trowell, University of Bristol, supervised by Prof. P.J.C. Donoghue; Mr P.G. Choate, University of Manchester, supervised by Dr R. Sansom; Mr W. Deakin, University of Bristol, supervised by Prof. E.J. Rayfield; Ms A. Nadhira, Imperial College London, supervised by Dr M.D. Sutton; Mr W. Richardson, University of Brighton, supervised by Dr S.C.R. Maidment; Mr S. Walker, Edge Hill University, supervised by Dr B.A. MacGabhann; Ms S. Wright, University of Oxford, supervised by Prof. R.J. Benson; and Ms K. Zarzyczny, University of Leeds, supervised by Dr A.M. Dunhill. In 2017 the Association decided that bursary students will receive an increased weekly allowance benchmarked using UK government guidelines for the National Living Wage.

1.8 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 Scarborough in 2017). 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 (currently £30,000 per annum), supporting recurring festival activities, engagement grants and commissioned projects.

1.9 Engagement Grants: The scheme received a total of four applications in 2017. One was recommended for funding, totalling £4,810, and was awarded to Ms V. Wright of Making Faces Theatre for the project 'Bringing Evolution to Life'.

1.10 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), palaeontological networking sites (European Coalfield Conservation Opportunities), and online outreach projects (*Palaeontology [Online]*). The listserv PaleoNet also migrated to the Association server in early 2017. The Association Twitter account, @ThePalAss, had 4,122 followers at the end of 2017, an increase of 1,018 on the number at the end of 2016. In order to increase redundancy and reduce costs, in late 2017 the Association website and server hosting service was moved to the AWS cloud.

1.11 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. Stefan Bengtson



(Naturhistoriska riksmuseet). 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. Jennifer C. McElwain (Trinity College Dublin). 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 Stephen L. Brusatte (University of Edinburgh). The Mary Anning award, for an outstanding contribution by an amateur palaeontologist, was made to Mr Mohamed 'Ou Said' Ben Moula (Taichoute, Morocco). The 2017 Best Paper Awards in *Palaeontology* and *Papers in Palaeontology* were made respectively to Dr Laura C. Soul and Prof. M. Friedman for their paper entitled 'Bias in phylogenetic measurements of extinction and a case study of end-Permian tetrapods', **60(2)**, 169–185; and Ms Léa Leuzinger and colleagues for their study on 'A new chondrichthyan fauna from the Late Jurassic of the Swiss Jura (Kimmeridgian) dominated by hybodonts, chimaeroids and guitarfishes', **3(4)**, 471–511. Council also awards undergraduate prizes to outstanding students in university departments where palaeontology is taught beyond Level 1; a total of 20 were awarded throughout the year.

1.12 Forthcoming plans: The Association will continue to make substantial donations from General and Designated funds to promote the charitable aims of the Association. The Executive Officer and Treasurer are to undertake a further review of the financial position and future budgets during 2018. In 2018 the Association will develop a more formal risk register to mitigate against foreseen and unforeseen events, such as financial fluctuations and Council succession planning. Resources will be made available to continue a similar programme of grants, meetings, outreach and public engagement activities. At the 2017 AGM the membership agreed with the Council's proposal to increase the membership fees in order to help rebalance the funding streams of the Association. The fees from 2019 will be: Ordinary Membership fee £40 (up from £30), Student Membership fee £20 (up from £15). The Association has allocated £15,000 for student travel grants to assist those presenting at the 5th International Palaeontological Congress in Paris in July 2018. In 2017 Council approved £18,000 to fund a diversity study of the Association. A tender process was initiated and contractors Parigen Ltd. were engaged to survey members and other palaeontologists and to produce a report for the Association, which will be presented to Council in 2018 at its May meeting. Recommendations from this report will be considered for action and implemented as necessary. The 62nd Annual Meeting will be held in December 2018 at the University of Bristol. The 2018 Progressive Palaeontology conference will be jointly held at the University of Manchester and Manchester Metropolitan University. Volume 61 of *Palaeontology* and volume 4 of *Papers in Palaeontology* will be published. Two additions to the *Field Guide to Fossils* series are in production and expected to be published in 2018. In 2017 the Public Engagement Group approached artist Mr James McKay to produce a book, *The History of Life*, for the Association, which is intended for sale at Association events and for other outreach, with publication expected in early 2019. In 2017 the remit of the Golden Trilobite Award was reconsidered, and it was agreed to expand the scope of the award. It will be renamed the Gertrude Elles Award for Public Engagement and is intended to promote high-quality public engagement in the field of palaeontology. Nominations for the first award under the new scheme will be sought in 2018. Development of the Association's new website launched at the 2015 Annual Meeting has continued throughout 2016 and 2017, with some final changes expected in 2018.



1.13 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 in setting the grant-making policy for the year.

2. ACHIEVEMENTS AND PERFORMANCE

2.1 Meetings support: During 2017, the Association agreed to support a total of 15 palaeontological meetings, symposia or workshops worldwide (in Austria, Estonia, Greece, Ireland, UK and USA). In addition, our Postgraduate Travel Grant scheme supported ten postgraduate students to present their work at national and international conferences: Mr J.A. Herrera-Flores (University of Bristol), Ms F.M. Holwerda (LMU Munich), Ms E.G. Martin-Silverstone (University of Southampton), Ms A. Penny (University of Edinburgh), Ms R. Pointer (University of Exeter), Ms A.C. Pugh (University of Leeds), Mr T.J. Raven (Imperial College London), Ms L. Sewell (Bournemouth University), Mr B.O. Shirley (FAU Erlangen-Nuremberg) and Mr H. Zhang (University of Bristol). The Association's support enabled the worldwide dissemination of research to the benefit of the global palaeontological community.

2.2 Unconscious bias: In 2017 the Association produced a guidance document regarding unconscious bias to be circulated to each committee of Trustees for consideration prior to assessing grant applications.

2.3 Publications: During 2017, 213 papers were submitted to either *Palaeontology* or *Papers in Palaeontology*. Of these, 163 (77%) were considered to be within scope by the Editorial Board and 107 (50%) were subsequently accepted following peer review; a further 19 papers are still awaiting submission of a revised manuscript before a final decision is made. This represents an upward trend in submissions and is accompanied by an improvement in the Impact Factor of *Palaeontology*, which increased from 2.312 to 3.132. The Impact Factor of *Papers in Palaeontology* is now 2.412. Downloads of articles via Wiley Online Library were 23% higher in 2017 relative to 2016 for *Palaeontology* and 68% higher for *Papers in Palaeontology*. The average time from acceptance to publication was 41 days for papers published in volume 60 of *Palaeontology* and 49 days for those in volume 3 of *Papers in Palaeontology* which tends to include longer papers (some papers in both volumes were published online in 2016). The Association continues to sponsor a rising number of Dryad data records; in the 2017 volumes, 51 papers had associated data files, representing 60% of all papers published. This is a significant increase from 51% in 2016. The Association produced a booklet to celebrate the 60th anniversary year, entitled 'Looking Back in Time', containing recollections and reminiscences from some of the Association's founding and honorary life members.

2.4 Support for research: In 2017 the Association agreed to fund the research activities of 19 early career researchers based in four countries (Sweden, Switzerland, UK and USA). Apart from directly benefiting the career development of the individuals concerned, the Association's funds continue to enable more palaeontological research to be undertaken worldwide than would otherwise have been the case. Overall, the number of grants funded in 2017 was broadly similar to 2016 (from 20 to 19). Compared to 2016, applications for Research Grants increased from ten to 15, and thus the success rate decreased from 33% to 20%. The applications to the Small Grants Scheme increased



again (from 22 to 34), and the success rate consequently dropped from 36% to 24%. Applications to the Undergraduate Research Bursary Scheme decreased slightly in 2017 compared to 2016 (from 13 to 10) and the success rate increased to 80%.

2.5 Mentoring scheme for early career palaeontologists: In 2017 the Association devised a mentoring scheme for early career palaeontologists, with particular focus on palaeontologists at post-doctoral level in the first instance. A call for potential mentors was made in the *Newsletter* and on social media, and a number of offers were received. This will be taken forward in 2018 and guidelines for mentors and mentees will be developed.

2.6 Outreach, education and public engagement: During 2017, the Association supported the two major UK fossil festivals, in Lyme Regis and Scarborough, which attracted respectively an estimated 9,000 and 5,000 members of the general public of all ages. A dedicated event for secondary school students was associated with the Lyme Regis Fossil Festival, and workshops were also delivered to over 400 primary school children across the two festivals. During 2017, an Engagement Grant was awarded to fund a project led by Ms V. Wright that should reach a wide audience. Continued use of social media, in particular the Association's Twitter account and Facebook group, has enabled the rapid and regular dissemination of research news including new publications, meetings and other information, to a growing audience. We now have more than 4,100 Twitter followers and over 1,500 Facebook group members.

3. FINANCIAL REVIEW

3.1 Reserves: As of 31st December 2017, The Association holds reserves of £776,624 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 research grants and grants-in-aid to be awarded. 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 £141,018 in Designated Funds, which contributes interest towards the funding of the Sylvester-Bradley, Hodson, Callomon, Whittington and Stan Wood awards and towards the Jones-Fenleigh fund. Funds carried forward to 2018 totalled £917,642.

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 2017, was £393,360. Governance costs were £23,093. Total resources expended were £448,617. 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 organisation (CIO) under the Charities Act 2011. All contracts and assets were transferred to the new organisation 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 new legal status means that there is a new registration number (1168330) and a new constitution. 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. In 2017 Dr F.L. Gill was co-opted on to the Council but is not a Trustee.

4.3 Membership: Membership on 31st December 2017 totalled 1,173 (1,128 at end 2016). Of these, 630 were Ordinary Members, 188 Retired Members, 20 Honorary Members, 307 Student Members and 28 Institutional Members. There were 41 institutional subscribers to *Papers in Palaeontology*. Wiley also separately manages further Institutional subscribers and arranges online access to publications for those Institutional Members on behalf of the Association.

4.4 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 drawn up in 2016 to minimise risk has been signed by most parties during 2017. The final outstanding agreements will be signed in early 2018. There are a small number of risks around the Association's transition to the AWS cloud, although the Trustees believe that appropriate arrangements have been made to enable a smooth transition.



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 Registered office: The contact address of the Association is The Palaeontological Association, Ainsley House, 12 Waddington Street, Durham, DH1 4BG, UK.

5.3 Trustees: The following members were elected at the AGM on 15th December 2016 to serve as Trustees in 2017:

Prof. M.P. Smith	President
Prof. E.J. Rayfield	Vice President
Prof. R.J. Twitchett	Vice President
Dr P. Winrow	Treasurer
Dr C.T.S. Little	Secretary
Dr A.B. Smith	Editor-in-Chief
Dr M. Ruta	Editor Trustee
Dr A.R.T. Spencer	Internet Officer
Dr M.E. McNamara	Newsletter Editor
Dr T.J. Challands	Book Review Editor
Dr L.G. Herringshaw	Publicity Officer
Dr C.J. Buttler	Education Officer
Dr L.M.E. McCobb	Outreach Officer
Dr T.R.A. Vandenbroucke	Meetings Coordinator
Prof. A.S. Gale	Ordinary Member
Dr A.M. Dunhill	Ordinary Member
Dr D.P.G. Bond	Ordinary Member
Dr I.A. Rahman	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 29th June 2018.



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

I report on the accounts for the year ended 31 December 2017 set out on pages 9 to 14.

Respective responsibilities of Trustees and Examiner

The charity's Trustees are responsible for the preparation of the accounts. The charity's Trustees consider that an audit is not required for this year (under Section 144(2) of the Charities Act 2011 (the 2011 Act)) and that an independent examination is required. The charity's gross income exceeded £250,000 and I am qualified to undertake the examination by being a qualified member of ACA ACMA.

It is my responsibility:

- to examine the accounts under Section 145 of the 2011 Act;
- to follow the procedures laid down in the General Directions given by the Charity Commission (under Section 145(5)(b) of the 2011 Act); and
- to state whether particular matters have come to my attention.

Basis of the independent examiner's report

My examination was carried out in accordance with the General Directions given by the Charity Commission. An examination includes a review of the accounting records kept by the charity and a comparison of the accounts presented with those records. It also includes consideration of any unusual items or disclosures in the accounts, and seeking explanations from you as Trustees concerning any such matters. The procedures undertaken do not provide all the evidence that would be required in an audit, and consequently no opinion is given as to whether the accounts present a 'true and fair view' and the report is limited to those matters set out in the statements below.

Independent examiner's statement

In connection with my examination, no matter has come to my attention:

- (1) which gives me reasonable cause to believe that, in any material respect, the requirements
- to keep accounting records in accordance with Section 130 of the 2011 Act; and
 - to prepare accounts which accord with the accounting records and to comply with the accounting requirements of the 2011 Act

have not been met; or

- (2) to which, in my opinion, attention should be drawn 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 2018



THE PALAEOLOGICAL ASSOCIATION

**Statement of Financial Activities
for the Year Ended 31 December 2017**

	Notes	Unrestricted funds £	Designated funds £	31.12.17 Total funds (relating to new CIO) £	31.12.16 Total funds (relating to previous charity) £
INCOME AND ENDOWMENTS FROM					
Donations and legacies		50,900	5,428	56,328	59,811
Charitable activities					
Public Meetings		37,314	—	37,314	40,081
Publications		322,556	—	322,556	287,947
Investment income	2	<u>11,961</u>	<u>2,017</u>	<u>13,978</u>	<u>13,978</u>
Total		422,731	7,445	430,176	401,799
EXPENDITURE ON					
Raising funds	3	32,164	—	32,164	41,852
Charitable activities					
Public Meetings		168,056	—	168,056	84,705
Grants & Awards		46,440	13,686	60,126	82,398
Administration		44,603	—	44,603	70,192
Publications		120,575	—	120,575	184,737
Governance Costs		<u>23,093</u>	<u>—</u>	<u>23,093</u>	<u>16,584</u>
Total		434,931	13,686	448,617	480,468
Net gains/(losses) on investments		<u>60,340</u>	<u>—</u>	<u>60,340</u>	<u>74,439</u>
NET INCOME/(EXPENDITURE)		48,140	(6,241)	41,899	(4,230)
RECONCILIATION OF FUNDS					
Total funds brought forward		<u>728,484</u>	<u>147,259</u>	<u>875,743</u>	<u>879,973</u>
TOTAL FUNDS CARRIED FORWARD		<u>776,624</u>	<u>141,018</u>	<u>917,642</u>	<u>875,743</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 2017

		Unrestricted funds	Designated funds	31.12.17 Total funds (relating to new CIO)	31.12.16 Total funds (relating to previous charity)
	Notes	£	£	£	£
FIXED ASSETS					
Investments		627,665	33,896	661,561	656,325
CURRENT ASSETS					
Debtors	6	183,856	1,983	185,839	159,826
Cash at bank		<u>—</u>	<u>105,139</u>	<u>105,139</u>	<u>121,255</u>
		183,856	107,122	290,978	281,081
CREDITORS					
Amounts falling due within one year	7	<u>(34,897)</u>	<u>—</u>	<u>(34,897)</u>	<u>(61,663)</u>
NET CURRENT ASSETS		<u>148,959</u>	<u>107,122</u>	<u>256,081</u>	<u>219,418</u>
TOTAL ASSETS LESS CURRENT LIABILITIES		<u>776,624</u>	<u>141,018</u>	<u>917,642</u>	<u>875,743</u>
NET ASSETS		<u>776,624</u>	<u>141,018</u>	<u>917,642</u>	<u>875,743</u>
FUNDS	8				
Unrestricted funds				<u>917,642</u>	<u>875,743</u>
TOTAL FUNDS				<u>917,642</u>	<u>875,743</u>

The notes form part of these financial statements.

The financial statements were approved by the Board of Trustees on 29th June 2018.



THE PALAEOLOGICAL ASSOCIATION

Notes to the Financial Statements for the Year Ended 31 December 2017

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 sales of scientific publications, and subscriptions from individuals and institutions which relate to the period under review.

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 asset investments

Investments are initially recognised 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 2017

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.

2. INVESTMENT INCOME

	Post-CIO 31.12.17 £	Pre-CIO 31.12.16 £
Deposit account interest	34	3,684
Investment Income	<u>13,944</u>	<u>10,276</u>
	<u>13,978</u>	<u>13,960</u>

3. RAISING FUNDS

	Post-CIO 31.12.17 £	Pre-CIO 31.12.16 £
Voluntary Income Costs: Administration	28,384	38,116
Investment Management Costs: Stockbroker Fees	<u>3,780</u>	<u>3,736</u>
	<u>32,164</u>	<u>41,852</u>

4. TRUSTEES' REMUNERATION AND BENEFITS

There were no Trustees' remuneration or other benefits for the year ended 31 December 2017 nor for the year ended 31 December 2016 for the previous organisation.

Trustees' expenses

The total travelling expenses reimbursed to 18 Members of Council (2016, pre-CIO: 19) was £14,983 (2016, pre-CIO: £15,989).



THE PALAEOLOGICAL ASSOCIATION

Notes to the Financial Statements – *continued* for the Year Ended 31 December 2017

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

	£ 2017	£ 2016 (pre-CIO)
Salaries	80,032	80,338
Social Security Costs	5,094	5,567
Pension Costs	<u>7,494</u>	<u>12,288</u>
Total	<u><u>92,620</u></u>	<u><u>98,193</u></u>

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

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

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

6. DEBTORS: AMOUNTS FALLING DUE WITHIN ONE YEAR

	Post-CIO £ 2017	Pre-CIO £ 2016
Sundry Debtors	<u>185,839</u>	<u>159,826</u>

7. CREDITORS: AMOUNTS FALLING DUE WITHIN ONE YEAR

	Post-CIO 31.12.17 £	Pre-CIO 31.12.16 £
Trade creditors	18,713	43,325
Subscriptions in advance	<u>16,184</u>	<u>18,338</u>
	<u><u>34,897</u></u>	<u><u>61,663</u></u>

8. MOVEMENT IN FUNDS

	Balance transferred from previous charity £	Net movement in funds £	At 31.12.17 £
Unrestricted funds			
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>
TOTAL FUNDS	<u><u>875,743</u></u>	<u><u>41,899</u></u>	<u><u>917,642</u></u>



THE PALAEOLOGICAL ASSOCIATION

Notes to the Financial Statements – *continued* for the Year Ended 31 December 2017

8. MOVEMENT IN FUNDS – continued

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

	Incoming resources £	Resources expended £	Gains and losses £	Movement in funds £
Unrestricted funds				
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>
TOTAL FUNDS	<u>430,176</u>	<u>(448,617)</u>	<u>60,340</u>	<u>41,899</u>

9. RELATED PARTY DISCLOSURES

There were no related party transactions for the year ended 31 December 2017.

10. 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 2017 (Post-CIO)	31st December 2016 (Pre-CIO)
Realised Gain/(Loss)	£4,605	£9,577
Unrealised Gain/(Loss)	<u>£55,735</u>	<u>£64,862</u>
Total per Statement of Financial Activities	<u>£60,340</u>	<u>£74,439</u>

11. INVESTMENT PORTFOLIO 2017

See pages 16–17.

12. COMMENCEMENT OF CIO

This is our first year of trading as a Charitable Incorporated Organisation – there is no previous history for the new legal entity. For clarity and transparency we have therefore shown comparison figures for the last year of trading as an unincorporated association.

**Palaeontological Association year ended 31st December 2017.**

Nominal	Holding	Cost (bought pre 2017) £	Value end 2016 £
£20,000	UK 4.5% Gilt 07/03/19 GBP 0.01	20,092.99	22,235.00
£18,000	UK 4.75% Stock 07/03/20 GBP 100	18,145.87	20,874.00
£49,685.81	COIF Charities Fixed Interest Fund	65,807.52	69,033.46
£14,490.65	COIF Charities Fixed Interest Fund	19,192.48	20,133.31
1,425	BP Ord 25c shares	5,047.35	7,262.00
600	Royal Dutch Shell B shares	4,422.42	14,124.00
600	BHP Billiton \$0.5 shares	4,341.48	7,839.00
437	IMI Ord 25p shares	4,267.00	4,545.00
180	CRH ord EUR 0.32	4,426.82	5,094.00
1,100	Smith(DS) ord GBP 0.10	4,569.69	4,489.00
500	Halma ord GBP 0.10	5,232.04	4,488.00
420	Experian Ord 10C	3,444.95	6,611.00
300	Diageo Ord GBP 0.28	5,826.00	6,330.00
200	Persimmon Ord 10p	2,258.00	3,552.00
70	Reckitt Benckiser Group ord GBP 0.10	5,325.75	4,820.00
300	Unilever PLC Ord GBP 0.031111	4,326.21	9,878.00
170	Astrazeneca Ord 25c	8,145.00	7,544.00
450	Glaxo Smithkline Ordinary 25p shares	7,083.98	7,029.00
300	Relx Olc GBP 0.1444	4,438.20	4,347.00
175	Carnival Plc Ord USD 1.66	3,996.49	7,219.00
1,000	BT Group Ordinary 5p shares	3,446.05	3,669.00
2,277	Vodafone Group Ord USD 0.11428571	3,434.00	4,551.00
641	National Grid Ord GBP 0.12431289	3,648.26	6,661.00
2,250	Barclays 25p Ord shares	4,867.00	5,028.00
1,465	HSBC Holdings Ordinary 0.5 US Dollar shares	4,534.00	9,624.00
1,140	Great Portland Estates Ord	8,503.00	8,022.00
600	Mercantile Investment Tst Plc ord GBP 025	10,171.60	10,284.00
4250	Fidelity EUR Value Ordinary 25P shares	4,059.07	7,799.00
650	RIT Capital Partners Ordinary £1 shares	4,903.90	12,253.00
425	Findlay Park Partners US Smaller Companies	6,158.47	30,272.00
2,825	Ishares S&P 500 GBP	20,319.63	51,472.00
700	Eastspring Investments Japan Dynamic Rg GBP Cap	7,837.74	9,076.08
500	Eastspring Investments Japan Dynamic Rg GBP Cap	5,598.38	6,482.92
30	Roche Hldgs Ag Genusscheine Nvp	3,335.33	5,551.00
9,000	Baillie Gifford & Co Japanese Income Growth Y Net		
6,600	Fund Partners Ltd Crux European Spl Situation	7,140.00	12,996.00
26	Veritas Asset Mgmt Veritas Asian A GBP	8,182.27	12,434.00
900	JPMorgan Am UK Ltd Emerging Markets I Instl	5,043.10	6,344.00
4,443	Aberdeen Investment Property Trust B	4,681.00	5,092.00
800	BH Global Ltd ord GBP	10,226.25	10,440.00
4,400	Invesco Fund Managers Targeted Y Acc	9,770.33	9,789.00
25	Marshall Wace Ucit Funds Plc GBP Acc	4,849.70	4,780.00
9,000	Charities Property Fund Income	11,043.28	10,713.00
1,021.54	COIF Charities Investment Fund Acc Units	59,678.69	139,684.15
262.26	COIF Charities Investment Fund Acc Units	15,321.31	35,861.12
	Total	427,142.60	656,325.04



Schedule of Investments (Note 11 to the Accounts)

Proceeds (sold in 2017) £	Cost (bought in 2017) £	Gain realised during 2017 £	Value end 2017 £	Gain unrealised during 2017 £
			21,244.00	-991.00
			19,955.00	-919.00
			68,839.69	-193.77
20,000.00		-133.31		
			7,448.00	186.00
			15,051.00	927.00
			9,135.00	1,296.00
			5,825.00	1,280.00
			4,783.00	-311.00
			5,693.00	1,204.00
			6,300.00	1,812.00
			6,871.00	260.00
			8,175.00	1,845.00
			5,476.00	1,924.00
			4,843.00	23.00
			12,377.00	2,499.00
			8,706.00	1,162.00
			5,951.00	-1,078.00
			5,217.00	870.00
			8,561.00	1,342.00
			2,717.00	-952.00
			5,351.00	800.00
			5,609.00	-1,052.00
			4,570.00	-458.00
			11,235.00	1,611.00
			7,849.00	-173.00
			13,074.00	2,790.00
			9,635.00	1,836.00
			12,753.00	500.00
			33,975.00	3,703.00
			56,094.00	4,622.00
			10,265.00	1,188.92
7,081.98		599.06		
			5,620.00	69.00
	11,977.02		12,042.00	64.98
			15,358.00	2,362.00
			16,977.00	4,543.00
			8,240.00	1,896.00
			5,296.00	204.00
			10,912.00	472.00
			9,914.00	125.00
			5,141.00	361.00
			11,393.00	680.00
			157,089.46	17,405.31
40,000.00		4,138.88		
67,081.98	11,977.02	4,604.63	661,560.15	55,735.44



Detailed Statement of Financial Activities for the Year Ended 31 December 2017

	31.12.17 (Post-CIO) Unrestricted funds £	31.12.16 (Pre-CIO) Unrestricted funds £
INCOME AND ENDOWMENTS		
Donations and legacies		
Donations	5,732	17,360
Subscriptions	<u>50,596</u>	<u>42,451</u>
	56,328	59,811
Investment income		
Deposit account interest	34	3,684
Investment Income	<u>13,944</u>	<u>10,276</u>
	13,978	13,960
Charitable activities		
Scientific Journals	318,416	281,466
Special Papers	698	1,368
Newsletter	87	405
Field Guides	2,872	4,211
Distribution	483	497
Scientific Meetings	<u>37,314</u>	<u>40,081</u>
	<u>359,870</u>	<u>328,028</u>
Total incoming resources	<u>430,176</u>	<u>401,799</u>
EXPENDITURE		
Raising donations and legacies		
Administration	28,384	38,116
Investment management costs		
Stockbroker Fees	3,780	3,736
Charitable activities		
Scientific Journals	70,627	60,144
Newsletters	19,479	16,475
Marketing	1,193	2,750
Publication Costs	85,222	73,409
Editorial Costs	34,160	31,959
Public Meetings & Costs	77,950	84,705
Grants & Awards	41,393	60,916
Research Grants	18,733	21,482
Administration	<u>44,603</u>	<u>59,897</u>
	<u>393,360</u>	<u>411,737</u>
Support costs		
Governance costs		
Trustees' expenses	14,983	15,989
Accountancy and legal fees	595	595
Administration	<u>7,515</u>	<u>10,295</u>
	<u>23,093</u>	<u>26,879</u>
Total resources expended	<u>448,617</u>	<u>480,468</u>
Net (expenditure)/income before gains and losses	(18,441)	(78,669)
Realised recognised gains and losses		
Realised gains/(losses) on fixed asset investments	60,340	74,439
Net (expenditure)/income	<u>41,899</u>	<u>(4,230)</u>

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



Nominations For Council

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

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

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

All potential Council Members are asked to consider the following:

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

Further information on the responsibilities of Trustees can be obtained by e-mailing <secretary@palass.org>.

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

Nominations are as follows:

- Vice-President: Prof. T.R.A. Vandenbroucke*
- Editor Trustee: Prof. M.A. Purnell*

* denotes Council nominations

Council vacancies: 'job descriptions'

Vice-President (two-year term)

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

Editor-in-Chief (five-year term)

Primary roles

- Oversee the production of the Association's publications and provide vision and leadership for their future development; act as line manager for the Publications Officer and set priorities and goals for the journals.



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

Secondary roles

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

Editor Trustee (three-year term)

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

Publicity Officer (three-year term)

Together the Publicity Officer, Outreach Officer and Education Officer comprise the Public Engagement Group (PEG). These posts have responsibility for all the Palaeontological Association outreach activities. Currently they include organizing the Association's presence at Lyme Regis Fossil Festival and the Yorkshire Fossil Festival, co-ordinating the Engagement Grants, answering relevant inquiries, and initiating other activities that promote and develop palaeontological outreach and education for the Association. The members of PEG work closely together and their roles often overlap; responsibilities particularly associated with the Publicity Officer post include leading the Association's publicity and promotion via social media and other outlets.



Awards and Prizes

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

Lapworth Medal

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



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

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

The Lapworth Medal is presented at the Annual Meeting.

President's Medal

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



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

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

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



Hodson Award

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

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

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

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

Mary Anning Award

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

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

Nominations should be attached in MS Word or PDF format, ideally as a single document, and should include the full contact details of the candidate. Nominations should be sent to <secretary@palass.org> by **31st March**.

The Award comprises a cash prize of £1,000 plus a framed scroll, and is presented at the Annual Meeting.

Gertrude Elles Award for public engagement

This new award replaces the Golden Trilobite. This year the deadline for applications is 30th September. See page 34 for full details.



Honorary Life Membership

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

Honorary Life Memberships are announced at the Annual Meeting.

Annual Meeting President's Prize

This is awarded for the best talk at the Annual Meeting. All student members of the Palaeontological Association, and all members of the Association who are early-career researchers within one year of the award of a higher degree (PhD or MSc), excluding periods of parental or other leave, are eligible for consideration for this award. Individuals may nominate themselves for consideration when submitting abstracts for the meeting. The prize consists of a cash award of £200, and is announced immediately after the oral sessions at the end of the Annual Meeting.

Annual Meeting Council Poster Prize

This is awarded for the best poster at the Annual Meeting. All student members of the Palaeontological Association and all members of the Association who are early-career researchers within one year of the award of a higher degree (PhD or MSc), excluding periods of parental or other leave, are eligible for consideration for this award. Individuals may nominate themselves for consideration when submitting abstracts for the meeting. The prize consists of a cash award of £200, and is announced immediately after the oral sessions at the end of the Annual Meeting.



GRANTS

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

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

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

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

- Title of meeting/ workshop/ short course
- Date and place proposed
- Name, position, and affiliation of the organizer(s)
- Brief description (not more than ten lines) of the rationale behind the meeting/ workshop/ short course
- Anticipated number of attendees
- Amount requested
- Other sources of funding applied for
- Specific use to which requested funds will be put

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

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



Engagement Grants

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

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

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

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

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.

1. Sylvester-Bradley Awards: Multiple awards of up to £1,500 each, for palaeontological research.
2. Callomon Award: An award of up to £1,500 for a project which is normally field-based.
3. Whittington Award: An award of up to £1,500 for a project which is normally based on museum collections.
4. Stan Wood Award : An award of up to £1,500 for projects in vertebrate palaeontology, and ideally involving fieldwork and fossil collecting.

There will be 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 to review the project, and one personal reference for the applicant
- A summary suitable for the non-specialist, which will be published in the Newsletter when the 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. Inquiries may be made to the Secretary (e-mail <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 careers. 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 £274 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> 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 Bursary Scheme, can be found on the appropriate page of the Association's website. Inquiries may be made to the Secretary (e-mail <secretary@palass.org>).

The deadline is **24th February** each year.



Successful applicants will be notified by the middle of May and funds will normally be available from 1st June. A full list of awards will be announced at the AGM.

Research Grants

Awards are made to assist palaeontological research up to a maximum value of £10,000 each, normally in support of single research projects or 'proof of concept' proposals with an aim of supporting future applications to national research funding bodies. Field-based projects are also eligible, but the scientific objectives and outcomes of the research must be made clear. Applications for investigator's salary costs will only be considered in exceptional circumstances and if awarded all legal and financial liability will lie with the applicant.

Preference is given to applications for a single purpose (rather than top-ups of other grant applications). The award is open to both amateur and professional palaeontologists, but applicants will normally have a PhD as a minimum qualification and must be members of the Association.

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

- A two-page curriculum vitae of the principal researcher
- A two-page 'Case for Support' which addresses the following points:
 - Underlying rationale and scientific issues to be addressed
 - Specific objectives of the research
 - Anticipated achievements and outputs
 - Methodology and approach
 - Programme and/or plan of research
 - How the research fits the charitable aims of the Association
 - Proposals for wider dissemination of results including those relating to the wider public understanding of science
 - A list of pending and previous applications (with funding bodies and results) for funds to support this or related research
- A breakdown and justification of the proposed expenditure
- A list of suggested referees who may be approached to review the proposal

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 Research Grants Scheme can be found on the appropriate page of the Association's website. Inquiries may be made to the Secretary (e-mail <secretary@palass.org>).

The deadline is **1st March** each year.

Funds will normally be available from 1st June, and the awards will be announced at the AGM.



Innovations in Palaeontology Lecture Series and the PalAss Exceptional Lecturer

In order to promote palaeontology to the wider academic community and public, and to recognize excellence in research among early to mid-career palaeontologists, the Palaeontological Association is introducing the **Innovations in Palaeontology Lecture Series**, to be given by the *PalAss Exceptional Lecturer* who will be selected in a competitive process.

This scheme aims to:

- Improve the dissemination of cutting-edge palaeontological research to the broader academic community and public.
- 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 who are at early to mid-career stages.

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 Palaeontological Association will 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.
- Once awarded, grants will be administered by the home institution of the *PalAss Exceptional Lecturer*. 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*.

Time line of the scheme:

- 1st October 2018: Deadline for nominations for the *PalAss Exceptional Lecturer*.
- 15th December 2018: The *PalAss Exceptional Lecturer* will be announced at the Annual Meeting.
- February 2019: The call for host institutions to participate in the **Innovations in Palaeontology Lecture Series** will be published in the spring *Newsletter*.
- 1st May 2019: Deadline for applications from host institutions.
- September 2019 – May 2020: delivery of lectures.



Eligibility and selection process of the PalAss Exceptional Lecturer:

- Eligible candidates will have a PhD in palaeontology or a related field and will be in the early to mid-stage of their career.
- Applicants can reside in any country, but must be members of the Association.
- Candidates must self-nominate.
- To self-nominate, a two-page CV, statement of motivation, and a title and illustrated 200-word abstract of a proposed seminar must be submitted via the Association's webpage.
- The *PalAss Exceptional Lecturer* will be chosen based on the 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.

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.

Uwe Balthasar

Meetings Coordinator



Gertrude Elles Award for public engagement

In order to promote high-quality public engagement in the field of palaeontology Council has instituted this new award, which is named after pioneering early 20th century palaeontologist Gertrude Elles.

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 should consist of a brief supporting case and a portfolio of up to four images. The supporting case should 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 should be compiled into a single PDF of less than 10Mb and sent to the Secretary (e-mail <secretary@palass.org>) by **30th September 2018** (at 12:00 GMT) The Award will be considered by Council at its October meeting and winners will be invited to an award ceremony at the Annual Meeting in December. Awards will also be announced in the *Newsletter*, on the Association website and through social media.

(There will be a profile of Gertrude Elles in a future edition of the *Newsletter*.)



Diversity study update June 2018

As reported previously, the Palaeontological Association has commissioned consultants Parigen to carry out a study into the diversity of the Association membership and palaeontology more broadly. The study was carried out between November 2017 and May 2018 and quantitative and qualitative data from Association members and non-members were collected by means of an online survey, focus groups at the Annual Meeting 2017, and formal and informal interviews with current and former palaeontologists. We were delighted by the support for the study, with a membership response rate of 41% and 585 full responses to the survey in total.

Survey responses were received from palaeontologists from 39 different countries, demonstrating the international nature of the Association, but by far the largest response, 50% of the total, came from UK residents. Palaeontologists from a range of sectors responded to the survey, although unsurprisingly universities and museums were the most common employers (see Figure 1).

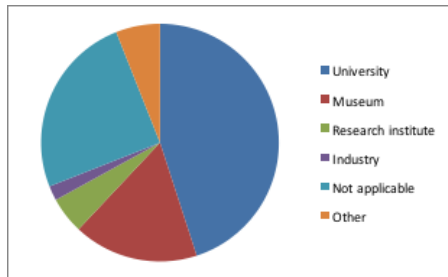


Figure 1. Employment sector of survey respondents

Some of the key issues raised by respondents are outlined below.

- There was a strong feeling that the Association should make more efforts to promote palaeontology to currently under-represented groups, particularly people from ethnic minorities and less affluent backgrounds.
- Many observations were made about the attrition of women in palaeontology with advancing career stage and the promotion of gender equality more broadly.
- A need for career advice and support for those at early career stages was highlighted.
- Respondents were keen to see the Association review its own activities, including the Annual Meeting and the allocation of prizes and awards, to make them more inclusive and to increase the transparency of the associated processes and decisions.

Overall, there was a sense that many palaeontologists want to promote their discipline as being diverse, exciting, relevant, and welcoming to everyone, incorporating a wide range of sub-disciplines and different ways of contributing. As one survey participant put it: 'Diversity is central to generating debate and keeping palaeontology in the spotlight as a relevant discipline in the modern world'.

PalAss Council will be carefully considering the findings and recommendations from the study and formulating a diversity action plan over the coming months, which will be reported in future Newsletters and at the 2018 Annual Meeting.

Fiona Gill

University of Leeds



Are you a post-doctoral palaeontologist who would like a mentor?

The Palaeontological Association is establishing a mentoring scheme to assist palaeontologists at the start of their academic careers. Mentoring is a valuable tool, helping individuals make informed choices via the exchange of knowledge and experience.

We have identified priority areas and in the first instance we will focus on the transition from postdoctoral position to permanent job. Other transition points such as late-stage PhD to postdoctoral position and mid-career to senior leadership role will be considered later.

We already have palaeontologists in permanent positions who are willing to act as mentors and are now looking for postdoc palaeontologists who would like to take part in the scheme.

The Palaeontological Association mentoring scheme will be via direct mentoring. That is, direct contact between the mentor and mentee via e-mail, Skype or other forms of communication. Full guidelines on expectations, lines of communication and length of the mentorship will be provided. It is expected that mentors should provide open and honest advice whilst maintaining confidentiality at all times.

If you are you a post-doctoral palaeontologist and are interested in having a mentor please e-mail Vice-President Dr Caroline Buttler (<Caroline.Buttler@museumwales.ac.uk>).

Caroline Buttler

Amgueddfa Cymru – National Museum Wales



ASSOCIATION MEETINGS

Code of Conduct for Palaeontological Association Meetings

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

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

Behavioural expectations

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

Digital images and social media

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

**62nd Annual Meeting of the Palaeontological Association**

University of Bristol, UK 14 – 17 December 2018

The Annual Meeting of the Palaeontological Association will be held at the University of Bristol. Dr Jakob Vinther is the primary convener, and the e-mail address for all meeting matters is <annualmeeting2018@palass.org>.

Please note that the timetable below is provisional; exact timings and speaker order are subject to change.

Programme**Friday 14th December: Workshops, Symposium and Reception**

Two short workshops will be available: “Bayesian phylogenetic analysis of morphological character data using RevBayes” and “Workshop in 3D data visualisation and segmentation using Avizo”. There will also be a taphonomy workshop running concurrently. Sign up for these events during registration and see further details below, along with Meeting details. Venues to be announced.

The Annual Symposium will be held in the Great Hall at the University of Bristol, Queens Road. The theme is ‘Frontiers and Advances in Dinosaur Palaeobiology’:

- 14.15 – 14.30 Welcome
- 14.30 – 15.00 Darla Zelenitsky (University of Calgary)
The evolution of nesting and reproductive traits in dinosaurs
- 15.00 – 15.30 Karl Bates (University of Liverpool)
Dinosaur biomechanics: a tale of hard tissues and soft evidence?
- 15.30 – 16.00 Victoria Arbour (Royal Ontario Museum)
TBC
- 16.00 – 16.30 Emily Rayfield (University of Bristol)
Dinosaur skull function, an evolutionary perspective
- 16.30 – 17.00 Break
- 17.00 – 17.30 Jasmina Wiemann (Yale University)
How fossil biomolecules unveil the hidden stories of dinosaur biology
- 17.30 – 18.00 Jingmai O’Connor (IVPP)
The trophic ecology of Mesozoic birds
- 18.00 – 18.30 Bhart Anjan Bhullar (Yale University)
Evolution, development, and the assembly of the modern bird
- 18.30 – 19.00 Xu Xing (IVPP)
Research on bird origins: recent advances and future perspectives
- 19.15 – 21.30 Icebreaker reception in the Life Sciences Building, 24 Tyndall Avenue.



Saturday 15th December: Conference, AGM, Annual Address and Dinner

The main part of the Annual Meeting will proceed with two days of talks and posters. Talks will be held in the Social Sciences complex on Priory Road, while poster sessions and coffee will be held at the Life Sciences building. The two venues are a five-minute walk from each other.

The Saturday morning and afternoon will feature double or triple parallel sessions held in the Priory Road Complex. The Annual General Meeting as well as the Annual Address will be held in the main lecture theatre at the same address.

The Annual Address take place at 16.00 and will be given by Professor Dame Jane Francis (British Antarctic Survey). The title is 'Ice in a greenhouse world – 60 Ma and 2060!'

Following the Annual Address there will be a poster session from 17.00 to 18.30 in the Life Sciences building where drinks and light snacks will be served. Poster presenters should be at their posters presenting during this time interval.

Following the poster and drinks session, the Annual Dinner will begin at 19.00. This will be held in the Bristol City Museum, which is about a ten-minute walk from the Life Sciences Building and close to major hotels.

Sunday 16th December: Conference

A full day of talks in parallel/triple sessions (morning) and joint session (afternoon).

Depending on the demand, it is likely that we will be offering lightning talks. We will offer delegates who submit abstracts the opportunity to decide if they deem their talk to be amenable for this format. If insufficient speakers offer themselves, the reviewing panel may make decisions based on the suitability of the abstracts.

Monday 17th December: Field-trips

We will run two field-trips. The first trip will visit a classic Triassic–Jurassic section in Watchet, North Somerset. At this locality well-preserved ammonites can be found with ammonite quality nacre. Soft-bodied coleoids and vertebrate remains are also common. This will be both a fossil-hunting trip and a chance to see some spectacular geology and alpine folding. Depending on the tide schedule we will be visiting a local pub with a magnificent West Country cider selection and have fish and chips.

Field-trip leader: **Jakob Vinther**

The second trip will be a visit to the classic microvertebrate sites near Bristol, including Aust and several quarries with fissure fill microvertebrates.

Field-trip leaders: **David Whiteside and Michael J. Benton**

Places for both trips will be limited and will be allocated on a first come, first served basis.

Venue and travel

The Conference will be held at the University of Bristol campus in Clifton, Bristol. All venues are a short walk from each other.



Bristol is best reached by train or aeroplane. The best-connected railway station for the campus is Bristol Temple Meads, which has connections to all major parts of the UK. Bristol Airport services several airports on the continent. Several airlines fly out of Bristol and are reasonably priced. Buses leave from Bristol airport at ten-minute intervals and run all night at less frequent intervals. These cost £7 one way or £11 return. Taxis and Uber connect to the airport and cost between £22 and £30.

Buses connect to the campus from Temple Meads, with the number 8 leaving directly outside the station and stopping in the University precinct. There are also infrequent trains to the Clifton Down railway station, a ten-minute walk from campus. You can read more and plan your trip using this URL: <<https://visitbristol.co.uk/about-bristol/travelling-around-bristol/public-transport>>. Google Maps on your smartphone is also useful for navigating the city.

It is also possible to drive into Bristol by car. Unless your hotel has free parking, expect to pay between £10 and £16 per day for parking.

Getting to Bristol

By Train:

Bristol can be reached from any part of the UK. Your destination would be the Bristol Temple Meads railway station as Bristol Parkway is further away from the Campus at higher cost for bus or taxi. From there you can either walk (30 mins), take bus number 8 or a taxi/Uber (the ride should cost around £8-10). As some of you will be aware, the privatized UK rail companies are expensive. Return tickets are often more economical than two singles. Booking well in advance is advisable to avoid losing all the money that you had hoped to spend in the pub. You can book from several websites but try <<http://www.nationalrail.co.uk/>> and look for off-peak times.

By Coach:

London is connected by National Express (<www.nationalexpress.com>) and Megabus (<www.uk.megabus.com>). This can be a very cheap option to access Bristol from around the UK. Book in advance. Buses stop either at Bristol Bus & Coach Station or near Cabot Circus. The easiest way to get to the campus from there is on foot or by taxi. Do note that the campus is at the top of a large hill and is not for the faint-hearted.

By air:

Bristol Airport is very well connected with regular flights to all areas of Europe and is also a cheap option for people coming from the north of the UK. For more information see <<http://bristolairport.co.uk>>. Cardiff is about an hour away and is another alternative, well connected by train to Bristol; however, note that the airport is a fair way away from the city and the railway station. You can also fly into London. NB. expect to add £60-140 in transport to Bristol if flying into London, plus three hours or more commute in each direction.

By Car:

There are car parks around Clifton. Street parking in Clifton, near the University, costs up to £10 per day. Bristol is about 1.5-2 hours' drive from London, as an example.

Accommodation

Delegates are responsible for booking their own accommodation. There are several hotels near the University in different price classes. Due to the festive season being at its peak, and Clifton being a



popular party destination, booking well in advance is strongly advisable. Prices are high near the University and downtown Bristol. Near the University there are youth hostels (<<https://www.yha.org.uk/hostel/yha-bristol>>) with beds from £25 and a range of hotels with prices starting at £60 per night and going up fast. A cheap nearby option would be The Washington (<<http://the-washington-guesthouse-bristol.business.site>>). More comfortable hotels are The Berkeley Square Hotel with prices at £121 (<<https://cliftonhotels.com/bristol-hotels/berkeley-square>>), or the Berkeley Square House, with prices around £94 (<<https://www.berkeleysquarehousebristol.co.uk>>). Another increasingly popular option is to stay in AirBnB (<<https://www.airbnb.co.uk>>) or Homestay (<<https://www.homestay.com/united-kingdom/bristol>>). We stress that these suggestions are not recommendations. Alternatively, good online resources are <www.booking.com>, <www.trivago.co.uk> or <www.tripadvisor.co.uk>.

Registration and booking

Registration, abstract submission and booking (including payment by credit card) commences on Monday 9th July 2018. Abstract submission closes at midnight on Friday 21st September 2018. After this date registration will incur an additional service charge of £35. The final deadline for registration is Friday 16th November 2018. No refunds will be available after the final deadline.

Registration, abstract submission, booking and payment (by credit or debit card) will be through online forms available on the Palaeontological Association website <<http://www.palass.org/>>. Please note that all prices will be given in sterling (£ / GBP). Accommodation must be booked separately (see above). Early registration is £110 for ordinary and retired members; £75 for students; and £150 for non-members. Registration includes the icebreaker reception on Friday evening, the full registration package, lunch and tea/coffee/biscuits from Friday through to Sunday.

The Annual Dinner will cost £65. It will be held at the Bristol City Museum, which is a ten-minute stroll from the Priory Road and Life Sciences Building. The evening will feature a welcome with prosecco, followed by a three-course meal with coffee and petit fours. The venue will be open until 1am with a bar and we will have a local DJ. Note that attendance at the Annual Dinner will be capped at 250 persons allocated on a first come, first served basis.

Oral presentations

Talks during the general meeting will be allocated 15 minutes. You should prepare your talk to allow for three minutes of questions and switching between speakers. We will run parallel sessions during most of the meeting in lecture halls adjacent to each other. There will be single or double screens be set to 'mirror' mode and hence no double-screen presentations will be possible.

Please prepare your presentation in Windows PowerPoint, PDF format or export your document into one of these formats and ensure that all files and slides are still compatible. If you are using a Mac, prior to the meeting please check your presentation on a PC as this is the system we will be projecting from.

If we are oversubscribed, we may offer that you present a poster instead. A panel at the University of Bristol will make a decision on the nature of your presentation based on the abstract and how developed the research is. We will also consider career stage in allocating talks.



Posters

Please produce posters in A0 portrait format. There will be no space to display landscape format or any larger formats. There will be materials to affix the poster, such as pins. If you wish to affix your poster in a less destructive way, please bring alternative adhesives. We will seek to have all posters available throughout the meeting. Poster sessions will take place in the Life Sciences Building throughout the meeting.

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 2018 meeting, small grants of up to £100 will be available to student presenters who are travelling from outside Bristol. The number of awards 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>) once the organizers have confirmed that their presentation is accepted, and before 1st December 2018. Entitle the e-mail "Travel Grant Request". No awards can be made to those who have not followed this procedure.

Bristol

Bristol was rated the best town to live in in the UK in 2017. Described as a 'small town that feels like a big city', Bristol boasts a range of cultural events, restaurants, pubs, museums and historic buildings. Go through the town and see how many Banksy paintings you can spot, or take part in one of the guided tours. The Clifton Suspension bridge is a magnificent industrial age monument based on initial designs by I. K. Brunel. Stokes Croft is a great hub for music, art and counter-cultural lifestyles. It is worth visiting; see <<https://visitbristol.co.uk>> to check events during your stay.

Childcare

There are nursing rooms/baby changing facilities in the basement of the Life Sciences Building as well as the Priory Road complex.

Disabled access

There is access via elevators and lifts throughout the Life Sciences and Priory Road Complex. For more information, see <<https://www.disabledgo.com/access-guide/university-of-bristol/10-priory-road>> and <<https://www.disabledgo.com/access-guide/university-of-bristol/life-sciences-building>>.

Workshops

Bayesian phylogenetic analysis of morphological character data using RevBayes

14th December 09.00 – 12.30

Course instructors: Rachel Warnock (ETH Zurich), Mark Puttick (University of Bath), Joseph O'Reilly (University of Bristol), Holly Betts (University of Bristol)

Reconstructing evolutionary relationships among extinct and living species is a key topic in palaeobiological research. For most fossil species, phylogenetic relationships can only be established using morphology, which has traditionally been analysed using parsimony.



Alternatively, morphological data can be analysed using maximum likelihood or Bayesian approaches, which incorporate explicit models of the evolutionary process. Bayesian phylogenetic models, in particular, allow for the analysis of the fossil record under complex macroevolutionary models and can incorporate multiple sources of information, including time, and uncertainty. This short workshop will provide an introduction to Bayesian approaches for the analysis of morphological character matrices and comparison to other approaches. There will also be a brief introduction to the Bayesian phylogenetics software package RevBayes and a hands-on tutorial. RevBayes provides an interactive and flexible environment for statistical inference in phylogenetics and macroevolution. More information about the software can be found online, at <<https://revbayes.github.io/revbayes-site/>>. Researchers at any level are welcome. Interested participants will be given the opportunity to register for the workshop online as part of the Annual Meeting registration process, at no additional cost. More information about the workshop venue will be posted online before the meeting.

3D data visualization and segmentation using Avizo

14th December 10.00 – 12.30

Course instructor: Thomas Davies (University of Bristol)

This workshop will provide a practical introduction to the Avizo 3D software package for working with 3D tomographic datasets such as synchrotron- or computed-tomography imaging techniques used widely in palaeontology. There will be a brief introduction to 3D tomographic techniques, followed by a hands-on introduction to using the software for image visualization and segmentation. The workshop is suitable for researchers at any level with no, or limited, prior experience of working with 3D data. Interested participants will be given the opportunity to register for the workshop online as part of the Annual Meeting registration process, at no additional cost. More information about the workshop venue will be posted online before the meeting.

Friends of the Rotten

For the last couple of years, an informal workshop among researchers and students dealing with taphonomy has taken place prior to the Annual Meeting. If you are interested in being informed further about this particular event and included on their mailing list, please contact Dr Maria McNamara via e-mail to <maria.mcnamara@UCC.ie>, entitling your message "FOTR". Venue and times will be announced via e-mail later this year for those who have indicated interest.

We look forward to seeing you in December!

The logo for the Annual Meeting is inspired by the hot air balloons that are a frequent sight in Bristol during the summer, not least in the annual hot air balloon festival. The Victorian Clifton Suspension Bridge shown in the background is a splendid place to see the balloons. For this occasion, the 'balloon' is an articulate brachiopod.



Fossil Festiv-'ull

2018 Yorkshire Fossil Festival comes to Hull!



Saturday 15th and Sunday 16th September 2018
As part of the Hull Science Festival
at the University of Hull

#YorksFossilFest

<http://scifest.hull.ac.uk/>

University of Hull, Cottingham Road, Hull. HU6 7RX



A new Fellow of the Royal Society



Greg Edgecombe, Merit Researcher at the Natural History Museum in London, has been elected as Fellow of the Royal Society as of May 2018. The Royal Society is an independent scientific academy made up of the most eminent scientists in the UK and the Commonwealth; new members are selected for the excellence and importance of their contribution to science. Greg has been elected as a member in recognition of his hugely influential research on the evolution of arthropods, the most diverse and abundant animal group alive today. His early palaeontological work on trilobites quickly marked him out as a future world-leading palaeontologist. Later work on stem lineage taxa from fossil Lagerstätten, such as the Chengjiang Biota, has formed the basis for our modern understanding of

the evolutionary relationships within Arthropoda and illuminated the origins of their anatomical complexity during the Cambrian Explosion. Greg is also the leading authority on modern centipedes with expansive work exploring their anatomy and the significance of these important terrestrial venomous predators. He has been on the leading edge of integrating morphological information with molecular datasets, expanding the methods of phylogenetic analyses while also revealing the position of arthropods in the animal kingdom. This vast body of work has resulted in over 300 publications.

Greg has also found time to contribute extensively to the scientific community by taking positions on numerous scientific councils and journal editorships, while also being unceasing in his support for his colleagues, in particular in nurturing early-career scientists. In recognition of these many contributions, Greg already received the President's Medal of the Palaeontological Association in 2011, and was also recognized by the Australian Academy of Science in 2004 with the Fenner Medal for Distinguished Research in Biology. With his numerous ongoing research projects in collaboration with colleagues all over the world, there is undoubtedly still much more to come.

Allison Daley

University of Lausanne



Palaeontology in the news

After a fabulously interactive annual address at our last AGM, Mark Purnell and his team of Leicesterian collaborators have served up a fascinating review of how animals rot, and how exceptional fossils get preserved (Purnell *et al.* 2018). With a subtitle of ‘opening the black box,’ I rather hoped this would be a ride on time for the media, and I wasn’t to be disappointed. As of 6th June 2018, the paper had accrued an Altmetrics rating of 114, which is more than an England batsman ever manages these days, so must definitely be a top score (actually, one of the articles was published in the Long Room¹, so maybe the Home of Cricket is listening). I found it interesting that the media articles² arranged themselves into distinct headline clusters: the press release had gone with a ‘curse of the zombie fossils’ approach, but then two articles plumped for a ‘why this lab reeks of animal flesh’ angle (*e.g.* Live Science³), whilst two more chose to analyse ‘why complete dinosaur fossils are so rare’ (*e.g.* Newsweek⁴). Europa Press provided a very detailed article on the study in Spanish⁵, which leads me to recommend that the Association’s new Publicity Officer is someone with language skills.

This is demonstrated all the more by the coverage of Francisco Serrano and colleagues’ reconstruction of flapping, bounding flight behaviour in Early Cretaceous birds (Serrano *et al.* 2018). Again, if Altmetrics are to be trusted, the press interest was solely in Spanish language news outlets⁶ and there were some big hitters. El País⁷ (Spain’s most widely read newspaper); La Razón⁸; and National Geographic⁹. Sadly, my Spanish is vastly rudimentary, so I can’t offer any insight as to the quality of the coverage.

From my shocking Anglocentrism to shocking fossil fish, and an article led by Benedict King, on the evolution of electroreception in early vertebrates (King *et al.* 2018). Having been published in February, the study must just have missed being picked up in the last *Newsletter*, but Benedict’s article in The Conversation¹⁰ led to a fair bit of interest, especially in Australia.

Finally, we move to the intriguing question, raised by the work of Humberto Ferrón and colleagues (Ferrón *et al.* in press) of how fast the biggest bony fish could move. Modern osteichthyans are no larger than the (admittedly fairly sizable) sunfish, but the Mesozoic monster *Leedsichthys problematicus* was quite another scale. Assessing how fast it could have moved – nearly 18 km an hour – caught the attention of our very own¹¹ Colin Barras, who penned a piece for the pages of

¹ <<https://www.longroom.com/discussion/944224/why-this-lab-reeks-of-animal-flesh-and-contains-a-suitcase-full-of-slime>>

² <<https://wiley.altmetric.com/details/34643200/news>>

³ <<https://www.livescience.com/62100-rotting-hagfish-vertebrate-fossils.html>>

⁴ <<http://www.newsweek.com/dinosaur-decomposition-study-explains-why-fossils-are-rarely-complete-854093>>

⁵ <<http://www.europapress.es/ciencia/ruinas-y-fosiles/noticia-paleontologos-investigacion-macabra-ciencia-paso-cadaver-fosil-20180321182552.html>>

⁶ <<https://wiley.altmetric.com/details/33469326/news/>>

⁷ <https://elpais.com/elpais/2018/02/27/ciencia/1519757940_696501.html>

⁸ <<https://www.larazon.es/sociedad/ciencia/dos-fosiles-espanoles-aclaran-el-vuelo-de-las-primeras-aves-E017807443>>

⁹ <http://www.nationalgeographic.com.es/ciencia/actualidad/fosil-polluelo-prehistorico-descubierto-hoyas-cuenca_12453>

¹⁰ <<http://theconversation.com/the-shocking-facts-revealed-how-sharks-and-other-animals-evolved-electroreception-to-find-their-prey-91066>>

¹¹ Colin was interviewed on these pages many issues ago, explaining how he went from palaeontological PhD to science writing (*Newsletter* 75, page 56, to be precise: <https://www.palass.org/sites/default/files/media/publications/newsletters/number_75/number75.pdf>)



Science¹². A Smithsonian magazine article then reported on the Barras article¹³, so with the World Cup approaching, I will conclude with Eric Cantona's gnomic thought that "When the seagulls follow the trawler, it is because they think sardines will be thrown into the sea".

Talking of trawlers, do join us in Hull in September for the Yorkshire Fossil Festival!

Liam Herringshaw

Publicity Officer

<publicity@palass.org>

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The Marsh Awards 2018

Nominations are being accepted for the three Marsh Awards for 2018 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 2018**. Further information and the respective nomination forms can be found on the website at <<http://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

¹² <<http://www.sciencemag.org/news/2018/05/ancient-fish-was-bigger-whale-shark-and-faster-scientists-ever-imagined>>

¹³ <<https://www.smithsonianmag.com/smart-news/new-study-suggests-theres-no-metabolic-reason-giant-bony-fish-cant-exist-today-180969206/>>



Palaeontology is now leading the field: new impact factor rankings

The 2018 Journal Citation Reports (JCR), covering publications in the years 2016 and 2017, were published in late June, and I am delighted to report that the impact factor of *Palaeontology* has continued its upward trajectory, jumping to 3.7. This places *Palaeontology* as the top-ranking journal in the JCR category 'Paleontology', positioned well above other journals in this field by a considerable margin (see Table). This ranking is a reflection of the exciting, trend-setting science now being published by *Palaeontology* that is clearly shaping and influencing research within the discipline. *Papers in Palaeontology*, whose function is to support heavily descriptive, taxonomic work, is also fairing well, with an impact factor of 2.2. While this is slightly down on last year, it remains in the top ten palaeontology journals, and demonstrates the value of high-quality systematic work to the field.

Why does impact factor matter? The charitable activities of the Association, such as the many grants it provides, are largely funded by the income generated from sales of the journals. High impact factors identify our journals as must-have publications, encouraging both continued and new subscriptions worldwide and thus ensuring a healthy income stream to the Association that can then be used to further its aims.

I am very grateful to all those who have contributed to the quality and success of the journals, particularly the authors who chose to submit their work and the referees who ensured the high quality of the resulting publications. Special thanks go to the Editorial Board, the subject-based scientific editors and our Publications Officer Sally Thomas for their dedication and hard work in maintaining standards, ensuring rapid turnaround, and making the journals the success they are. For anyone considering publishing with us, please see the guide for authors on the Association website.

Andrew B. Smith

Editor-in-Chief

InCites Journal Citation Reports		Clarivate Analytics	
Rank	Journal Title	Total Cites	Journal Impact Factor
1	PALAEONTOLOGY	4,020	3.730
2	PALEOCEANOGRAPHY	7,100	2.718
3	JOURNAL OF PALAEOGEOGRAPHY	185	2.632
4	PALEOBIOLOGY	3,804	2.400
5	PALAEOGEOGRAPHY PALAEOCLIMATOLOGY PALAEOECOLOGY	20,887	2.375
6	JOURNAL OF SYSTEMATIC PALAEOONTOLOGY	1,057	2.326
7	VEGETATION HISTORY AND ARCHAEOBOTANY	1,782	2.232
8	LETHAIA	2,325	2.218
9	JOURNAL OF VERTEBRATE PALEONTOLOGY	5,224	2.190
10	PAPERS IN PALAEOONTOLOGY	112	2.156



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 Briony Mamo, Liz Martin-Silverstone and Collin VanBuren.

Briony Mamo is an Australian in Hong Kong, employed as a postdoctoral researcher at The University of Hong Kong's Faculty of Science on an "Earth as a Habitable Planet" Fellowship.

Q1: How did you end up in Hong Kong?

I met my current PI, Moriaki Yasuhara, through my previous position at JAMSTEC (Japan Agency of Marine-Earth Science and Technology). When we were at the North American Paleontological Convention conference a few years back



in Gainesville, Florida we were delighted to find we had similar research interests but through different palaeontological proxies, and went about applying for funding together. We applied for several funding schemes based in Hong Kong and I was lucky to receive one.

Q2: How is your position funded?

Over the years I've been based at the University of Hong Kong (now on my third short contract), my funding has been sourced from several schemes. The "Earth as a Habitable Planet" fellowship was funded by the HKU Faculty of Science. I've also received further employment with contracts that are partially subsidised by the University and partially by Dr Yasuhara.

Q3: What is your project about?

In Hong Kong, my investigations focus on establishing modern baseline benthic communities stretching from the north-east of Hong Kong, bordering mainland China, around to the Pearl River Estuary in the west. Previous work shows a stark water quality gradient heading west across Hong Kong waters and my work seeks to discern benthic ecosystem ecology across this region. Initial results are showing surprisingly flourishing communities distinctly controlled by subtle local parameters. Cores have also been collected to compare modern communities to those of the past and chart microbenthic community adaptation and coping strategies to the substantial environmental change the region has undergone throughout relatively recent and palaeontological time.

Q4: What surprised you most about living in Hong Kong?

The welcoming attitude and readiness to make new friends in a city filled with a large community of expats. Moving to a country on your own where you know no one can be daunting. Once



you're there, settling in, finding your feet and figuring the city out can take time and be a lonely experience. That never happened when I moved to Hong Kong. It's a diverse city where many different cultures meet and mesh. So many people here, whether in academia, finance, NGOs, *etc.*, understand what it's like to move all over the world and to not really know where you'll end up once the current contract is finished. I think this influences people's social attitudes so it's a fantastic city to go out and meet new people in.

Q5: What do you miss most about Australia?

I miss people far more than anything about Australia itself. But if I had to name anything it'd be the clean air, my favourite beers and a good pub parmy.

Briony tweets from @BrionyMamo.



Liz Martin-Silverstone is a Canadian in the UK who recently completed her PhD at the University of Bristol.

Q1: How did you end up in the UK?

My partner and I were looking at where we could both do grad school in the fields we were interested in (pterosaurs and biomechanics for me, quantum physics for him) and we heard about the University of Bristol. It had the earliest deadline, and since he is British-

Canadian, we decided to both apply. We both got in (him for PhD, me for MSc) so we decided to move. That was almost seven years ago!

Q2: How is your position funded?

As an international student, it's tough to get funding in the UK. My PhD was partially funded by the University – they agreed to waive half of my tuition (£9k/year instead of £18k), and they provided a Research Training Support Grant (RTSG) for me. Fortunately, as a Canadian, there are a few Canadian scholarships that can be taken out of the country. I was lucky enough to get a Natural Sciences and Engineering Research Council (NSERC) Postgraduate Doctoral Scholarship, which covered the rest of my tuition for three years. In my final year, I received an award from the Government of Alberta, my home province, called the Sir James Lougheed Award of Distinction, which ended up being essentially a stipend. I was not able to find enough funding to cover living expenses during my PhD, but with small grants from the Palaeontological Association, Geological Society of London and Society of Vertebrate Paleontology, I was able to do all of my research and attend most conferences I had hoped to go to. I had to dip into my savings for my living expenses, since being an international student in the UK is so expensive.

Q3: What is your project about?

My PhD was on pneumaticity and mass estimation of pterosaurs. I used CT scans to look at the internal structure of pterosaur bones, and to recreate 3D models of pterosaurs in order to understand the distribution of mass.

**Q4: What surprised you most about living in the UK?**

I was generally surprised at just how different the UK is culturally from Canada. I think people generally assume that if you share a language, you're probably similar, but there are a lot of large differences. For example, the sense of humour took a long time to get used to. And the differences in language that do exist, words that I had never heard before coming to the UK and things I say that people don't know at all.

Q5: What do you miss most about Canada?

My family. None of my family lives in the UK, and that can be tough. My brother has three kids, and my sister just had her second child, so it's tough not being around for them. More superficially, I miss the mountains and the great outdoors. I miss seeing elk and moose when you go up to the mountains for the weekend.

Liz tweets from @gimpasaura.



Collin VanBuren is an American in Australia employed as an Endeavour Postdoctoral Fellow at Macquarie University.

Q1: How did you end up in Australia?

I ended up here because I wanted to work with John Alroy on a quantitative project related to the application of functional traits to macroecological questions. John and I met during the Fossilworks workshop in 2014 and had discussed me coming back to do a postdoc at a couple of SVP meetings and over e-mail. He suggested I apply for an Endeavour Fellowship, and luckily my application was successful.

Q2: How is your position funded?

My postdoc is funded by an Endeavour Postdoctoral Research Fellowship, which comes from a funding scheme that funds researchers at all stages (including postgraduates completing their degree) to study or research in Australia. My specific fellowship funds postdocs for 4–6 months to complete a research project at any university or research institution in the country. Applications are due in June for fellowships beginning between 1st January and 30th November of the following year.

Q3: What is your project about?

My project focuses on spatial diversity patterns in extant Australian frogs. First, we are testing for provinciality and latitudinal diversity gradients using taxonomic diversity and then testing if these patterns match what is found when using functional and phylogenetic diversity metrics. The goal is to identify areas of conservation concern and also hopefully look at how recent species extinctions have affected these metrics.

Q4: What surprised you most about living in Australia?

I don't think much has surprised me about Australia, actually. I attended the Fossilworks workshop here in 2014 and lived with Australians for most of my time in the UK, so I like to think I was fairly prepared for what to expect. Of course, that doesn't make the beaches or the nearby national parks any less beautiful or the coffee any less amazing.



Q5: What do you miss most about the United States?

Having lived abroad for nearly seven years between my master's in Toronto and PhD at Cambridge before coming to Australia, it's hard to say what I miss most because I think I've acclimatized to it. After being away for long enough, I do start to crave fried food (a clear indication that I'm from rural middle America), and of course I miss my family and friends. That said, I think the experiences gained from being abroad are well worth it.

Collin tweets from @CollinVanBuren and further information about his research can be found on his website (<collinvanburen.weebly.com>).

“Popularizing Palaeontology: Current and Historical Perspectives” (PopPalaeo) workshops and network

From the beginnings of research into the Earth's deep past in the late eighteenth century, extinct animals, narratives of life's history and accounts of palaeontological discovery have had a strong hold over public audiences. But why is this, how has this affected the development of palaeontology as a science, and what has been the long-term impact of palaeontology on the public? These are big questions that are currently being thought about – not just in palaeontology and science communication, but also in the media, museums, and the humanities and social sciences.

As a historian of science, I started working on a project on the history of palaeontology a few years ago, with some of these questions in mind. I noticed how people from a variety of subjects – like the history of science, English literature and sociology – were interested in examining palaeontology as an example of a “popular science”, and that palaeontologists, museum professionals, artists and science communicators were very interested in the history of their fields and the phenomenon of popular science more generally (as well as conducting lots of really interesting outreach projects). There seemed to be great potential in getting people together to really get to grips with these issues, which very much require multiple perspectives to understand.

With some support initially from my University (King's College London), and now with an International Research Network grant from the UK Arts and Humanities Research Council, I've started to organize a series of workshops and public engagement events to investigate these themes. Partly this involves examining the ways that palaeontological subjects have been presented through science books, lectures, talks, artworks, film, computer games and other media. It is also important to think about why some subjects – such as dinosaurs, exotic fieldwork, and human origins – have dominated public presentations, while other aspects of the discipline have often been neglected. Over the years, palaeontology has affected bigger public debates on issues like the environment, nature, animals, evolution and the place of science in society, and considering how this has worked is another major topic. And a final aim will be to think about new directions that palaeontological outreach and engagement can take.



The first workshop was held in September 2016 at King's College London. A number of papers raised the importance of the connection between art and science (Darren Naish and John Conway), and the popular presentation of particular organisms – specifically Azhdarchid Pterosaurs (Mark Witton), George Gaylord Simpson's 1951 book *Horses* (Joe Cain), and Mesozoic mammals (Elsa Panciroli). The relative profile of specimens and subfields was also an important topic, with Mark Carnall talking about “underwhelming fossils” in museum collections, and Elizabeth Jones discussing the rise of ancient DNA research as a “celebrity science”. Another set of papers tackled the popularization of palaeontology in the early twentieth century, particularly focusing on dinosaur research in Germany (Marco Tamborini, Ilja Nieuwland and Mareike Vennen) and human origins studies in the USA (Marianne Sommer). We also talked about particular media presentations, like Pixar's *The Good Dinosaur* of 2015 (Will Tattersdill) and Henry Neville Hutchinson's extremely popular and influential 1892 work, *Extinct Monsters* (Richard Fallon). We then finished with two fascinating papers on current outreach projects: Shaena Montanari on her Dinosaur Doctors initiative, using palaeontology in children's hospitals; and Dave Marshall on the development of the Virtual Natural History Museum, an online palaeontological resource. Both of these outreach projects had been enabled by the PalAss Engagement Grant scheme.



Discussions at Popularizing Palaeontology Workshop I in September 2016.

In the second workshop in December 2017 we moved to some questions that were left unresolved from the first event, namely: why popularize palaeontology at all? And what potential risks are there in this process? A series of papers from museum and historical perspectives (Mark Carnall, Liz Hide and Ilja Nieuwland) examined some of the competing reasons for this, and also some of the major challenges and problems that this can throw up. We also had talks on outreach in palaeontology (Steve Brusatte) and archaeology (Lorna Richardson), and a discussion of how children became a key audience for palaeontological outreach by looking at 1900s fiction (Richard Fallon) and the changing presentation of Mary Anning (Melanie Keene). The discussion of the relationship between art and palaeontological science also continued: Paul Brinkman talked about the art and career of John Conrad Hansen at Chicago's Field Museum; and Katrina



van Grouw talked about her experiences integrating Mesozoic themes into her art and writing. Finally, we thought about the relative predominance and appeal of particular palaeontological topics, with Paige Madison examining the presentation of the Taung Skull in the 1920s, and Darren Naish going over the biased emphasis on particular organisms and groups in review texts.



“The Art of Extinct Animals” pop-up exhibition at Popularizing Palaeontology Workshop II in December 2017.

An additional thing I would like to do with this network is to integrate public engagement and outreach activities with the more academic events. As such, on the evening of the first day we held a pop-up exhibition of palaeoart, featuring displays from Beth Windle of thylacines and Pleistocene hyenas, John Conway with life-sized illustrations of *Velociraptor* and other (relatively small) dinosaurs, and Mark Witton and Bob Nicholls gave overall displays of their works. The artists also gave some fascinating talks in a nearby lecture hall on their methods of reconstructing extinct animals, and John Conway finished off by placing palaeoart within the wider history of art.

The first two events were a great success and fulfilled the main aim of connecting specialists from different fields to discuss the common problems around the public role of palaeontology. To continue the discussions we will be holding four more workshops over the next two years, with the following themes and questions:

May 2018 – Representations (Artis Library, University of Amsterdam). Thinking about some of the major stereotypes, cultural references and images associated with palaeontology.

December 2018 – Debates (King’s College London). How the public discussion of palaeontology has connected with wider debates on scientific, social and cultural issues, ranging from evolution, ‘progress’, nature, biodiversity and spectacle.

Spring 2019 – Objects (North Carolina Museum of Natural Sciences). How particular palaeontological objects have been presented and discussed in public contexts, whether these be organisms, specimens, institutions (such as museums and research laboratories), or individual palaeontologists.



September 2019 – Media (London). Focusing on particular forms of popular media used for the presentation of palaeontological themes (such as film, documentaries, exhibition displays, newspaper stories, books, novels and lectures) and the role that the media has had in conditioning the interaction between scientists and publics.

If you are interested in getting involved in the network or coming to any of the events please do get in touch, and if you cannot make the events themselves then all the papers will be recorded and uploaded to the network website as audio and video, along with blogposts from the participants. You can also look out for the #PopPalaeo hashtag on Twitter. More information, a contact form and the videos from the first two workshops can be found at <www.poppalaeo.com>.

Chris Manias

King's College London

The eight-legged friend

Give a dog a bad name... The humble pooch has definitely been one of the winners in the animal stakes since humans arrived on the scene. True, there are a few individual dogs widely regarded as being on the dark side: that Baskerville hound, for instance, or the sinister dog-headed god Anubis of ancient Egypt, weighing the souls of the dead, or the immortal Muttley, Dick Dastardly's wheezing sidekick of the Hanna-Barbera *oeuvre*. But these are the exceptions. For each of these, there are a dozen or more of the likes of Lassie, Rin Tin Tin (not to be confused with Tintin's dog Snowy), Gromit, Toto and Deputy Dawg. The cats don't do badly either, even given their haughtier demeanour. The ancient Egyptians famously put them on a pedestal, Colette wrote more fondly about cats than about humans, while Mark Twain found them a muse so effective he often had over a dozen of them creating mayhem around the house – including one that occupied a pocket on the billiard table.

Add a few more legs¹, though, and the scales are tipped, quite emphatically. One might consider the squid and octopi², systematically cast by humans into the most villainous of roles³. The kraken, a ship-devouring monster that arose in Norse legend about a millennium back, is generally held to originate from sightings of giant squid. Linnaeus classified it as a cephalopod, christening it *Microcosmos marinus* in the first edition of *Systema Naturae* (though removing it from later editions, calling it a 'unique monster' that he had not personally seen). A little later, Victor Hugo, in *The Toiler of the Sea*, used some of his most spine-chilling prose to describe the battle between his hero, Gilliatt, and the 'devil fish' octopus (when God wills it, he wrote, he 'excels in the execrable'). Jules Verne, who in *20,000 Leagues under the Sea* could display a sympathy towards the non-human world that was ahead of its time, nevertheless painted the giant squid as a pitiless and voracious killing machine that threatened both passing sperm whales

¹ Using the word 'leg' with a looseness that has become sadly typical of these essays.

² The majestic Oxford English Dictionary has 'octopuses' as the plural, I know, though other sources suggest octopi as a commonly used 'hypercorrect' form, meaning it is 'incorrect because of a mistaken idea of standard usage'. Wonderful! – so hypercorrectness is naturally where the heart inclines...

³ The spiders and millipedes fare little better, mind. But that's another story.



and the mighty *Nautilus* submarine itself, and that pioneer of popular science-fiction needed to insert a good dollop of heroic derring-do into the tale to save the day.

Is all this righteous horror just a little ... unjust? One of my abiding memories is of a family holiday on the northern rocky coast of Mallorca, where a little gentle snorkelling uncovered shoals of jewel-like fish⁴ swimming among the submerged crags. Then, a movement among the rocks ... and we leapt startled out of the water to safety. An octopus – surely ten metres across! After a while curiosity got the better of naked terror, and we returned in trepidation to take a peek – by now it had shrunk to only a couple of metres across – before again hightailing it back to the shore. Another cautious venture into imagined Gilliatt-land, and this monster of our minds – those antique novelists and blockbuster directors had done their work all too well – was by now about a foot across, and making its way across the sea floor with what we could only describe as a kind of *sentient* curiosity that seemed a world apart from the beautiful but instinctive darting of the jewel-fish. It was quite riveting. From time to time, it was clearly watching *us*, in what seemed an eerily similar way to how we were watching it. Octopi, glimpsed from time to time over the next few days, became the main attraction of our submarine explorations, and the main item crossed off the menu gastronomically, on the grounds that it felt like the height of bad taste to eat a creature that might now hide the soul of a poet beneath its endlessly protean mantle.

Divining the octopus mind has occupied quite a few scholars, rather more rigorously than in such accidental encounters. The philosopher Peter Godfrey-Smith in the thought-provoking *Other Minds*⁵ begins his own descriptions with a quotation made by Claudius Aelianus in the third century AD, that 'mischievous and craft are plainly seen to be characteristics of this creature'. His narrative then develops this pithy encapsulation with chapter and verse on complex and aware behaviour, from personal observation and from the zoological literature: how octopi choose their moment to escape from tanks when the scientist's back is turned; how they can find discarded half-coconut shells on a sea floor, carry them back, then re-assemble them into a sphere to hide inside; how they navigate mazes, unscrew bottles (even from the inside), how they show behaviour that can only be described as playful – or, squirting water at their human captors, indeed mischievous.

A cute kitten with eight legs? Well, the point is made that the octopus has a great many neurons, but most of them are concentrated in the arms⁶. This is nothing like the vertebrate model: the octopus mind, hence, is far more *distributed* – and so, of course, more mysterious and alien, despite the cross-species observations that seem to hold something resembling fascination for both sides. It is not just the octopus: the cuttlefish is also brought into the debate by Godfrey-Smith, who describes what he calls the 'friendliness' this cephalopod can show to a human diver – an active and curious engagement, mirrored by the expressive and mercurial colour changes of that animal. The brilliance does not last long. Godfrey-Smith describes his shock on learning that the complex bodies and minds of most squid and octopi fall apart after just a year or two. Compare this brief lifespan with that of another mollusc, *Arctica islandica*, the ocean quahog (not

⁴ I know, I know ... a cliché beyond the pale. But there seemed to be no better adjective at the time.

⁵ Godfrey-Smith, Peter. 2016. *Other Minds: The Octopus and the Evolution of Intelligent Life*. HarperCollins. I thank Adrian Rushton for introducing me to this book.

⁶ Or legs, as it were.



the most fascinating of pets, one would hazard), that can reach 500 years and more. Nature's patterns can be quirky, not to say poignant.

So far, so good – but why does this matter to palaeontology? Well, we explore the prehistoric world with enormous energy and great rigour to reconstruct the biospheres that have succeeded each other over many millions of years in deep time. The energy and rigour can be on a high-superhuman scale – think of Louis Agassiz, anatomizing 1,700 fossil fish, or Alcide D'Orbigny, putting names and hence respectable nineteenth century formality on nearly 18,000 microfossil species. And we reconstruct these worlds with as much accuracy as we dare in museum dioramas, while Hollywood uses the big fierce animals of the past to send a shiver up the collective spine of the paying public. But there is another dimension that might be developed, if only to soften the worst of the public caricatures of our profession. What, on a smaller, humbler and more familiar scale, were the creatures of those worlds *like*?

After all, for every zoologist and palaeontologist, there are thousands of people who share the worlds of other organisms in one way or another in ways less rigorously but, just perhaps, in some ways more fundamentally. We keep pet cats and dogs and other creatures, treat them as family members, form close attachments to them, and imagine personalities for them – or at least interpret what we can dimly translate of their actions and signals in terms of personality. We go bird-watching, whale-watching, take trips to the zoo. We sometimes find more emotional solace from these creatures than we do from our fellow humans.

There is no democracy in this, though. To most of us⁷, a kitten and a crocodile are not alike in our personal animal cosmologies. We develop prejudices for favourite and less-favourite animals, and some part of this depends on how they interrelate with us. As a kid, I grew up around a wild bird hospital, and one could clearly sense the difference between an owl (beautiful, but mostly thick as two short planks), seagulls (thugs – though not always dislikeable ones) and the clear family favourites, rooks and crows. These were birds of quite another feather, which showed the kind of awareness, sentience and ability to form trans-species relationships that one might compare with those of a cat – or an octopus. Our ancestors, less cut off from the natural world than we modern humans are, certainly developed this kind of taxonomy to a much greater degree. Even some of our rather closer scientific ancestors, such as the Comte de Buffon, used the personalities of animals in his zoological classification, regarding the then nascent Linnean system as too crudely mechanistic.

In reconstructing the world of the past, our focus on such as phylogenetic lineages, palaeoecological reconstructions, not forgetting the twin labyrinths of systematic taxonomy and biostratigraphic correlation, mostly overwhelms such less reproducible sentiment. Such as, for instance: where might one find in, say, the Jurassic, the kind of animal intelligence and sentience that we as humans might be able to relate to? Here, one can posit, if one likes, that time-worn time-travelling palaeontologist landed into those distant times. Or to put it another way, which of those ancient creatures might we choose for a pet, to provide some human company on what might otherwise seem a friendless planet?

The dinosaurs themselves, feathered or otherwise, may be just simply out of scale, even if we might not feel the kind of terror and disgust conjured up, say, by the pen of Arthur Conan Doyle in *The Lost World*, or by contemporary Hollywood. The few tiny mammals of those times might

⁷ Though perhaps not to the admirable David Attenborough.



simply run too scared of the saurian overlords to retain any sense of trust. The early birds (one suspects) might more resemble indifferent seagull and owl than sympathetic crow as regards avian intelligence. Perhaps for a sense of contact with sentient Jurassic life, one might have to don aqualung, turn to the sea and go to meet the cephalopods.

If this line of organisms really is the second great pinnacle of intelligence on Earth, then perhaps one of the times of its greatest development might offer contact with the kind of behavioural complexity that a human might relate to, both scientifically and emotionally. Octopi were present then, from the scant fossil evidence. And, there was that mighty array of ammonites and belemnites. Ammonite behaviour fossilizes even more poorly than does the carcass of a Jurassic octopus – at least as regards the subtle, complex interactions that can be seen in cephalopods today. But, if we wish to imagine Jurassic life at the level of communing in a simple and unscholarly way with the life of the times, then this might be the stage to explore. Some of those ammonites, especially the cartwheel-sized ones, must have lived longer than the sadly transient octopi of today, something that might be linked to deeper thought, or at least longer acquaintance. And, as a sop to our sensibilities, these animals possessed shells overtly beautiful to human eyes.

Our time-traveller might need, of course, to keep a watchful eye out for any hungry marine reptiles that might be lurking. In that case, it may be prudent, and helpful to the fostering of inter-species acquaintance, to design some more secure meeting-ground. This is now standard practice – but at the very beginning of such engineering in modern times, an elegantly shelled cephalopod stole the show.

This was not the pearly *Nautilus*, but the argonaut (sometimes called the 'paper *Nautilus*') *Argonauta argo*, a creature that has been wondered and puzzled over since the times of the ancient Greeks, with honorable mention by Aristotle, Lord Byron, Alexander Pope and (in much more idyllic prose, now) Jules Verne. The little pelagic octopus of *Argonauta* can leave its shell completely, use it to brood its young, or even trap bubbles of air in it to adjust its buoyancy. Was this particular octopus, then, a shell-scavenger, in much the way that a hermit crab selects a home from among abandoned gastropod shells? That was a generally held idea among the savants of those times.

There then came on to the scene someone who got much closer to the lives of these creatures, a woman as remarkable as her contemporary Mary Anning of Lyme Regis – but whose story had a considerably happier ending. Jeanne Villepreux came from a mostly illiterate background in southern France. She did learn to read and write, but the background worsened when her mother and sister died, and a stepmother came upon the scene. In 1812, aged 18, she set out to walk the nearly 500 kilometres to Paris, in the care of a cousin, with a flock of animals for slaughter in that city's abattoirs. The care was illusory. Along the way, the cousin attacked her. Escaping, and finding temporary shelter in a convent, she made her way to Paris alone, with no place to live and no employment.

By sheer chance, one of the great couturiers of that city took pity on her and gave her work. She thrived, to the extent of being given responsibility for a royal wedding dress, and among the festivities she met a rich young English businessman, James Power. They fell in love, married, and settled in Sicily. Such a fairytale ending should have ended in a life in elegant society for



the newly wealthy Jeanne Villepreux-Power. Instead, she focused her life on study of the natural history of Sicily – among which she resolved to solve the millennia-long mystery of *Argonauta*, which then teemed along those shores.

Instead of studying dead specimens, the basis for the earlier scholarly work on these animals, she kept company with them alive. And rather than going into the sea, she brought the sea to her in a practical engineering sense, by building ‘Power cages’ to hold in the seawater, and placing within these the organisms that she wished to study. Some of these cages were constructed in the sea and others (the fore-runners of our familiar aquaria, of which she is generally regarded as the inventor) were placed higher, on dry land.

For some ten years, she kept these ‘voracious little worlds’ going, and in one of them she managed to grow *Argonauta* from eggs – a difficult task as these animals do not tolerate captivity well. The experiment was a success. She observed how the juvenile octopi indeed secreted their delicate shells, using a sheet of tissue that Aristotle (and after him Byron, and Pope, and Verne) had interpreted as sails, that they imagined caught the wind to propel these little creatures along the sea surface like so many molluscan yachts. She demolished both the yacht model and the model of a kind of ‘hermit argonaut’, and communicated her results to other scientists including that formidable old warrior Richard Owen of London’s Natural History Museum, who – normally brooking little competition on anything that came close to his own ground – expressed much admiration. Jeanne Villepreux-Power broke into the male-dominated scientific hierarchy of the day, being elected to the Royal Society of London in 1839 – and eventually to 15 other scientific academies across Europe.

The reward of a natural gift for science, or the result of an innate sympathy for organisms not of our kind? One wonders ... and one would guess both. Victor Hugo would doubtless say it is sympathy for the devil. But, this kind of sensibility might help us get down to Earth, in our long and lonely journeys along the fourth dimension.

Jan Zalasiewicz

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R for palaeontologists

8. Analysis of Phylogenetics – Part 1: Introduction

Introduction

My primary aims when I started writing this series were to demonstrate that coding is not as scary or as difficult as it may appear, and secondly that there are a range of tools readily available to assist you in manipulating, analysing and plotting your data. As a result, I have ended up spending a lot of time dealing with the wider skills useful for all R coders rather than more applied techniques. As with other areas of data science there has been a steady growth in the number of packages available for palaeontological analyses, which has helped to revolutionize the way these analyses are conducted in recent years.

This, and the next couple of articles, will focus on the packages that have been designed for the analysis of phylogenetic trees. In the first instance I will cover the basics of how R deals with phylogenies, then move on to the time-scaling and plotting of trees.

Useful packages for phylogenetic analysis

As you will now be well aware there are more than a couple of thousand packages available for the R language (12,585 on CRAN alone as I type and likely several more by the time you are reading this). For the analysis of phylogenies alone there are more than 50 packages available, allowing a huge range of analyses to be conducted such as modelling evolutionary or diversification rates.

However, before we begin I want to introduce the *ape* package (Analysis of Phylogenetics and Evolution; Paradis *et al.* 2006). This package provides functions for reading, writing, manipulating, analysing and simulating phylogenetic trees and is important as many of the other packages I will cover rely on this package for their own uses.

As always, before we begin the package needs to be installed and loaded into the R environment, as follows:

```
install.packages("ape", dependencies=TRUE)
```

```
library(ape)
```

The structure of a phylogeny in R

To begin with we can use the *ape* package to generate a simple random tree with 10 taxa so we can see the underlying structure of these data objects. This can be done using the `rtree` function:

```
tree <- rtree(n=10)
```

(Note that because this is a random tree your own output will likely differ slightly from the one shown here.) We can plot this new tree using the `plot.phylo` function as follows (although you can also use the `plot` function and it will work in the same way):

```
plot.phylo(tree)
```



As you can see we've created a random topology containing ten taxa. By calling up this data object we only get to see some limited information about its contents such as the number of tips, internal nodes, the names of the first six tips and whether the tree includes branch lengths.

Phylogenetic tree with 10 tips and 9 internal nodes.

Tip labels:

t5, t3, t7, t9, t4, t2, ...

Rooted; includes branch lengths.

While this can be useful for general purposes sometimes it is more informative to look at the full structure of the object, which we can do using the `str` function:

`str(tree)`

This will produce the following output:

```
List of 4
 $ edge   : int [1:18, 1:2] 11 12 12 11 13 13 14 15 16 16 ...
 $ tip.label : chr [1:10] "t5" "t3" "t7" "t9" ...
 $ edge.length: num [1:18] 0.242 0.157 0.207 0.216 0.813 ...
 $ Nnode    : int 9
 - attr(*, "class")= chr "phylo"
 - attr(*, "order")= chr "cladewise"
```

To make this easier to understand we should start by plotting all of this information on our random tree using the `plot` function from earlier, as well as three other functions that add the number of each tip, node and edge to the tree (Figure 1a, over the page):

```
plot.phylo(tree, label.offset=0.1)
tiplabels()
nodelabels()
edgelabels()
```

Starting with the tips you can see that these are labelled from 1 to the number of tips in the tree (n). The internal nodes are then labelled continuing on from this point (*i.e.* $n+1$). It is worth pointing out that for any given tree these figures are a constant and will remain the same even, for example, after rearrangement of the nodes by the `ladderize` function (Figure 1b).

```
plot.phylo(ladderize(tree))
```

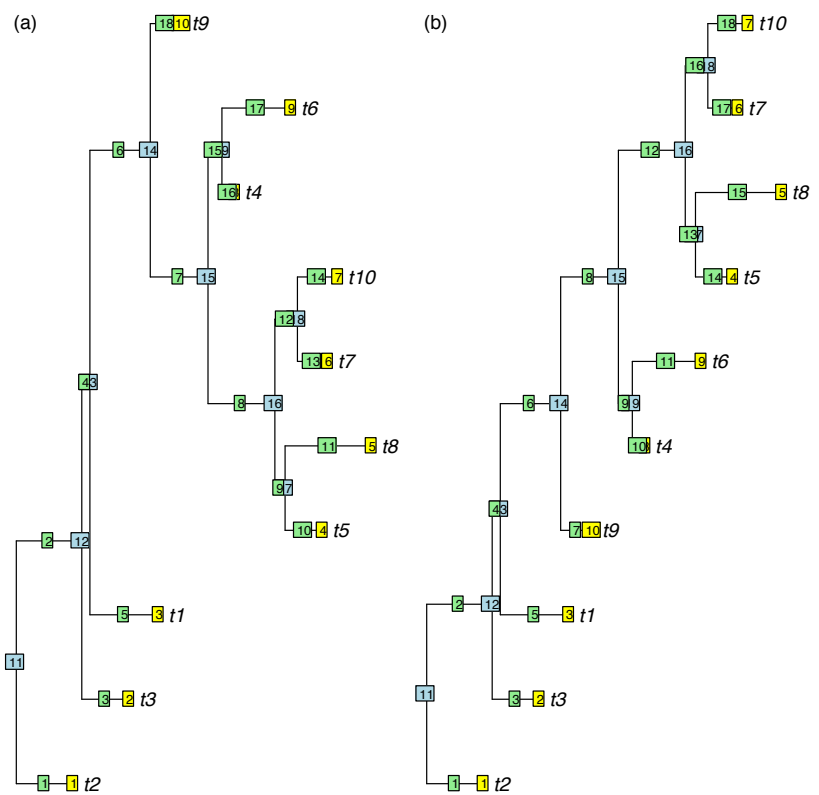


Figure 1. Randomly generated tree with tip (yellow), internal node (blue) and edge (green) numbers shown for the (a) default plot and (b) with the tree shown ladderized.

The final component to discuss is the edges, or the branches that connect the nodes (both tips and internal nodes). We can examine them by typing:

```
tree$edge
```

This will output a table that shows the start and end node for each edge in the tree. Below is the output for the first five edges.

	[,1]	[,2]
[1,]	11	1
[2,]	11	12
[3,]	12	2
[4,]	12	13
[5,]	13	3

You can see how these relate if you compare the table above with the edge numbers, highlighted in green, in our randomly generated tree (Figure 1). For example, the first edge (*i.e.* the first row in the table above) connects the 11th node, the root node, with the 1st node, with the taxon called t2.



Loading in the tree and data files

Now we've been through a quick overview of how phylogenetic tree data are structured within R we can move on to the main aim of this article. Prior to the majority of analyses of phylogenetic data, it is important that the branches of your tree have some kind of length. For the analyses in this article and for others in the future I will focus on time-scaled trees, *i.e.* where the length of each edge represents the geological range in millions of years. Here we are going to work through an example of first time-scaling a tree and second plotting the resulting tree against the geologic time scale.

The datasets and examples I will be working through in this article come from the *strap* package (Stratigraphic Tree Analysis for Palaeontology; Bell and Lloyd 2015), which was developed by Graeme Lloyd and myself. This package was designed for calculating branch lengths, plotting against the geologic timescale and calculating the stratigraphic fit of phylogenies. The paper cited above, and references contained therein, provide more detail of some of the methods I will discuss here.

The first step as always is to install and then load the relevant package:

```
install.packages("strap", dependencies=TRUE)
```

```
library(strap)
```

Loading in the tree and data files

Before we start working through examples to calculate branch lengths and plot the resulting trees we need some data to which we can apply these methods. The *strap* package contains two in-built datasets, one for lungfish (from Lloyd *et al.* 2012) and one for asaphid trilobites (from Bell and Braddy 2012). However, it is probably more useful to show you how to import your own datasets first.

Firstly, the tree we will be using is in the Newick format, and these files are best imported using the `read.tree` function from the *ape* package as follows.

```
Dipnoi.tree <- read.tree("Dipnoi.tre")
```

It is worth noting that other functions exist, in the same package, that allow for the importing of different formats of trees, such as using the `read.nexus` format to import files in the #NEXUS format.

Secondly, as well as the tree file we also need an additional file that contains the stratigraphic ranges of all taxa in the tree. This file contains two columns of numbers (for first and last appearances, respectively, in millions of years), with row names that must correspond exactly to the taxon names in the tree file.

```
Dipnoi.ages <- read.table("Dipnoi-ages.csv", row.names=1)
```

As I mentioned earlier these datasets are both already in-built into the *strap* package and are stored as the `Dipnoi` dataset.



If we view the tree we have just loaded by typing **Dipnoi.tree** we will get the following output:

```
Phylogenetic tree with 86 tips and 85 internal nodes.
```

```
Tip labels:
```

```
    Psarolepis_romeri, Diabolepis_speratus, Dipnorhynchus_kiandrensis,  
    Archaeonectes_pertusus, Uranolophus_wyomingensis, Speonesydrium_iani, ...
```

```
Rooted; no branch lengths.
```

From this simple output we can see that the tree contains 86 tips (for which it has provided the names of the first six species) and 85 internal nodes. This output also notes that currently the tree has no branch lengths. To illustrate this we can plot the tree in a simple way using the plot function:

```
plot(Dipnoi.tree, no.margin=TRUE, cex=0.4)
```

Figure 1a shows the default plot of a tree with no branch lengths, whereby all the tips are placed at the same distance from the root of the tree.

Time-scaling the tree

Now that we have all the data we need we can use the **DatePhylo** function to calculate the branch lengths for our lungfish tree using the following:

```
Dipnoi.ts.tree <- DatePhylo(Dipnoi.tree, Dipnoi.ages, method="equal", rlen=1)
```

If no errors occurred while running this function you can now look at the tree as we did earlier by typing **Dipnoi.ts.tree**. You will see the same output as before, but with the difference that the output now indicates that the tree has branch lengths. The effect of this can be seen if we plot the time-scaled tree against the original tree (Figure 2b) or if we type the following to output the branch lengths:

```
Dipnoi.ts.tree$edge.length
```

You will note that here I have included an argument specifying the method to be used in calculating the branch lengths. There are a number of different methods to reconstruct branch lengths and the default option for this function will result in branches that have a length of zero. I don't have time to go through this in detail here but see Bell and Lloyd (2015) for a more thorough discussion of these issues.

Before I move on to plotting the time-scaled tree it is important to make the point that there are other packages that perform similar functions to *strap*. **timePaleoPhy** from the *paleotree* package (Bapst 2012) operates in a similar way to **DatePhylo** and can be used in conjunction with other functions of *strap*.

Plotting phylogenies

In the first couple of articles I described the strengths of the graphics capabilities of R and demonstrated some of the many arguments available for the basic **plot** function to control the look of graphics. The same is true for the **plot.phylo** function in that it provides a similar level of control over all graphical elements of your phylogeny – including the tips, nodes and edges as well as the overall size and shape of the phylogeny.

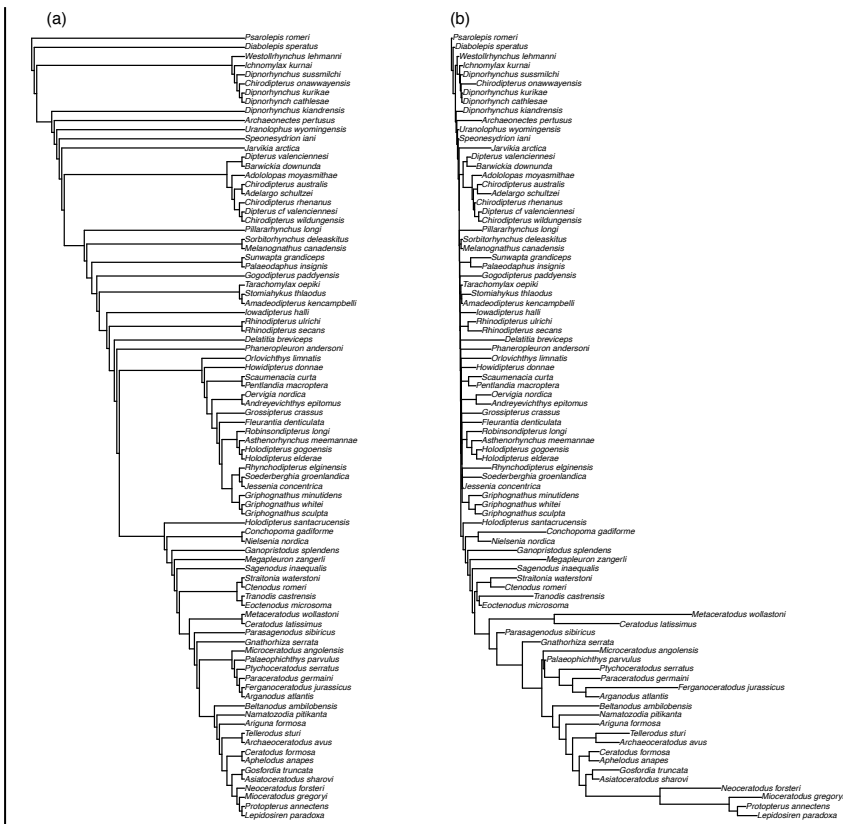


Figure 2. Plot of the Lloyd et al. (2012) lungfish tree (a) without and (b) with branch-lengths.

I won't go through all of the available options in detail save to say that the syntax for the arguments in **plot.phylo** should be familiar from **plot**. Table 1 highlights a number of these arguments so you can experiment with your own trees, and more information about this function can be found in the usual help file:

help(plot.phylo)

Table 1. Some key arguments used to control the look of plots of phylogenetic trees.

Argument	Result
type	The type of phylogeny to be drawn, i.e. "phylogram", "cladogram", "fan" or "radial".
cex	Controls the size of the tip names.
edge.col; tip.col;	Controls the colour of the branches or tip names.
no.margin	Sets all the margins of the plot to zero.
edge.width; edge.lty	Sets the width or the type of line for the branches.
underscore	When set to FALSE removes the underscores from tip names.
font	The type of font for the tip labels
align.tip.label	When set to TRUE will align all tip labels and add dotted lines between the tips of the tree and the labels.



To end with I want to demonstrate another of the capabilities of the *strap* package. The **geoscalePhylo** function allows for our time-scaled tree to be plotted against the current geologic time scale (Gradstein *et al.* 2012). As we have used **DatePhylo** above to calculate the branch lengths all the information we need is already included within the data. Firstly, as we have discussed above, there is a length for every branch (stored as `$edge.length`) and critically there is also an age for the root of the tree (stored under `$root.time`).

Importantly, while this method is ideal if you have used either the *strap* or *paleotree* packages as they will calculate and return the root time, this may not be true if you have used another method to calculate the branch lengths. In this case you can simply add a root age to your tree using the following example:

```
exampleTree$root.time <- 102.3
```

The **geoscalePhylo** function allows the user some control over the plot, including the look of the geologic time scale (such as the temporal units to be included) and the direction the tree is plotted in. Also, by providing the dataset containing the first and last appearances we used earlier the plot can also include the taxon ranges themselves as thicker lines. Figure 3 shows the plot when some of these options are used.

```
geoscalePhylo(Dipnoi.ts.tree, ages=Dipnoi.ages, tick.scale="Epoch",  
direction="upwards")
```

However, while there are a number of available options, all that is needed to produce the default plot is the name of the dataset you want to plot:

```
geoscalePhylo(Dipnoi.ts.tree)
```

Summary

In this article I have aimed to cover some of the basics of phylogenetic analysis, including how these data are stored in R as well as how to load in, time-scale and plot phylogenetic trees. What I have discussed here will become more relevant in future articles as I will cover more applied analytical methods that take advantage of these principles.

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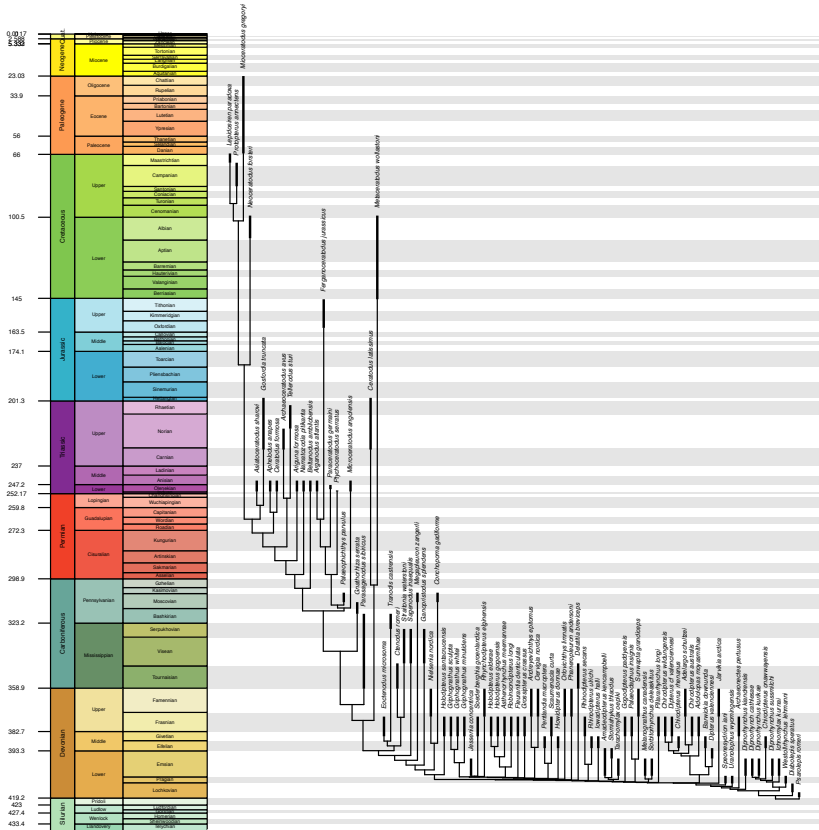


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The Virtual Natural History Museum

As researchers, we are blessed with the unprecedented level of access to specimens that digitization has brought to our field. With just an e-mail to a museum curator, we can often obtain high-resolution images of specimens in just a few days, and – as is becoming more and more common – many museums already possess digital catalogues of their specimens which we can instantly access.



Although we have such a wealth of digital content available to all of us, this is not immediately apparent or accessible to non-researchers. As with physical collections, digitized collections must positively fulfil the following criteria (and likely more) in order to be of use to the public:

- Are people aware of the existence of the museum?
- Are people aware of the existence of its online collections?
- Can people access these collections?
- Are people aware of the contents of its digitized collections?
- Are all specimens available to view?
- Is the collection small enough to be manageable?
- Is context/explanation of the significance of a specimen given?
- Is the exploration of these collections educational and enjoyable?

To address many of these challenges, Palaeocast has conceived the Virtual Natural History Museum (V-NHM). This is an innovative new website designed to facilitate and encourage new audiences to explore palaeontological content by collating existing multimedia and presenting it back within the context of a public display: a digital museum for digital fossils. Instead of being presented with researcher-intended taxonomically-arranged lists, users will be given a virtual space with exhibits and galleries to explore.

In being digital, the V-NHM will also have several key advantages over its physical counterparts:

- It will have no overhead costs other than the initial cost of the website and the yearly domain registration and hosting;
- It is accessible to anyone, anywhere in the world, with an internet connection;
- It will have no opening or closing times;
- It has no limits to its size or how many specimens can be displayed;
- Layout of the museum and exhibitions can be instantly changed;
- Museum content and displays can be instantly changed.

It doesn't stop at images either; as the field utilizes and develops new digital solutions to research questions, the resulting multimedia outputs can be made instantly available to any other researcher in the field. Whether using CAT-scans, biomechanical models, phylogenetic analyses or photogrammetry, each method delivers its own multimedia output. Recordings of past



conferences and lectures can also be made available on demand (we've already got the last few years-worth of PalAss presentations recorded). All of these outputs can be incorporated into the V-NHM, so the museum experience evolves from a specimen behind a glass cabinet to a specimen that you can virtually manipulate, see inside of and listen to experts discuss.



The Jurassic exhibition space.

One demographic of particular importance to us are students. Back in 2012, the Earth Science Teachers' Association (ESTA) wrote an open letter to members of the Association asking for such a digital resource. Given the difficulty and cost of curating a teaching collection that contained enough good specimens or replicas to teach the curriculum, students were at risk of the subject becoming ever more paper-based. The ESTA members stated that access to good quality copyright-free images of fossils would be 'extremely beneficial' and asked for advice, assistance and support in the development of interactive web-based resources and palaeontological-themed games and activities that would help capture the imagination of school pupils.

Since there is no limit to the V-NHM's number of floors, rooms, exhibits or fossils, we intend to create an educational wing to the museum, where teachers and students can find the best fossils that will help teach them the national curriculum. The ESTA and the OCR have both been very excited about this prospect.

As to where the project is now, the Virtual Natural History Museum was successfully funded through a grant from the Palaeontological Association in 2014 (Engagement Grant number PA-OE201401), another grant from the Geologists' Association and an additional crowdfunding



campaign. Since then, there has been a lengthy developmental stage in which the back-end functionality of the Museum has been developed together with Silverchip Ltd, a web development company. This has now been completed, the Museum created and the use of the collections of many of the UK's major institutions negotiated. The project is now focusing on the contents and layout of the public displays.



The grand entrance of the V-NHM.

An Invitation

Of vital importance to this is getting the input of the palaeontological community, since deciding which content to display and what to write about it is a task that I cannot and should not attempt alone. We're all experts in our own fields, and writing a paragraph about the significance of any of the taxa/specimens we study is something that would come very easily. Yet for the public and for education, this kind of information is invaluable. I would therefore invite the palaeontological community to get involved with the project and share our vision to create the world's greatest palaeontological museum online. Individual submissions can be made via www.vnhm.org/submissions – or if you'd like to be a digital curator, please contact dave@vnhm.org.



Dave Marshall
University of Bristol



>> **Future** Meetings of Other Bodies



International Conference on Ediacaran and Cambrian Sciences

Xian, China 11 – 21 August 2018

This is a joint meeting of the Ediacaran and Cambrian subcommissions and will feature three days of topical sessions focusing on Neoproterozoic–Cambrian life and environments. Pre- and post-conference field excursions will be arranged. Registration and abstract submission are now closed.

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



10th European Palaeobotany & Palynology Conference (EPPC)

University College Dublin, Ireland 12 – 17 August 2018

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

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



GeoBonn 2018

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

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

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



8th International Conference on Synchrotron Radiation and Neutrons in Art and Archaeology

University of Portsmouth, UK 3 – 7 September 2018

SR2A conference series focuses on the innovative use of synchrotron and neutron radiation to investigate artistic and archaeological materials and artefacts. The 2018 conference will specifically focus on Technique Advancements for Synchrotron Radiation and Neutrons, Multi-technique Analytical Processes and Complementary Methods, the Impact of Analytical Techniques, Conservation & Monitoring methods, Materials & Processes, and Archaeological & Paleontological Advances.

The conference is open to all interested professionals, including archaeologists, conservation scientists, conservators, geochemists and material scientists, researchers with experience utilising large-scale research facilities and other analytical techniques, curators, cultural heritage managers, art historians, students and potential users of synchrotrons. Abstract submission is now closed; registration closes on 24th August. Further details at <<http://www.diamond.ac.uk/Conference/SR2A-2018.html>>.



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

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

SVPCA is a meeting for current research in vertebrate palaeontology and comparative vertebrate anatomy, and has been held annually in the UK, Ireland or France since 1953. The meeting is held in conjunction with SPPC, a forum for discussion of fossil preparation, conservation and related topics co-organized with the Geological Curator's Group. The 2018 SVPCA and SPPC meetings will be held jointly at the Universities of Manchester and Salford with two days of meetings and a field-trip. The Jones-Fenleigh Fund is available to help delegates with no institutional financial support to attend the meeting. Registration and abstract submission are open until midnight on 18 July. Please see the website for details: <http://svpca.org/years/2018_manchester/>.



The Micropalaeontological Society 6th Silicofossil and Palynology Joint Meeting 2018

Plymouth University, UK 5 – 8 September 2018

The 6th Silicofossil and Palynology Meeting will be held at Plymouth University with lectures and posters on 5th – 7th September and a field excursion on 8th September. Local organization will be provided by Prof. Malcolm Hart, Dr Meriel FitzPatrick, and Dr Christopher Smart.

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

Please see the website for details: <<https://www.tmsoc.org/silicofossil-palynology-joint-meeting-2018/>>.



11th International Meeting on Phytolith Research

Wuhan, China 14 – 16 September 2018

The International Phytolith Society holds biennial meetings, which attract a world-wide audience and create the chance for researchers in phytolith studies from different disciplines (archaeology, botany, plant physiology, environmental studies, geology and many more) to get together and focus on phytoliths.

Please see the website for details: <<http://www.11thimpr.cn>>.



78th Society of Vertebrate Paleontology Annual Meeting (SVP)

Albuquerque Convention Centre, USA 17 – 20 October 2018

Each year, vertebrate palaeontologists, preparators, writers, artists and enthusiasts convene to share the latest research, attend workshops and field-trips, and meet new fossil fans as well as old friends. It's the world's foremost forum on vertebrate palaeontology, usually referred to simply as 'SVP'.

The 78th Annual Meeting of the Society of Vertebrate Paleontology will be held in Albuquerque, New Mexico. Abstract submission is now closed, Early bird registration is open until 16th August.

Visit <www.vertpaleo.org> for up-to-date meeting information.



Linnean Society Palaeobotany and Palynology Specialist Group Meetings

Burlington House, London, UK 21 – 22 November 2018

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



1st Palaeontological Virtual Congress

Virtual environment 1 – 15 December 2018

The emergence of new applications and technologies opens a wide range of possibilities regarding new forms of communication in the scientific world. Aware of this we are glad to present the 1st Palaeontological Virtual Congress with the purpose of spreading worldwide the most recent scientific advances in palaeontology in a fast, easy and economical way.

This Congress is a pioneer in palaeontology, being exclusively developed in a virtual environment. Oral communications and posters about any palaeontological field will be presented through an online platform created *ad hoc*. The simplicity of this new format allows for low-cost registration



fees and saves travel and maintenance expenses. Consequently, this initiative aims to give international projection to the palaeontological research carried out by groups with limited economic resources and promoting the participation of palaeontologists from developing countries.

On the other hand, the 1st Palaeontological Virtual Congress combines the benefits of traditional meetings (*e.g.* providing a forum for discussion, including guest lectures or the production of an abstract book among other things) with the advantages of online platforms, which allow reaching a higher number of researchers across the world. In this sense, online congresses also enable the creation and management of new thematic workshops by the participants. We strongly encourage you to send us your own workshop proposals dealing with any palaeontological topic. The organizing committee will review your proposal and tell you if it is accepted.

Please see the website for further details: <<http://palaevoc.uv.es/>>.



JK2018

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

The aim of JK2018, the International Meeting around the Jurassic–Cretaceous Boundary, is to discuss eustatic, biological, physiographical, geochemical *etc.* events at/near the boundary (*i.e.* over an interval of time spanning the Kimmeridgian to the Hauterivian, with a special focus on Tithonian to Valanginian strata). Early bird registration closes on 15th September.

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



The past is a foreign country: how much can the fossil record actually inform conservation?

London, UK 28 – 29 January 2019

This meeting, to be held at the Royal Society in London, aims to bring together researchers from the fields of deep-time palaeontology, Quaternary science, historical ecology and conservation biology to provide expert-based interdisciplinary assessment of the potential opportunities for using different long-term biodiversity archives to inform conservation and environmental management, and critical evaluation of the potential limitations of using past data to understand the present and predict the future. This scientific discussion meeting is organized by Dr Samuel Turvey and Associate Professor Erin Saupe. Participants of the meeting will be able to present a poster. If you would like to apply to present a poster please submit your proposed abstract to the Scientific Programmes team no later than Friday 26th October 2018 (see website for details). Please note that places are limited and abstracts will be selected at the scientific organizers' discretion.

Register online at <<https://royalsociety.org/science-events-and-lectures/2019/01/the-past-is-a-foreign-country/>>.



4th International Meeting of Early-Stage Researchers In Palaeontology (IMERP)
Cuenca, Spain 12 – 14 June 2019

The IMERP is aimed at early-stage palaeontologists, from undergraduate students to postdoctoral researchers. Geologists, biologists or any scientist with research topics related to palaeontology, as well as palaeoartists, are also welcome. The IMERP has two main objectives: to provide a friendly environment for early-stage researchers to share their research through oral or poster presentations and follow each other's progress; and to share new methods and ideas useful in palaeontology, thus developing the skills of the attendees with the help of leading experts invited to give lectures about their fields. The IMERP is held in villages or towns located close to areas of geological interest. A field-trip in this palaeontological and geological heritage area will be offered.

More information will be provided closer to the date. Check the website for updates:
<www.imerp2019.weebly.com>.



3rd International Congress on Stratigraphy (STRATI 2019)
Università degli Studi di Milano, Italy 2 – 5 July 2019

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

For more information please e-mail <info.strati2019@unimi.it>.

Please help us to help you! Add your own meeting using the link on the Association's web page:
<<https://www.palass.org/meetingsevents/future-meetings/add-future-meeting>>.



Meeting REPORTS



The Lyell Meeting 2018, Mass extinctions: understanding the world's worst crises
The Geological Society, Burlington House, London 7 March 2018

Mass extinctions have tailored the path of evolution of life on earth ever since it began. These catastrophes have drawn a great deal of attention from researchers and this year's Lyell Meeting set out to explore some of that research into these dark times of Earth's history.

When one is dealing with a mass extinction it is of vital importance to be able to provide a correlation between different stratigraphic sections across the world. Keynote speaker **Sofie Lindström** (Geological Survey of Denmark and Greenland) showed how this could be achieved by use of palyno- and ammonite-biostratigraphy combined with geochemical perturbations and radiometric dating. This provides not only a high-resolution model for correlating event beds (from the end-Triassic mass extinction event in this instance) but also reveals the order of events. Sofie also discussed the potential driving mechanisms behind the end-Triassic mass extinction and linking these to the environmental disruptions set in motion by Large Igneous Provinces (LIPs). LIPs were a strong running theme throughout the meeting, with these extremely large volcanic centres often attributed the blame for the world's worst mass extinctions (when you don't have a meteorite at hand). Though be it volcanism or bolide impact it is crucial to be able to place both the extinction and the murder weapon (as it were) together at the same time. This is often rather difficult as only in a handful of cases are the extinction horizons and the flood basalts present in the same stratigraphic section. However, **Lawrence Percival** (University of Lausanne), **Tasmin Mather** (University of Oxford) and **Thierry Adatte** (University of Lausanne) each discussed the potential

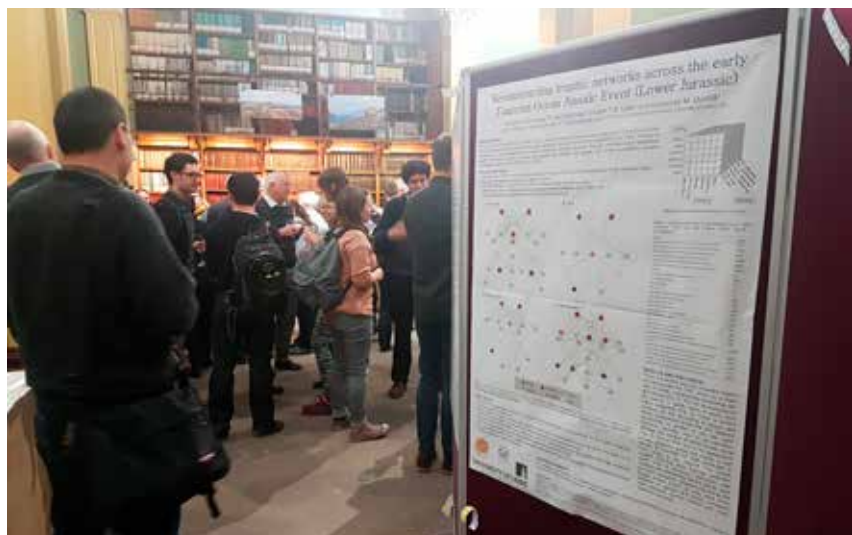


Photo: Autumn Pugh.



use of mercury as an indicator for large-scale volcanism during different extinction events. This rather unpleasant element is emitted from volcanoes as a gas and becomes incorporated in organic-rich sediments; the advantage of this is that elevated mercury signals can be detected from sections that also record the extinction, allowing the link between volcanism and its effects on biotas to be tested.

But it is not the mercury that is the killer with LIPs, rather it is the vast emissions of CO₂ and SO₂ emitted and the cascade of environmental changes that these can cause. We learnt from **Karen Bacon** (University of Leeds) how elevated SO₂ can render leaves rounder and smaller than they would be otherwise, and from **James Rae** (University of St Andrews, though presented by **Sarah Greene**, University of Birmingham) how increasing atmospheric CO₂ during the lowermost Jurassic may have lowered the pH of European shelf seas. Marine anoxia is often considered a part of the cascade of effects brought about by LIPs, with **Sarah Beith** presenting a poster that suggested photic zone euxinia occurred around the end-Triassic mass extinction. It was interesting to learn that the Toarcian Oceanic Anoxia Event (TOAE), which is often cited as being the cause of a secondary magnitude mass extinction in the Lower Jurassic, may not have extended everywhere, with evidence presented from Bulgaria by **Autumn Pugh** (University of Leeds).

And so, we have the links between LIPs and mass extinctions, and the effects of LIPs on their contemporaneous environments. Now what about the response of the organisms that inhabited the planet during these diabolical times?



Photo: Autumn Pugh.



Photo: Autumn Pugh.

Here the focus seemed to be pinned more on the effects on functional ecologies of the animals. **Catalina Pimeiento** (Museum für Naturkunde and Smithsonian Tropical Research Institute) presented work on the loss of functional diversity across mass extinction events, highlighting the importance of redundancy – this being the number of taxa that occupy the same life mode. The greater the redundancy, the greater the resilience that life mode had across an event. Keeping with this theme **Alex Dunhill** (University of Leeds) highlighted the dangers of being a reef-dwelling organism during the Mesozoic, especially if you happened to be a suspension feeder, predator or bear any photosymbionts. Although the majority of talks focused on the marine realm a handful presented data from the



terrestrial, with a particularly interesting talk regarding the ecologies of birds across the Cretaceous–Paleogene (K-Pg) event, presented by **Daniel Field** (University of Bath).

On a lighter note there were a series of talks scattered throughout that looked away from the doom, death and devastation (and many other words beginning with the letter 'D'), and instead told the story of how life continued and prospered after mass extinctions. Such talks included those of **Hojung Kim** (University College London) and **Sarah Alvarez** (University of Bristol) on the restoration of nanofossil communities following the K-Pg event, the second keynote speaker **Mike Benton** (University of Bristol), who rather intriguingly presented the only talk that focused primarily on the Permo–Triassic mass extinction, and lastly yours truly on the recovery from the early Toarcian mass extinction event.

The meeting was an outstanding success with 20 talks, nine posters and a record-breaking attendance – 125 delegates, beating the previous record by 3. A special nod of acknowledgement must go of course to **Dave Bond** (University of Hull), **Paul Wignall** and **Alex Dunhill** (both of the University of Leeds) for convening the event. And lastly if you could not attend the meeting and are feeling as though you have missed out then you can catch up by visiting the Geological Society's Youtube page under Lyell 2018 where you'll find several of the talks in glorious technicolour for your delectation.

Jed Atkinson

University of Leeds



**Advances in Palaeobiological Modelling at the European Geosciences Union (EGU)
General Assembly**
Vienna, Austria 8 – 13 April 2018

Working in a geology department has meant that I have heard a lot about EGU over the past couple of years. Akin to Christmas on the European geosciences calendar, it was advertised by my colleagues as a magical conference in a magical city. So, when **Alexander Dunhill**, **Rachel Warnock** and **Erin Saupe** invited me to speak at an EGU session they were co-organizing I jumped at the chance to get a piece of the action.

Following the success of their session on computational palaeobiology at GSA in Seattle last October, Alex, Rachel and Erin were keen to take this flavour of palaeontological research to the European stage. The EGU session focused around recent computational modelling advancements in palaeobiology and featured talks and posters on a range of topics from virtual palaeontology and morphological analysis, to phylogenetic, statistical and ecological modelling. These, of course, are not new topics in palaeontology, but modelling approaches are evolving fast in many directions, especially as palaeontology is colliding with different disciplines. Bringing a diverse set of researchers from various career stages together at EGU is therefore an ideal opportunity to keep up to date and showcase new ideas on the broad topic of modelling.

Those of you reading this who have had the opportunity to attend EGU may recall the sheer size of the conference. As I arrived at the conference venue bright and early on a very sunny morning,



EGU: Dinosaur hall in the Natural History Museum Vienna.

there was no question of what direction to take as the hordes of delegates getting off at the same metro stop piled past me towards the conference centre. Once inside, it was clear that the conference operated with military-style precision. Organizers and helpers swarmed in and out of rooms wearing bright yellow t-shirts and small groups very quickly began to form in every part of the main foyer speaking a plethora of different languages.

Fossil fans, clutching coffee cups filled with anything but the artisan coffee one expects while in Austria, gathered for the first session of the morning to hear talks from six invited speakers. **Daniele Silvestro** kicked off the session describing quantitative methods he uses to infer diversification, dispersal and extinction. I followed with an overview of my recent research on patterns of early tetrapod diversity and biogeography. Next, **Bjarte Hannisdal** discussed ways in which causal connections can be extracted from palaeontological time series, before **Sam Giles** switched to a different kind of modelling as she talked about the fresh insights on the rise of ray-finned fishes gained from CT scans of fossils. **Christopher Dean**, who successfully defended his PhD thesis only a fortnight prior to the conference, spoke about missing molluscs and modelling the spatial impacts of aragonite bias. To close the oral session, and allow us to go in search of 'proper coffee' (and a slice of Sachertorte), **Graeme Lloyd** took us on a journey through discrete character morphospace.



EGU: *Oestocephalus granulatus*, a *lepospondyl* from Nyrary coal mine.



During the day, there were many other talks in the discipline of stratigraphy, sedimentology and palaeontology on offer, including sessions on human evolution and mass extinctions, along with the second session supported by the Palaeontological Association on geochemical-palaeobiological interactions through Earth history (see following report).

Later that afternoon, discussions moved downstairs to one of five colossal halls for the poster session. The selection of posters on display showcased an even broader range of fossil organisms whom have had their data subjected to palaeobiological modelling – from plankton and molluscs to sharks and antelopes. Beers and wine in hands, we settled down for lively discussions about each other's data and methods, creating new connections and building upon old ones in the process. We even managed to snare a few geoscientists who had been drawn to our posters by silhouettes of various dinosaur species. I don't think they regretted stopping by either, because they scuttled hurriedly away to tell their friends about what they learned about measuring phylogenetic diversity, geometric morphometrics and biomechanical analyses (or so I hope...). We ended the day in traditional Austrian style: by eating our own weight in schnitzel and drinking plenty of fine wine and beer.

I couldn't leave Vienna without visiting the Natural History Museum, so following the conference I made a pilgrimage there. As spectacular as the facade is, it barely went any way towards preparing me for the beauty of its contents. Each hall was filled to the brim with countless geological, palaeontological and zoological specimens, meaning there's something for everyone. Dinosaurs displayed with feathers? No problem. Meteorites to marvel at? Of course. Life-size reconstruction of a terror bird? No? Nevertheless, there's one there to fuel your nightmares. A personal highlight was the wonderful collection of amphibian fossils from the Nýřany coal mine in the Czech Republic (late Carboniferous), where each specimen was displayed alongside a plastic model of what it would have looked like in life.

All in all, Vienna, and the Natural History Museum specifically, certainly turned out to be truly magical. 'Magical' might not be the word I would use to describe the conference itself, but I did come away from the event feeling invigorated and with a long list of papers to read – or did that invigoration come from feeling sunshine on my skin for the first time in months?

Emma Dunne
University of Birmingham



EGU: Votivkirche in Vienna.



Geochemical-palaeobiological interactions throughout Earth history at the European Geosciences Union (EGU) General Assembly 2018

Vienna, Austria 8 – 13 April 2018

In pursuit of its aim to bring palaeontology to EGU, the PalAss sponsored two sessions at the conference this year as part of its Grant-in-aid programme. Both sessions were hugely successful, and very well-attended despite the early morning starts. The second session, entitled “Geochemical-palaeobiological interactions throughout Earth history”, was a broad-themed affair, with talks and posters covering aspects of geochemical-palaeobiological interactions from the Palaeoproterozoic to the present day, with a perhaps predictable focus on the Ediacaran. The session kicked off with **Graham Shields-Zhou** presenting his ‘free lunch’ model for the Shuram anomaly, based on his and others’ work on the Chinese successions. Using a mass-balance approach coupled with evidence of redox layering constraining the distribution of early animal-based ecosystems, he presented a convincing argument that extrinsic tectonic controls rather than biological ones were in the driving seat of the Ediacaran–Cambrian radiation of large multicellular life. Involving the weathering of evaporites formed on Rodinia and pyrite formation and burial resulting in a surplus of oxygen, this model requires no fundamental change in biology but can be explained neatly by the orogenic events happening during this interval. This was followed by a fascinating talk by **Magnus Ivarsson** of the University of Southern Denmark, who presented a review of the work of his group on the fossil record of endolithic microbes in igneous rock. Through micro-3D-imaging techniques they have documented fungal hyphae, prokaryote cells and microstromatolites and even trace fossils in the pores, fractures and vesicles in basaltic rock dating from the Palaeoproterozoic. Magnus concluded with a salient take-home point: who knows how abundant these fossils are, if only people were to look?

We were delighted to welcome **Elena Naimark** next, from the Russian Academy of Sciences. Elena presented an interesting talk on the work of her group on decay of brine shrimp over five-year-long experiments. With exquisite images of almost pristine shrimps after five years, she argued that under her experimental conditions Fe ions released from the montmorillonite burial material led to early and persistent (Si-stabilised) pyrite spheres that enabled exceptional preservation when compared to preservation in chlorites. **Kilian Eichenseer** followed, presenting a thorough study comparing the occurrence of aragonite calcifiers with aragonite/calcite sea conditions. He showed that biotic interactions were more important than sea mineralogy, both during and after the Permo–Triassic mass extinction and for corals from the Mesozoic to Cenozoic. **David Bond** then gave a dynamic talk on the kill mechanism of the P-T extinction to a packed conference room. Through detailed study of the P-T sections from the Tethys, he argued that much of the evidence for ocean acidification likely relates to karstic weathering following the widespread regression at this time, and urged that independent evidence of acidification was needed prior to accepting this as the kill mechanism. The final talk of the session was presented by **Roy Wogelius** on behalf of Phil Manning and colleagues. Roy gave us the highlights of the exceptional and wide-ranging results this team has achieved using synchrotron analyses that, crucially, combine imaging and spectroscopy. Their set-up enables detection of metal co-ordination chemistry, allowing discrimination of (for example) pheo- and eumelanin based on the metals each molecule contains. These analyses have been conducted over whole specimens, allowing the colours and patterning



of whole organisms to be reconstructed. After this visually spectacular end to the talks, the session broke into smaller discussion groups, with members taking the opportunity to soak up the sun in the beautiful Donaupark gardens adjacent to the conference centre.

Attendees reconvened later that evening at the poster session. Posters from both PalAss-sponsored sessions were conveniently located adjacent to each other, allowing for mingling of attendees of both sessions. Posters ranged from exploring the link between climate change and the deep biosphere (**Diana Carlsson**) to the population structure of rangeomorph communities (**Katie Maloney**) and to biomarker evidence for palaeoenvironmental conditions in the Central Paratethys during the Early Oligocene (**Małgorzata Wendorff-Belon**). The poster session was well-attended, and scientific discussion (lubricated by excellent Austrian beer) was dynamic and largely positive, with everyone keen to gain the most from the experience. Judging from the attendance at the talks and the poster session, I'd say the PalAss mission to bring palaeontology to EGU was hugely successful – long may it continue!

Charlotte G. Kenchington

Memorial University of Newfoundland



Delegates enjoying the evening palaeontology poster sessions at EGU. These sessions were sponsored with grant numbers PA-GA201711 and PA-GA201713.



10th International Symposium “Cephalopods – Present and Past”

Fez, Morocco 26 March – 3 April 2018

The 10th International Symposium on Cephalopods – Present and Past was organized by Omar Assobhei, the President of Sidi Mohammed Ben Abdellah University, Fez; Thomas Becker of the University of Münster, and Ahmed El Hassani of Hassan II Academy of Science and Technology, Rabat. Cephalopod researchers from all over the world travelled to attend what was a great conference.

Sadly, due to inclement weather conditions (which the British contingent were blamed for bringing), the icebreaker was held inside rather than at the poolside of the lovely Hotel Palais Medina and Spa where the conference was held.

Academic sessions started the following day with each session having a focus on a different cephalopod group. Nautiloids were first up with a diverse focus from the Palaeozoic to recent.

Peter Ward started proceedings with an update on his work tracking nautilus migration patterns. There followed a series of engaging talks on Palaeozoic nautiloids. Following this was a lively



discussion session on the future nautiloid Treatise chaired by **Andy King** and **David Evans**. It emerged that there are many differences in opinion and lots of new taxonomic discoveries to incorporate. The session continued after an amazing lunch, though we were all probably somewhat full of the beautiful cakes we were served. **Stijn Goolaerts** provided the only talk focusing on Mesozoic nautiloids, discussing turnover across the Cretaceous–Paleogene boundary. The session concluded with an exciting talk from **Christian Klug** and colleagues on Palaeozoic evolution of cephalopod mouthparts.



The delegates of ISCPP 10 in Fez. Photo courtesy of Ahmed El Hassani.

The afternoon continued with a series of interesting talks focused on Devonian and Carboniferous ammonoids and a poster session.

Day two started with a session on coleoid evolution and following a coffee break the session on belemnites began. **Patricia Rita** gave a highly engaging talk on her PhD work looking at the effect of the Pliensbachian–Toarcian crisis on body size. **René Hoffmann** presented work he has been doing with a group of colleagues looking at ‘what is recorded in your belemnite?’; watch for the paper when they present the results! After lunch the next session focused on new research directions: from geochemistry to modelling. **Neil Landman** gave a presentation on methane cold seeps and the clues they can provide to ammonite life modes. **Benjamin Linzmeier** spoke about how daily depth migration behaviours can be preserved in $\delta^{18}\text{O}$ of cephalopods. **Robert Lemanis** provided new results on his explorations of the mechanical function of folded septa, which he also presented at the Palaeontological Association Annual Meeting in London. **Kathleen Ritterbush** presented work from her PhD student **Nicholas Hebden** on understanding ammonoid hydrodynamics. **Gregory Barord** then gave the final talk of the session (and one of only two representing extant cephalopods), a fascinating discussion in using baited remote underwater video systems to save nautilus. Then followed a poster session and conference dinner in the lavish Palais Ommeyad.

The final day of the academic sessions focused on the remaining ammonoids, from the Permian to the Cretaceous. **Kathleen Ritterbush** continued where she left off from the previous day, presenting the hydrodynamic data that have come from the methods she had described. **Christina**



Ilfrit showed the initial results of work she has been doing on the giant *Parapuzosia* in Mexico. **Margaret Yacobucci** then followed with a lively talk on geographic range size of cephalopods predicting survivorship during the Cenomanian–Turonian interval. The afternoon very much continued with an extinction theme, as could be expected when discussing ammonoids in the Cretaceous.

Sadly, possibly due to the inherent bias in terms of palaeontology which Morocco offers (not necessarily a bad thing!), there were many fewer extant cephalopod workers than at the previous meeting hosted by Christian Klug in Zurich in 2014. In the closing discussion on the future of cephalopod research it was decided that meetings should be every three years and the next two are lined up: 2021 in London at the Natural History Museum and 2024 in Salt Lake City at the University of Utah.

The post-conference field-trip was a magnificent exploration into some of the cephalopod wonders that Morocco has to offer. On day one we briefly visited the Toarcian Ammonitico Rosso of Oued Zraa, with a cephalopod fauna similar to that of Whitby! Then followed a not insignificant drive south to the Erfoud region where our grand tour of the Devonian began the next day.



A smattering of cephalopod workers at Jebel Mech Irdane.

Amongst a great many stops in the Devonian and Carboniferous, the highlights were the world famous Devonian mudmounds at Hamar Laghdad (the Kess-Kess) and Jebel Mech Irdane with the GSSP of the Eifelian-Givetian boundary.

Watch this space for news of the 11th ISCPP in London in 2021.

Zoë Hughes

Natural History Museum, London



Research Grant REPORT

Opening a new window onto the Cambrian Explosion of animal life

Ben J. Slater

Department of Earth Sciences (Palaeobiology), Uppsala University

Introduction

The radiation of bilaterian animals near the beginning of the Cambrian Period is the evolutionary revolution that divides the ecologically 'modern' Phanerozoic world from that of the preceding microbial-dominated biosphere. Tracing how this radiation unfolded has to a large extent relied on the records of biomineralized taxa, simply because these organisms are more readily fossilized. The misleading picture afforded by the shelly fossil record is most famously revealed in Cambrian Burgess Shale-type Lagerstätten, where the diversity of unmineralized organisms greatly outnumbers that of biomineralizers (Butterfield 2003). Cambrian Burgess Shale-type Lagerstätten, however, do not appear until Cambrian Stage 3, post-dating the rapid radiation of biomineralized taxa and trace fossils recorded in the earliest Cambrian. This temporal restriction of Burgess Shale-type Lagerstätten and their absence from the Cambrian Terreneuvian Series (~541–521 Ma) severely limits our picture of earliest Cambrian ecosystems (Budd 2003).

Small carbonaceous fossils (SCFs) are a polyphyletic assortment of organic microfossils preserved in siliciclastic sediments, encompassing the (usually) fragmented remains of metazoans, algae and protists (Butterfield and Harvey 2012). Often, SCFs capture elements of the biota that are otherwise only found among macrofossil-bearing Burgess Shale-type Lagerstätten. By contrast with these rare and restricted Lagerstätten sites, SCFs are preserved in a much broader array of sedimentary rocks, likely as a result of the relaxed biostratinomic demands on their fossilization. Consequently, SCFs offer the opportunity to greatly expand the fossil record of non-biomineralizing and cuticle-forming organisms in the Cambrian, particularly into parts of the Cambrian System which currently lack any known Burgess Shale-type Lagerstätten (Budd and Jensen 2003).

Recent identification of a rich SCF record in sediments from eastern Scandinavia (southeast Sweden and the Baltic islands, see Figure 1) has shed new light on the non-biomineralized constituents of early Cambrian ecosystems from this region (Slater *et al.* 2017a; Guilbaud *et al.* 2018). In eastern Scandinavia, the record of these SCF-bearing sediments begins in Cambrian Stage 4 (approximately 514 Ma or younger). In western Scandinavia (*e.g.* in southern Norway, Figure 1), however, comparable siliciclastic sequences encompass more-or-less the full range of the early Cambrian. The problem with constructing a similar SCF record in western Scandinavia is not so much one of discontinuity, but of diagenesis – the significant thermal metamorphism encountered in strata closer to the epicentre of Caledonian orogenic deformation is liable to have volatilized any original organic remains in the worst affected rocks (Slater *et al.* 2017b). Fortunately, substantial packages



of early Cambrian sediments in southern Norway have escaped such heating. This project focuses on sediments from the Mjøsa Lake region of southern Norway, alongside several other localities in southern Scandinavia. The aim is to extend the nascent SCF record in Scandinavia into the earliest Cambrian.

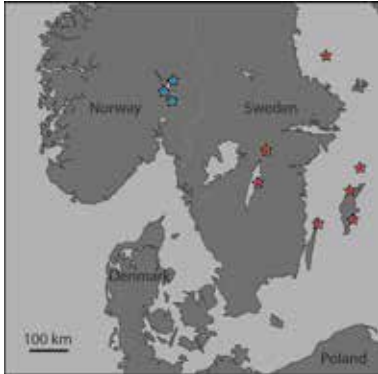


Figure 1. Map of Scandinavia showing localities where Cambrian SCF assemblages have been recovered in the east (red stars), and new target regions for this study (blue stars).

Methodology

During fieldwork to key localities around the Mjøsa Lake region, samples were systematically collected from targeted members and formations, spanning the latest Ediacaran to early Cambrian Stage 4 (Figure 2).

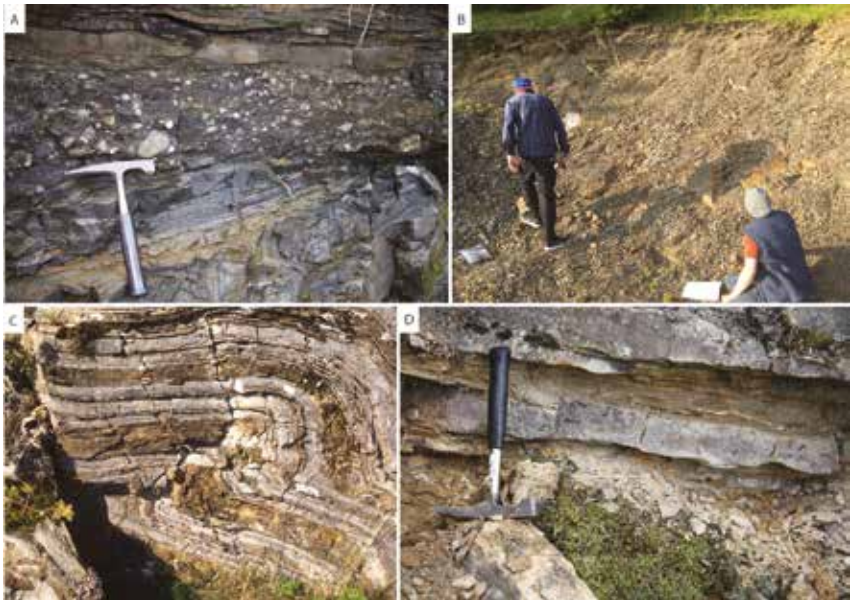


Figure 2. Field localities. A: River section at Lauselva showing gneissic Proterozoic basement overlain by Cambrian sediments. B: Cambrian section at Skyberg, (Sam Slater and Graham Budd in the foreground). C: Ediacaran sediments at Biri. D: early Cambrian mudstones and sandstones at Sollerud.



An interesting aspect of some of the targeted sections is that fine-grained sediments bearing carbonaceous remains are intimately associated with shelly fossil deposits, permitting close spatial and temporal comparison of these contrasting preservation modes: this is unlike the situation for the majority of SCF-productive sediments in eastern Scandinavia (Slater *et al.* 2017a), which preserve only a limited variety of shelly fossils. Where permitted by the lithology, both mudstones (SCF-bearing) and interbedded limestones (bearing shelly fossil remains) were sampled. Collected mudstone samples were subsequently processed for organic remains using a low-manipulation procedure optimized for the recovery of SCFs (see Butterfield and Harvey 2012), while limestones were subject to treatment with weak formic and acetic acid to recover phosphatic shelly remains.

Future work

Preliminary results show that several of the target sections are productive for both SCFs and acritarch assemblages. Ongoing processing and preparation of samples aim to identify the most productive horizons within these sections for further analysis and imaging of microfossils using SEM. Since the data on earliest Cambrian SCFs is currently limited, the question remains as to whether initial reports of Terreneuvian SCFs assemblages (see Slater *et al.* 2018) give a representative picture from this time window more widely, or if they are the product of a more localized facies-controlled signal – further investigations of the sediments recovered in this study will help to resolve how widespread these seemingly characteristic assemblages are.

Acknowledgements

I sincerely thank the Palaeontological Association for funding this research (grant PA-RG201702) which allowed me to conduct fieldwork to collect essential data for this project. Thanks also to Graham E. Budd, Sam M. Slater and Dasiel Borroto Escuela for their support with fieldwork and logistical aspects of the project.

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Small Grant REPORT

Breathing life into an extinct sea scorpion: revealing the gill structure of a three-dimensionally preserved eurypterid through microCT scanning

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Introduction

Exceptionally-preserved fossils provide unique windows into how extinct organisms lived. Through revealing interactions between species, catching behaviours frozen in time, or showing parts of an animal previously unseen, these fossils allow us to reconstruct long-dead animals as living creatures and place them on the tree of life. Applying new technologies to fossils allows us to make new discoveries among established collections and highlights the importance of taking a new look at old fossils; for example, the adoption of microCT scanning has revolutionized the study of three-dimensional fossil material (Cunningham *et al.* 2014).

This research project used microCT to reconstruct the internal structures of one such fossil, a unique three-dimensionally preserved *Adelophthalmus* eurypterid, or sea scorpion, from the Hunterian Museum in Glasgow (Figure 1). This specimen, which exhibits nodular preservation, has previously been noted to preserve the animal's three-dimensional morphology and internal organs such as the book gills (Manning and Dunlop 1995). Eurypterids are a diverse group of Palaeozoic arthropods that were important components of aquatic ecosystems, filling a number of dominant ecological roles similar to those now occupied by decapod crustaceans. Eurypterids are an excellent study group for macroevolutionary trends due to their well-known morphology and stable phylogeny; however, questions remain concerning both their exact phylogenetic placement within Chelicerata (Garwood and Dunlop 2014) and aspects of their physiology. Recent debates about eurypterid life habit have focused on evidence from the visual systems and claw morphology, with some studies suggesting eurypterids were scavengers or detritivores (Anderson *et al.* 2014) while others proposed they were active predators (McCoy *et al.* 2015). Respiratory structures can also be a useful proxy for metabolism: more active organisms have a larger respiratory surface area (Hughes 1983). High-fidelity scans of the Glasgow specimen will permit the measurement of respiratory surface area compared to body size. Through comparison with extant chelicerates and crustaceans it will be possible to estimate how active *Adelophthalmus* was in life and help resolve the debate about whether or not eurypterids were active predators.

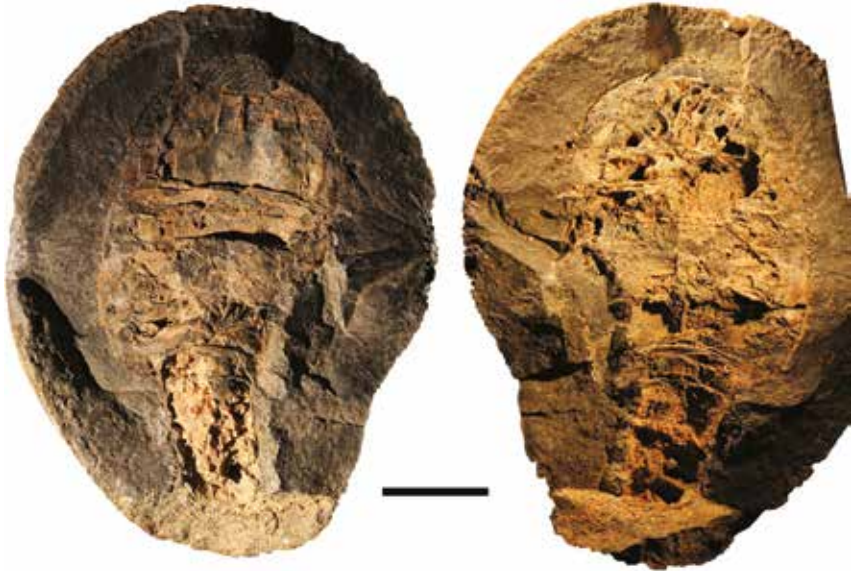


Figure 1. *Adelophthalmus* sp. part and counterpart exhibiting three-dimensional preservation from the Carboniferous of Montagne Noire, France, held in the Hunterian Museum in Glasgow. Scale bar is 10 mm.

Results of the microCT scans

MicroCT scans of the *Adelophthalmus* specimen confirmed exceptional three-dimensional preservation, including the prosomal appendages, which are not visible either on the nodule surface or across the plane of breakage. Internal structures, including the book gills, are clearly preserved (Figure 2a, b). Preliminary results indicate that eurypterids had horizontally-oriented book gills similar to xiphosurans, and that the gills had a surface area equivalent to that of modern active marine organisms. The initial effort of interpreting the microCT scans has focused on the posterior pair of book gills, which comprise only six lamellae (Figure 2c-f). This is a low number of lamellae in comparison to modern xiphosurans and arachnids, which can have hundreds (Suzuki *et al.* 2008; Kamenz and Prendini 2008). Juvenile horseshoe crabs, on the other hand, have fewer (less than ten) lamellae per gill, with more lamellae developing during each stage of moulting (Farley 2010). If eurypterids followed a similar developmental pathway to xiphosurans, then the posterior pair of book gills would have been the last to develop and therefore may have fewer lamellae than the more anterior book gills. Further study of the anterior book gills is needed to ascertain whether this is the case, although preliminary study of the scans suggest that the anterior gills only have at most six more lamellae (for a total of twelve). Alternatively, eurypterids may have had fewer gill lamellae than modern horseshoe crabs, such as in the Silurian chelicerate *Offacolus*, which has 3-4 gill lamellae per gill (Sutton *et al.* 2002). *Offacolus* is however much smaller than *Adelophthalmus*, being around 4 mm long compared to the 120 mm of *Adelophthalmus*, although another Silurian chelicerate, *Dibasterium*, is 23 mm long and is extrapolated to have 30-40 lamellae in its anterior gills (Briggs *et al.* 2012). All eurypterids have ancillary respiratory organs called *kiemenplatten*



associated with the ventral body wall, and these have been considered to have a role in respiration during terrestrial excursions (Selden 1985). The new information provided by the *Adelophthalmus* specimen suggests that *kiemenplatten* may have in fact facilitated gas exchange in aquatic settings, supplementing the reduced number of gill lamellae, rather than specifically aiding respiration in terrestrial environments.

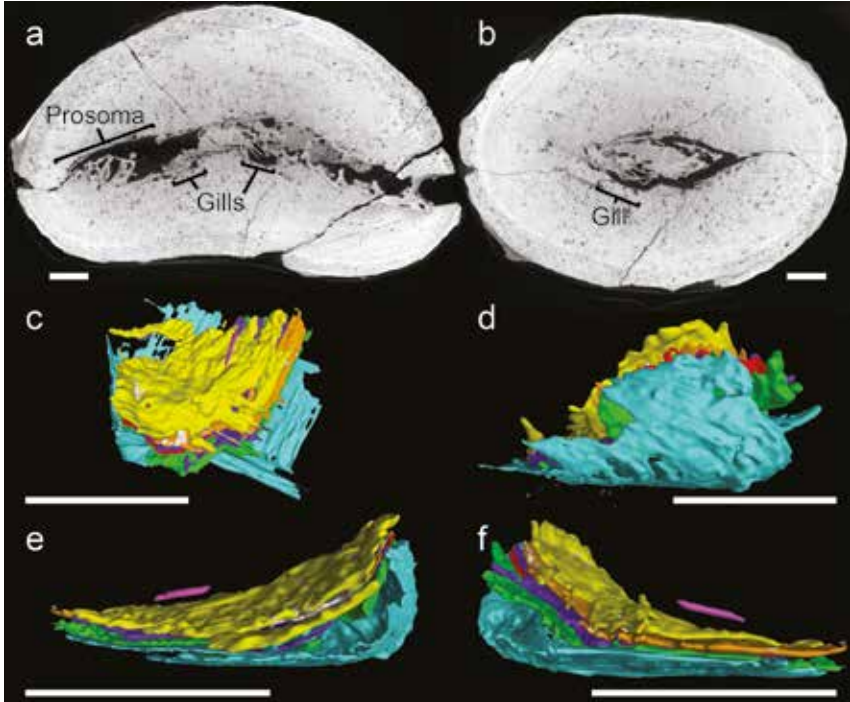


Figure 2. MicroCT scans of the *Adelophthalmus* specimen. a. lateral cross section of the specimen; b. midline cross section of the specimen; c-f. partial reconstruction of the left side of the fifth abdominal appendage. The operculum is coloured light blue, with each individual lamina coloured yellow, orange, white, purple, red or green. A portion of the sternite is in light purple in e and f. c: oblique dorsal view, showing the respiratory laminae overlying the operculum. d: oblique ventral view of the operculum. e: lateral view of operculum and book gill as viewed from the midline. f: lateral view of operculum and book gill as viewed from the lateral margin. Scale bars are 5 mm.

Acknowledgements

I thank Victoria McCoy (University of Bonn) and Melanie Hopkins (American Museum of Natural History) for their work in scanning the eurypterid specimen and preparing and interpreting the CT images, and the Palaeontological Association for Sylvester-Bradley Award PA-SB201602 that funded this research.



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Engagement Grant REPORT

Pliosaurus! Dive into the Jurassic deep

Isla Gladstone

Senior Curator (Natural Sciences), Bristol Culture

The exhibition

The 'Pliosaurus!' exhibition explored the story of a single extraordinary fossil – an 8.5-metre-long skeleton of top Jurassic marine predator *Pliosaurus carpenteri*. This specimen was discovered locally by collector Simon Carpenter in 1994 and excavated by the Museum and University of Bristol. Following preparation by conservator Roger Vaughan over ten years, research by Judyth Sassoon revealed it as a new species with evidence of disease preserved in its bones.



*The excavation: Kimmeridge Clay Formation; Blue Circle Cement Works, Westbury, Wiltshire.
© Bristol Culture*

In 2016 PalAss awarded an Engagement Grant (PA-OE201601) towards the first major palaeontological exhibition at Bristol Museum in over two decades to tell the story of this immense animal. Recognizing targeted interpretation as key to family learning, the grant supported a volunteer engagement programme and hands-on interactive content. The exhibition ran from June 2017 to February 2018, and provided a special opportunity to tell a complete palaeontological story, from excavation to reconstruction via scientific research. It targeted a core audience of families



with children aged 3–11 years as well as a priority audience of ‘Striving Families’ (CACI segmentation model), currently under-represented at the Museum. Our aim was to harness palaeontology’s popular appeal and accessible scientific techniques to break down barriers to science and open up future learning, using a child-led approach seeking to provide a new experience of museums.

Instead of presenting fossil alongside reconstruction as in traditional displays, the exhibition took visitors on a learning journey. In section one they stepped back 150 million years through a timegate to come face-to-face with a tactile life-sized reconstruction of the pliosaur, nicknamed ‘Doris’ by public vote, swimming in a tropical Bristol sea. With no physical barriers people were surprised and delighted to explore her texture, sounds and smells and discover that she had a sore mouth and flipper, as she came alive through the power of story and imagination. This experience was designed to prompt emotions from trepidation and excitement to empathy, and promote intuitive understanding of a fossil that, whilst relatively complete for a pliosaur, is incomplete and abstract from a child’s perspective. In section two they journeyed back to the present day to encounter the fossil itself and investigate the evidence that brought it back to life via a series of fun, interactive, question-led stations.



‘Meet the beast’: a tactile, life-sized model of Doris the Pliosaurus made by Tony Hitchcock. Doris proved popular on Twitter with the hashtag #DeadlyDoris. Photograph courtesy of Jamie Woodley.

Volunteer engagement programme

No matter how well-designed an exhibition, there is no substitute for a person on hand to answer questions and promote active investigation. Recognizing this value, the Engagement Grant enabled us to have Ryan Lewis onboard as a freelance Science Engagement Volunteer Co-ordinator to recruit, train and support volunteer engagers to ensure a high-quality family experience. The volunteer



programme was designed to generate a passionate and confident group of engagers who felt valued and motivated. An inclusive recruitment process set clear expectations through advertising, application pack and group interviews. Training was layered with an induction, volunteer handbook and day's learning about topics from starting a conversation to body language. Ongoing support was provided via e-mail updates and socials, with opportunities for feedback.

Overall 61 diverse volunteers were inspired to join the team, contributing 4,414 hours. An average of five volunteers per session far exceeded a target of four per holiday session only. Success in approach was seen in high retention rate, with 95% staying longer than the required six weeks and an incredible 39% (24) staying for the eight-month duration, far exceeding our expectations.

In a visitor survey a high number of comments reflected the value that the volunteer programme brought to visitor learning, for example: "The volunteer who informed us about Doris and showed the kids how to take part in activities made all the difference and turned a good exhibition into a fantastic exhibition". Volunteers also shared the benefits they felt in their volunteer evaluation, for example: "My time as a volunteer has given me the tools to be a more effective science communicator: talking to kids involves breaking down complicated concepts and portraying them in simple and fun ways! I would love to keep on doing science outreach in the future". A dedicated core group of volunteers went an extra mile, writing and illustrating a book about Doris for storytime in 'Little Jurassic Explorer' early years sessions, and helping take the exhibition out to areas of social deprivation.



'Investigate the evidence': ten interactive stations surround the 3D mounted fossil. © Bristol Museum & Art Gallery.

Interactive content

Focusing on a single specimen allowed us to explore the science behind its reconstruction in a breadth rarely available in an individual object label. In section two of the exhibition, ten evidence



stations surrounding a 3D mount of the fossil – posed to mirror the 3D model – investigated topics ranging from diet to excavation. A child-led, inclusive learning approach prioritised kinaesthetic ('doing') interpretation over text, incorporating a mix of low-tech familiar play items, high-tech digital and child-contributed content.

The grant from PalAss also supported specific development of digital interactives – an important interpretive method for older children within our target audience range, intuitively engaging and enabling more in depth exploration of topics. Digital interactive 'Disease Detectives' invited visitors to discover three areas of pathology via a touchscreen close-up of the fossil's jaw. Finding one activated an animated conversation between a palaeontologist and veterinary pathologist to investigate the fossil evidence. When all three had been encountered a scenario of disease was presented – linking back to features in the model.

Based on an arcade game, digital interactive 'Colour Wheels' allowed visitors to test different colour combinations for Doris based on living analogues. 'Colour Code Cracker' introduced the idea that in some fossils structural evidence of colour is preserved, via a game mixing pattern-matching and colour-by-numbers. This incorporated the recent reconstruction of *Psittacosaurus* by Jakob Vinther and Bob Nicholls.

Outcomes

The exhibition had over 76,000 visits, including many repeat visits, and a high satisfaction rating of 87%. Visits from our under-represented Striving Families priority audience were 125% higher than the Museum baseline of 3%, at 7% over the key summer period (6% total exhibition; 10% Bristol population); this far exceeded a target 50% increase. 55% of visitors had rarely or never visited museums. Key words in our visitor survey included interactive, fun, engaging and learning.

Doris the Pliosaurus now 'swims' in the Museum's back hall and content including digital interactives has been upcycled into new displays. Pliosaurus! volunteers continue to take Doris out into the community and support special events.

Acknowledgements

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Undergraduate Bursary **REPORTS**

Meta-analysis of phylogenetic data

Peter G. Choate

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Introduction

The validity of methods used in the derivation of phylogenetic trees is a frequent source of debate. Recent investigations using simulated character data have favoured the Bayesian Mk model over parsimony (O'Reilly *et al.* 2016; Puttick *et al.* 2017) and some debate exists regarding parsimony with implied weighting (Goloboff *et al.* 2017). However, simulated data may not accurately model empirical data. Biases due to character selection and availability cause heterogeneity in empirical datasets. This contrasts with simulated data, which are inherently homogeneous due to selection from an underlying model. As an alternative to simulated datasets, phylogenies can be assessed according to their stratigraphic congruence. In this project, a systematic process was developed to analyse a suitable set of morphological data matrices amenable to comparison via unweighted parsimony, weighted parsimony and the Bayesian Mk model. These matrices represented crown group tetrapods, for which a large body of empirical morphological data are available. The resulting phylogenies were assessed for stratigraphic congruence using publicly available first and last appearance stratigraphic range data available from the Paleobiology Database (PBDB, <<https://paleobiodb.org/>>).

Materials and methods

Data cleansing and preparation constituted the largest portion of the project and took several weeks. A total of 2,177 studies on crown group tetrapods were obtained from the repository of Lloyd (2011) with a wide range of study designs and methods of data collection. An overview of the elimination method is included in Figure 1. As a first step, matrices were eliminated due to structural criteria. These included datasets that did not have a minimum number of taxa (10), characters (20) or ratio of taxa to characters (2:3). Furthermore, matrices were excluded that were not compatible with Bayesian analysis in MrBayes (Ronquist *et al.* 2012). These matrices contained either complex character orderings that were not convertible or a multitude of character states that exceeded maximum allowances.

For each taxon name in each of the remaining matrices, an exact match was sought from the PBDB using the publicly available web API. If no match was found, the taxon was manually curated. In these instances, a match was accepted only if a trivial spelling mistake was found or an abbreviation was elaborated in the paper. Other unmatched taxa, such as specimen numbers, extant non-fossil taxa, nomen dubia, unexplained abbreviations, non-trivial or ambiguous spelling mistakes, arbitrary groupings of taxa and taxa not present on the PBDB were declared 'missing'. Following matching

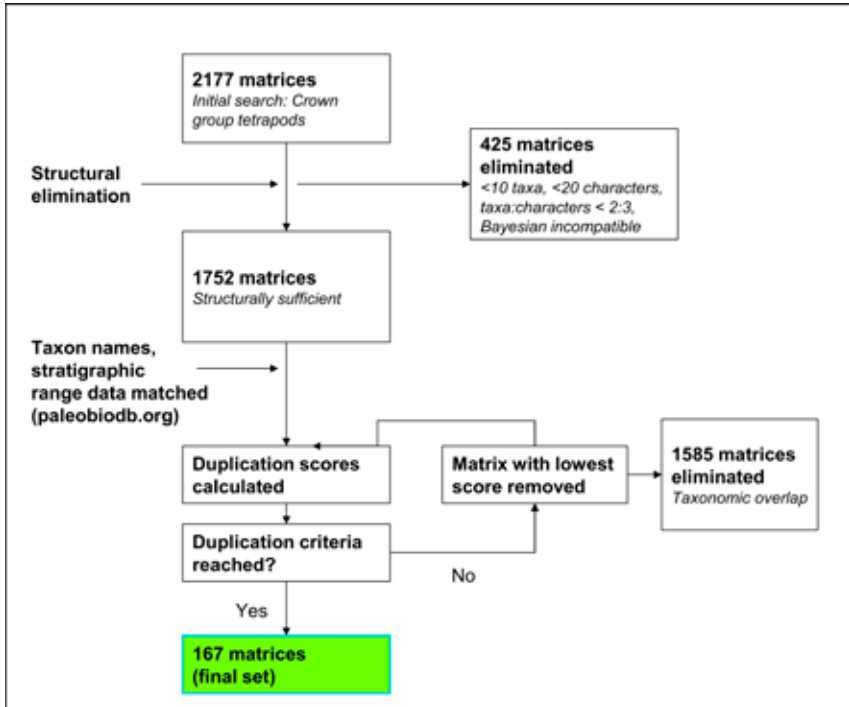


Figure 1. Results of the matrix elimination process. In total, 2,177 matrices were analysed of which 425 were eliminated for structural reasons, 1,585 for taxonomic overlap. This resulted in a final set of 167 matrices for analysis.

to the PBDB, first and last appearance data, where available, were extracted. In total, 88 % of taxon entries were matched to stratigraphic range information.

The final step involved the development of an algorithm to eliminate matrices due to taxonomic overlap. Firstly, it was determined that each matrix must be at least 50 % unique (*i.e.* 50 % of taxa were only found in that matrix). Secondly, on average, the set of retained matrices must be 75 % unique. In order to derive a set of matrices that satisfied these criteria, while maximising taxon diversity, a duplication score, *D*, for matrix *i* (*D_i*) was calculated for each matrix as follows,

$$D_i = \sum_{n=1}^{N_i} \frac{1}{d(n)N_i}$$

where *N_i* is the number of taxa in matrix *i* and *d*(*n*) is a function that returns the number of times that taxon *n* appears in all matrices that have not yet been eliminated. An entirely unique matrix returns a score of one, whereas a highly duplicated matrix returns a score approaching zero. The matrix with the lowest score (most duplicated) was removed and the scores were then recalculated. If two matrices had the same score, the one with the most recent publication date was retained. This process was repeated until the uniqueness criteria were achieved, resulting in a final set of matrices for analysis.



Given the short project time frame of eight weeks it was essential to employ the distributed computing services available at Manchester (<<http://ri.itservices.manchester.ac.uk/csf/>>). Parsimony searches were conducted in TNT. In addition to unweighted parsimony, for the implied character weighting variant, k values ($k=3, 12$) were chosen based on recent recommendations (Goloboff *et al.* 2008). Bayesian searches were conducted using MrBayes. Settings pertaining to the Mk model such as those for morphological analysis (Lewis 2001) and informative characters were set. Trees were randomly subsampled down to a manageable number (500) from the posterior distribution (excluding 25 % burn in) once convergence had been achieved. Similarly, trees resulting from parsimony searches were randomly subsampled to a maximum of 500 per simulation (although frequently less). STRAP for R (Bell and Lloyd 2015) was used to assess the trees for stratigraphic congruence with 1,000 random permutations and 1,000 sampled permutations. The results included four stratigraphic consistency metrics: The Stratigraphy Consistency Index (SCI), Relative Completeness Index (RCI), Gap Excess Ratio (GER) and Modified Manhattan Stratigraphic Measure (MSM*). In the subsequent phase of the project, stratigraphic congruence results of the Bayesian and weighted/unweighted parsimony were compared in mixed linear models (ANOVA) in R.

Results

Initially, 425 of the initial 2,177 matrices were eliminated due to structural criteria, leaving 1,752 matrices for potential inclusion. Following the elimination of taxonomic overlap, 167 of the 1,752 structurally sufficient matrices were retained with just a 22 % reduction in taxon diversity, indicating a high level of duplication in the original sample. Additionally, the retained set included 5,719 taxa with first and last appearance data, of which, 4,230 were unique. The average number of taxa (43) and characters (173) were close to that of the original set of 1,752 (39 and 181 respectively). Outgroups were manually identified and stipulated for each dataset.

In the subsequent phase, initial results showed that the trees from all methods are highly stratigraphically congruent (Fisher's combined probability of randomization tests $p < 1 \times 10^{-10}$). Interestingly, congruence of the Bayesian trees was significantly lower (Figure 2) for all congruence metrics ($p < 2.2 \times 10^{-16}$ in linear mixed-effect models), but no difference was found for unweighted versus weighted parsimony.

Discussion

The elimination process devised during this project together with the use of software, distributed computing, and automation of the taxon matching and taxonomic overlap reduction processes allowed the consideration of a large number of matrices, with repeatable results, within a short timeframe. In addition, the duplication scoring mechanism allowed reduction of overlap with highly preserved taxon diversity, numbers of taxa and characters. The calculation of stratigraphic congruence metrics for these samples has provided a sound basis for the subsequent phase of the project. Our initial results show that Bayesian approaches produce trees that are less stratigraphically congruent than approaches based on weighted and unweighted parsimony. No significant difference was found for weighted versus unweighted parsimony.

It is possible that stratigraphic range data are not strictly independent of phylogenies. Authors could, in theory, prioritise more stratigraphically congruent phylogenies prior to publication. Our work now focuses on establishing the effect (if any) that calibration of phylogenies according to stratigraphic ranges has had on the selection of phylogenies for publication.

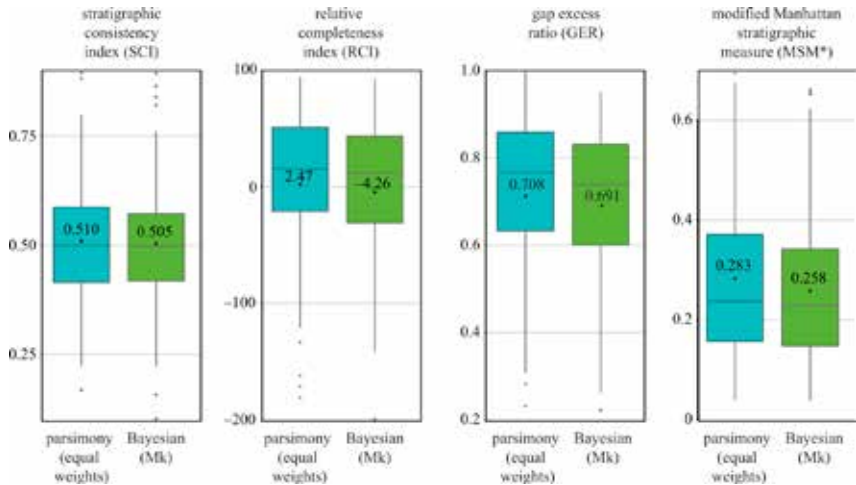


Figure 2. Distribution of average stratigraphic measures of trees from 167 data sets (either most parsimony trees or trees sampled from the posterior distribution of Bayesian searches). Box plots show median, upper and lower quartiles, outliers, whilst black spots and text values are averages for all datasets. (From Sansom *et al.* in press.)

Simulations may also not be representative of real world data and the methods involved in their simulation (*e.g.* randomised selection from a distribution of character states) may assume distributions that create bias in favour of Bayesian methods. Additionally, the selection of matrix structural properties such as numbers of characters and taxa in simulated data may represent idealisations that are not representative or attainable in empirical datasets. Further results as well as detailed background to the methods used in parsimony, Bayesian, stratigraphic congruence and statistical analyses will be discussed in our upcoming publication (Sansom *et al.* in press).

Acknowledgements

I would like to thank the Palaeontological Association for providing funding (PA-UB201707) for this project. This enabled me to collate the data, construct analysis pipelines and code, and conduct phylogenetic and stratigraphic congruence analyses. This supported the work of Robert S. Sansom who I thank for conceiving and supervising the project, along with input from Emma Randle, and for conducting further statistical analyses and preparing a manuscript for publication. I would also like to thank Joseph N. Keating for his advice regarding phylogenetic analysis methods.

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Taxonomy and taphonomy of 'sparkly worm tubes' from the Tafilalt Lagerstätte, Ordovician, Morocco

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Introduction

Mineralization is the most generic form of protection seen in the fossil record from as early as the Precambrian–Cambrian boundary. However, some organisms also use agglutination to create dwellings, by binding particles from their environment in a cement or organic matrix. A wide assortment of material has been used to create such structures, but a small proportion of organisms exhibit greater selectivity, from crinoidal ossicles (Ettensohn 1981), to mica flakes (Hagadorn and Waggoner 2000; Kirjanov 1968; Mens 2003; Signor and McMenamin 1987). Agglutination occurs from the Cambrian (McIlroy *et al.* 2001) to recent (Howell 1962) but specific mica agglutination has only been described from the early Cambrian. Our specimens are significantly younger, from the upper Ordovician First Bani Group, in the Tafilalt region of south-eastern Morocco. They consist of imbricated mica flakes forming tubes, with lengths up to at least 23 mm and widths between 0.6 mm and 2.5 mm (Figure 1). The specimens all appear to be lying flat on bedding plane surfaces but show no preferential alignment. Mica is abundant in the surrounding sediment, but the lack of



any other particles in the agglutinated tubes suggests that it was not simple availability controlling the composition of agglutinated particles. Rather, the uniformly micaceous composition suggests agglutination was selective for particular mineral grains.



Figure 1. Agglutinated worm tubes on a bedding plane surface. Scale bar is 10mm.

Palaeoecology and taphonomy

The lack of preferential alignment, combined with the uncertainty over their phylogenetic placement, makes palaeoecological and taphonomic interpretation difficult. The tubes appear to have been neither transported nor aligned by current flow. The question of precisely what the agglutinated fossils represent is also open. Were the particles directly agglutinated onto the body of the organisms? Or did they form an agglutinated tube, inside which the organism was free to move? One potential explanation is that the worm lived flat on the benthic surface with flexible micaceous armour. The curvature could be contributed by mobility as well as breakages and possible turbulent burial. The presence of extremely flexible specimens can support an epibenthic ecology, with flexibility reducing the potential for damage by the current (Figure 1). Alternatively, the organisms may have been anchored into the sediment, either infaunally or semi-infaunally, protruding upwards into the water column. Some tubes are preserved as cylindrical sections of mica with a vertical orientation on the surface, suggesting the specimens were positioned vertically. This interpretation could support the idea that the specimens were alive at time of burial, therefore showing that mica stayed aligned along the body. This is difficult to ascertain as the fossils exhibit no preservation of organic material. However, SEM-EDS elemental mapping shows iron enveloping or tracing agglutinated micas, in some cases with what appear to be framboidal pyrite pseudomorphs, likely formed around decaying organic material (Figure 2).

Consideration of the biomechanics of the organisms may also help to distinguish between possible lifestyles. Tube dwellers rotate their bodies within the tube and excrete out of the top, with some creating U-shaped burrows and excreting out of one end (Miller and Harley 2013). The fossils are clearly not U-shaped burrows and would be unlikely to have rotated in the structure due to flexibility. Direct agglutination whilst anchored would also be doubtful, leaving questions around how it would excrete as its posterior would be buried. If the worm was vertical in the water column,



the curvature of the fossil could perhaps be due to turbulent burial, demonstrated by the varying thicknesses of sedimentary laminae. The specimens are from a storm-dominated succession below fair-weather wave base, and it is possible that rapid storm deposition was important in preserving the agglutinated tubes. If they disaggregated before final burial, it would be difficult to recognize that mica grains had previously formed tubes, instead the sediment might just appear rich in mica.

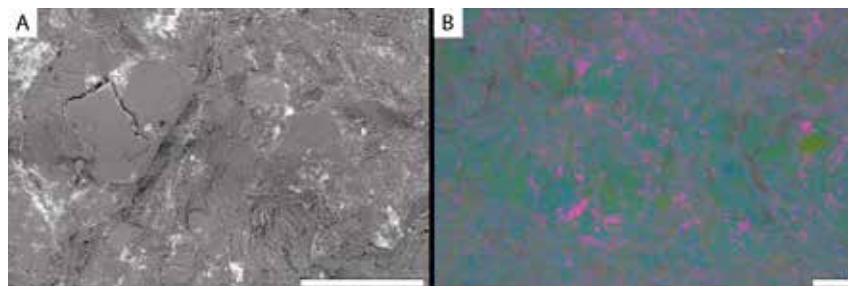


Figure 2. SEM images of agglutinated worm tubes. A. BSE micrograph of agglutinated mica, along with brighter iron oxide framboidal pseudomorphs after pyrite. B. EDS selective elemental map composite; colour scale: green = sodium, blue = aluminium, magenta = iron. Scale bars are 400 μm .

Affinities

Agglutination is known from various different groups of organisms. Some foraminifera build agglutinated tests, including some that are selective in which grains they use (Scott *et al.* 1998). Some marine crustaceans also construct agglutinated tubes (e.g. Appadoo and Myers 2003). Most similar to our micaceous tubes are modern suspension-feeding polychaetes such as *Owenia*, which create agglutinated tubes from shell fragments and sand grains (Neal and Avant 2008). Kirjanov (1968) and Signor and McMenamin (1988) suggested that similar Cambrian agglutinated micaceous tubes were polychaetes for this reason. However, the range of organisms that make agglutinated tubes, the lack of diagnostic characters in the tubes, and the absence of any preservation of the tube-maker itself mean that there is no definitive evidence to assign them.

Conclusion

These specimens demonstrate that mica agglutination extended into the Ordovician, implying that this selectivity was more common than previously thought. It is possible that rapid deposition, by storm events in these specimens, was important in preserving them, and that such mica-agglutinating tubes were a more significant part of Palaeozoic ecosystems than recognized to date. The specimens are still not fully understood, with a polychaete affinity possible, and have questions remaining over the phylogenetic affinities and its construction methods.

Acknowledgements

I would like to thank Breandán MacGabhann, Kathryn Coffey and Robert Hart (Edge Hill University), James Schiffbauer (University of Missouri), Lucy Muir (Nation Museum of Wales) and Joseph Botting (Nation Museum of Wales and Nanjing Institute of Geology and Palaeontology) for input and assistance, as well as the Palaeontological Association for funding the project through Undergraduate Research Bursary PA-UB201704.



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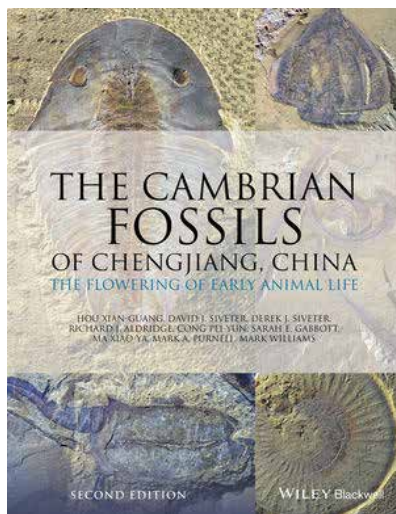
Book Reviews

The Cambrian Fossils of Chengjiang, China: The Flowering of Early Animal Life, 2nd Edition

Xianggang Hou, David J. Siveter, Derek J. Siveter, Richard J. Aldridge, Peiyun Cong, Sarah E. Gabbott, Xiaoya Ma, Mark A. Purnell and Mark Williams. 2017. 328pp. Wiley Blackwell, UK. Hardcover US\$110.00, ISBN: 978-1-118-89638-9.

The discovery of the Chengjiang biota was probably one of the most important scientific palaeontological breakthroughs of the 20th century. Not only does it shed new light on the amazing diversity of organisms during the Cambrian explosion, but it also reveals unique details of the palaeobiology of these organisms that are generally not preserved in other Cambrian Lagerstätten. This new edition of *The Cambrian Fossils of Chengjiang* offers a comprehensive study of the Chengjiang Lagerstätte (the only one in English), with 30 new species added since the previous volume, bringing the count of Chengjiang species to 250.

Following an entertaining foreword by Richard Fortey, a brief preface presents the techniques used to produce the book's amazing photographs and lists the repositories for all the specimens figured.



The first part of the book provides a detailed context for the Chengjiang biota. After a general introduction about the origin of Earth and its early life, it introduces the notion of the Cambrian Explosion and its controversies, notably highlighting the discrepancies between fossil and molecular clock data and presenting the concepts of crown and stem groups. The following chapters describe the history of the Lagerstätte discovery, before providing comprehensive palaeogeographic, stratigraphic and sedimentological contexts. The next section describes the taphonomical processes that allowed the exceptional preservation of features usually absent from most other Lagerstätten. This includes very fine details of arthropods' appendages, fully soft-bodied animals (e.g. ctenophores, arrow worms, etc.), and internal anatomical characters such as cardiovascular and nervous systems. This is followed by a very interesting chapter showing how diverse and complex Cambrian ecosystems were by presenting the faunal composition and the different ecologies represented in the biota. This first part of the book ends with a short presentation of other important Cambrian Lagerstätten, pointing out similarities and differences with the Chengjiang biota.



Then comes the systematic section (Part two) that represents the core of the book and details a large selection of Chengjiang organisms. Organized in phylogenetic order, from less to more derived forms, the chapters offer a good general introduction for each group before detailing selected species. Inside each of these chapters, the species portrayals are consistently organized: the quantity and preservation of the material, a short morphological description, followed by affinities, ecology, distribution and main references. Each species is accompanied by a full page of sumptuous photographs of the most representative specimens and, in most cases, by a nice reconstruction of the animal in its hypothetical life position. Finally, the book ends with a complete list of the species known from the Lagerstätte together with their authorship, dates when they were established, and possible synonyms.

Very much like its predecessor, this book is bound to become a standard reference thanks to its very well contextualized introduction and really complete overview of the Chengjiang biota. Whether you are a natural science teacher, a specialist of the Cambrian Explosion, have an interest in palaeontology and evolution of early life, or you just like the weird diversity of forms in Cambrian animals, then this book is for you. I would recommend it to all palaeontologists and libraries, this is a must-have!

Vincent Perrier

Claude Bernard University Lyon 1

Patrons of Paleontology: How Government Support Shaped a Science

Jane P. Davidson, 2017. Indiana University Press. US\$40.

ISBN 9780253025715. 233 pages, 64 illustrations.

In this book, Jane Davidson explores a topic that has received little attention so far, viz. government funding for palaeontological research. In a way, this is a very American book. To palaeontologists in many parts of the world, including Europe, Asia and South America, government support for palaeontology is simply taken for granted. In France, for instance, ever since its beginnings at the very end of the 18th century, scientific palaeontology has depended almost completely on government funding. Georges Cuvier worked at the National Museum of Natural History in Paris, a typical government institution. In a country like France where the large majority of universities and museums, not to mention the largest research institution in the land, the National Centre for Scientific Research (CNRS), are funded by taxpayers' money, the question may appear irrelevant. The same applies to many other countries, including socialist or former socialist countries like China or Russia, where the national academies of science – scientific bodies that in many ways are quite different from their western counterparts – have long been major funding agencies for palaeontological research.

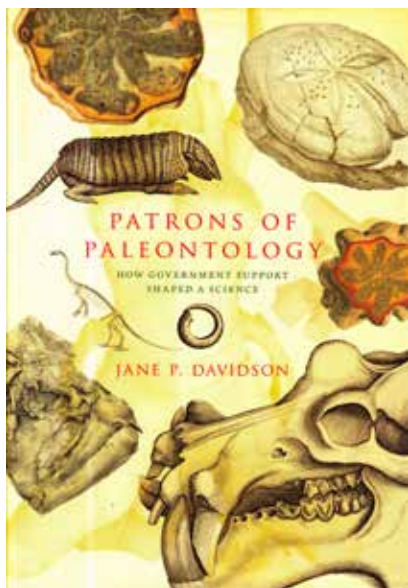
The American situation, where private funding (through museums and universities) has long played a major part, is more the exception than the rule. Moreover, 'government support' should be defined with some precision. Jane Davidson's book begins with a study of what she considers as government support for palaeontology (a term that in fact was introduced only in 1822 by the French scientist Henri-Marie Ducrotay de Blainville) in Early Modern Europe, as far back as Michele Mercati's *Metallotheca*, which was written in the 16th century but not published until 1719, with the support of Pope Clement XI. That Mercati was employed by a former pope to write a catalogue



of the papal collection of fossils and other rarities can indeed be considered as a form of government support. Things are not so clear when it comes to the works of English scholars of the 17th century such as Robert Plot and Edward Lhwyd. That they enjoyed the support of wealthy patrons, mostly members of the nobility, does not imply government support. English aristocrats of that period were wealthy because they owned huge tracts of agricultural land, and their possible financial support of 'natural philosophers' (as they were called), mainly in the form of subscriptions to their books, does not really imply government support – being a member of the ruling class did not necessarily imply that you used government money to help print books on fossils.

This ambiguity continues in the sections of the book about palaeontological research outside the United States during the 19th century. The Geological Survey of Great Britain, with Henry De la Beche as its first director, was indeed a government institution, but the Geological Society of London and the Royal Society were not, and their support of palaeontological publications cannot really be interpreted as government support. Similarly, the Bridgewater Treatises, including William Buckland's *Geology and Mineralogy Considered with Reference to Natural Theology*, were funded by a bequest from the Earl of Bridgewater to the Royal Society, not by taxpayers' money.

Because they are largely free of this ambiguity, the chapters about the funding of palaeontological research in the United States and Canada during the 19th century are the most valuable in the book. The author clearly shows how important state, army and national surveys were for the development of North American palaeontology at that time. Many eminent palaeontologists, including Joseph Leidy, Leo Lesquereux, John Newberry, Edward Drinker Cope, Othniel Charles Marsh, Lawrence Lambe and later Charles W. Gilmore, Charles D. Walcott and Henry F. Osborn, to name but a few, benefited from government support either for their field work or for their publications, or for both. Anecdotes about Edward Drinker Cope are especially revealing, as they show how he depended not only on support from various surveys, but also on help from the U.S. Army, which provided both considerable logistical help and protection (against the 'wild Indians', as they were called at the time). An often forgotten aspect of this government support, well discussed by Jane Davidson, is the financial assistance provided by the American and Canadian governments, through various national institutions, for the publication of a large number of large, beautifully illustrated monographs describing fossils found in the course of the various surveys conducted by governmental institutions. What the real cost to the taxpayer of these palaeontological expeditions and publications really was remains uncertain. Although the author lists the selling prices of some of these volumes, she says little about the government funds really allotted to 19th century American and Canadian palaeontologists for their field work, laboratory expenditures and publication costs – but perhaps this is difficult to reconstruct today, more than a century later.





The sections about countries outside North America are relatively weak, although the various geological surveys that were started in the British Empire during the 19th century receive due attention. Countries like Argentina, where very active, often government-backed palaeontological research developed during the 19th century, are not even discussed. Continental Europe is hardly mentioned at all, and not always as it could have been. To mention but an example, the French Geological Society is discussed, although it is not a governmental organization and never provided significant support to palaeontological research in the field, beyond publishing papers and memoirs by French palaeontologists. Palaeontological support for field palaeontology in France mainly came from the National Museum of Natural History, local museums, the Ministry of Education (sometimes through universities, sometimes directly), the Academy of Sciences and (since 1939), the National Centre for Scientific Research – all funded by taxpayers' money.

The book is profusely illustrated, mainly with illustrations and title pages from old palaeontological monographs. It would have benefited from more thorough proofreading and the palaeontology in it is sometimes shaky: *Oreodon*, an Oligocene artiodactyl, was not 'a type of rhinoceros' and *Liodon* and *Clidastes* were not plesiosaurs at all, they were mosasaurs.

All in all, this is an interesting book that draws attention to a little-studied aspect of the history of science, *viz.* the funding of palaeontological research. It opens up various directions for further research on that topic, especially outside North America, in countries where 'government support' probably did more to 'shape a science' – to the extent that a science can be shaped by external agencies rather than by the scientists themselves.

Eric Buffetaut

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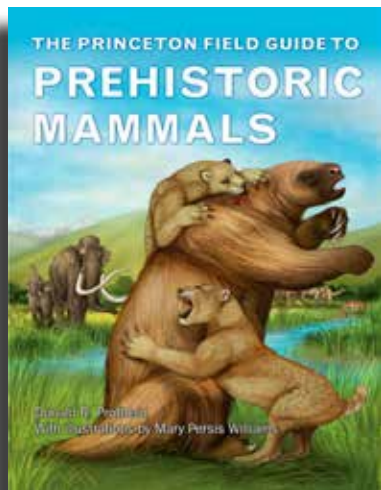
The Princeton Field Guide to Prehistoric Mammals

Donald R. Prothero with illustrations by Mary Williams. 2016. 240pp.
Princeton University Press. US\$35, £27. ISBN: 978-0691156828.

We are so used to seeing accessible guides to the world of *T. rex et al.*, it's always a pleasant surprise to find a mammal version. For every book on mammals, there are twenty more on dinosaurs. This richly illustrated, large hardback publication on mammals deserves its respectable place on any palaeontology bookshelf.

The book begins with an introduction that balances the level of detail you need to know to get to grips with mammals and their palaeontological study, while keeping the language accessible. Although it's readable for the interested public, it is no ABC. A page dedicated to tribosphenic molars uses much of the technical terminology we all know and love, but retains clarity with good use of photographs. Accessible discussions on modern classification and phylogenetics set the scene for the following chapters.

Chapter two briefly outlines some of the main mammal groups of the Mesozoic, before the following chapters tackle pouched mammals and placentals. This provides an overview of the two main branches of the mammal tree that persist to the present day, providing a framework for the rest of the book. Chapters four to seventeen each concentrate on all or part of a clade – Afrotheria



or Laurasiatheria for example – splitting them into sub-headings by order. The final chapter tackles the bigger macroevolutionary questions regarding the diversity of mammals, body size trends and the role of mass extinctions.

As you would expect from a palaeontologist who has done so much work on hoofed mammals, they are given an especially beautiful treatment across multiple chapters. Illustrations and photographs are generous in this guide, and while the main art style may not be to everyone's taste, it achieves what it sets out to do. Williams' artworks particularly come into their own illustrating the excellent phylogenies across all of the chapters. She gives us verdant pictures of key taxa from each evolutionary branch, making the taxonomy visually impactful rather than a dry bristle of Latin names.

The information presented throughout is up to date and covers the most important aspects of a bewildering array of amazing Cenozoic mammals. I especially loved the liberal use of photographs: of the fossils as well as living animals. This provides rich complement to the text, which is divided into manageable portions, perfect for dipping into as well as for sustained reading.

Being a Mesozoic mammal palaeontologist, I was a bit disappointed by the final chapter on the evolutionary history of mammals. Despite comprising two-thirds of the history of mammals, this section is reduced to a brief footnote by many authors. Prothero admits a bias towards larger, more bizarre taxa in this book, admitting to giving in to pressure to concentrate on species that traditionally capture public and media attention. The usual 'shrew-like' and 'primitive' descriptors for anything less than dog-sized reflect a common tired narrative I hope exciting contemporary research will soon supersede.

A single artist, Mary Persis Williams, is credited on the cover alongside the author. While her sleek and colourful pieces form a unifying thread throughout the pages, the book is actually full of works by other artists. As there is no credit below each image, this could give the misleading impression that all images are by the same person. The Illustration Credit page at the back lists by artists' name, making a specific image credit difficult to track down. As someone who treasures palaeoart, I found this less than ideal.

Like much material written for a general audience – and Donald Prothero is a seasoned science communicator – occasionally the simplification of scientific concepts can lead to minor inaccuracies. But this is balanced by some much-needed setting-the-record-straight paragraphs: for example explaining that the term 'mammal-like reptiles' is no longer in use. Specialists may occasionally squirm when checking out their own research focus groups, but this is par for the course, and likely to be a conscious stylistic choice. The readability created by this approach to writing about science is worth the occasional slight burp in technicality, and the result is an excellent guide that takes you through the major branches of the Cenozoic mammal tree.



The final question I would ask about any book like this is: would you give it as a gift? My answer is that I would unabashedly give it to anyone, from age ten to a hundred, from complete beginner in the subject of mammal palaeontology, to intermediate. While it may not suit every mammal specialist, the ease of reading and concise overview of the long evolutionary history of mammals makes it a useful reference book worth owning. If you're keen to hook someone on mammal palaeontology, this book is a good start.

Elsa Panciroli

University of Edinburgh



Books available to review

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

- *The White River Badlands: Geology and Palaeontology*, by Rachel C. Benton, Dennis O. Terry Jr., Emmett Evanoff and H. Gregory McDonald.
- *Acrocanthosaurus Inside and Out*, by Kenneth Carpenter.
- *Terrestrial Conservation Lagerstätten: Windows into the Evolution of Life on Land*, by Nicholas Fraser and Hans-Dieter Sues (eds).
- *Fossil Frogs and Toads of North America*, by J. Alan Holman.
- *The Tyrannosaur Chronicles*, by David Hone.
- *Trilobites of the British Isles*, by Robert Kennedy and Sinclair Stammers.
- *Life Through the Ages: Commemorative Edition*, by Charles R. Knight.
- *Fossilien im Alpstein*, by Peter Kürsteiner and Christian Klug.
- *The Epochs of Nature*, by Georges-Louis Leclerc, le comte de Buffon (Translated by Jan Zalaziewicz, Anne-Sophie Milon and Mateusz Zalasiewicz).
- *Dinosaurs: The Textbook*. (6th Edition), by Spencer G. Lucas.
- *Integrated Molecular Evolution*, by Scott. O. Rogers.
- *Burning Planet*, by Andrew Scott.
- *Die fossilen Brachiopoden der Schweiz* (2nd Edition), by Heinz Sulser.

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Careering off course!

Inspirational palaeontologists

Kay Behrensmeyer, Curator of Fossil Vertebrates at the Smithsonian



Photo: Jennifer Clark.

Kay Behrensmeyer is curator of fossil vertebrates at the Smithsonian National Museum of Natural History in Washington DC, a position she has held since 1981. She is also director of the Evolution of Terrestrial Ecosystems programme and an adjunct professor at the University of Arizona and George Washington University. She completed an undergraduate degree at Washington University in St Louis and her PhD at Harvard, studying with Brian Patterson. Her research has covered a wide range of time periods and taxa but she is most well known for her pioneering work on the taphonomy and palaeoecology of Cenozoic mammals in East Africa, and the environments in which humans evolved. This year she was awarded the Paleontological Society medal, their highest honour. She has also been featured in the Bearded Lady Project, which

highlights the role of women in palaeontology. This interview is transcribed from a conversation between Kay and myself.

How did you first become interested in palaeontology?

I became interested in palaeontology as a child. Partly it was because in Western Illinois near where I grew up there were beautiful exposures along creeks, and lots of blocks of rock with fossil crinoids and brachiopods in them. My brothers and I would ride our ponies down to the creek to look for fossils and put them in our pockets and take them back home. My mother and my aunts Marguerite and Selma were very interested in natural history, and they helped me find books to identify things. Fossils are fascinating, rocks are fascinating, living things are fascinating too, I learnt that early on.

When did that translate into you thinking you could do this as a career?

My father was an architect and I loved art as well, so up until the time that I went to university I thought I was going to be an artist. In my first year I took a course from a geologist, just because I thought geology would be interesting. He was really really good and

took us on field-trips and he showed me that I could be a geologist. I was also interested in palaeontology obviously, but he was a geological role model, so I definitely came into it from a geological background. After that I went to field camp in Montana, and I went back there a second year as the first female teaching assistant. We mainly did work in the Palaeozoic, mapping and identifying rocks using the fossils, so that was where I learned the basic skills I needed to be a field geologist and a field palaeontologist. After that I thought if I ever really needed a job I could teach geology and I would be happy.

A major focus of your research that I think many people know about is taphonomy, how did you first become interested in that?

When I was a kid I didn't have any taphonomic questions in my head at all, I was just looking for the best specimens, putting them in boxes and trying to identify them – the classic thing. E. O. Wilson, Steve Gould and Ernst Meyer were all teaching at Harvard when I started



my PhD, so there was a focus on ontogeny and phylogeny. There were many doors opening to me intellectually, so I would say that I was not really captured by taphonomy at that time. Then I was invited to go out the Wind River Basin in Wyoming with a more senior graduate student, he was a vertebrate palaeontologist, and it was very exciting getting out there and seeing outcrops that had actual vertebrates in them. At that time taphonomy was in the air as a new idea, and when we were out collecting bags of dirt to screen wash for mammals from the Paleocene we would find mammal teeth mixed up with shark teeth, wood, charcoal and other occasional marine things. They didn't all live in the same place so the question was obviously how did these all get together? That was the first taphonomic puzzle I encountered, and we talked about it over the campfire. When I was back at Harvard thinking about those puzzles I didn't really have a dissertation project in mind, and taphonomy intersected between geology and biology. I remember saying at one meeting I had with my committee at the time, that I would really like to be interdisciplinary. That was frowned upon, I got a sort of pat on the head and 'you'll learn you can't really do that', which made me even more determined to do that!

There is one taphonomy project, at Amboseli National Park, that you've had going now for, how many years is it?

42 now! I came out of my dissertation research thinking that I really needed to find out more about how bones get buried and recycled, and about the whole process of turning the remains of living organisms into the fossil record. When I was at Berkeley during my first postdoc I met David Western, an ecologist who was working in Amboseli National Park, and talked to him about how I hadn't been able to find a good ecosystem for this work. I'd written to ecologists working in Africa and they'd say 'Oh we never see any bones, we only see the live animals', but I thought that couldn't be true. David invited me to Amboseli to see if it was a good place for

me to study. He flew me down with a couple of other people in 1974, to see where he had been working since the late 60s. He did his dissertation on the modern animals there and so had the records of the living populations to compare to what was lying on the ground; it was just ideal. I got my first National Geographic grant to do that in 1975 and I think I've had five grants since to keep that going through the years, the last one was in 2016. That's been an incredible learning experience, just transformative for me.

What do you think is the most important research question that you're trying to address right now?

Well I keep coming back to the issue of mega biases in the vertebrate record. How the whole vertebrate record is biased by the places and times where you get the best preservation. Excluding bone beds, which are really important but we know quite a lot about them. It's more just the attritional assemblages that are understudied. The times when you would get more of a vertebrate record are probably intervals in the climate record that were not very rainy. I think there may be a chance of working this out in East Africa where some of the lake core records and the outcrop records are showing precessional cycles. If you're looking at precessional cycles for instance, the vertebrates that are most common in the record are at particular levels which represent the times of greater sediment input, which are the tipping points between drier and wetter climates. So the question is, what if a lot of our view of the vertebrate record is only from particular taphonomic windows, all the way through. It is also the case that a lot of the vertebrate record in fluvial systems is in channel fill deposits, so how does that represent a spatial sample of a particular part of an ecosystem? I'd just really like to be able to set aside everything else and dig into that as a problem. I think that now we have enough evidence that at least an ideas paper could be put together.



Has being in a museum as opposed to a university been something that you have always been pleased you decided to do?

Yes. I always thought I would be at a university because jobs at museums were so few and far between. It was real luck that I even knew about this job, and I really felt like I had won the lottery; for the first three years I was just floating on air. There are so many opportunities. In this position there is no real academic schedule so you can get involved in way too many things, which I have done. Different field places, conferences, exhibit opportunities, interacting with the public, and lots and lots of research collaborations. You pretty much write your own ticket when you're here. The other thing that's really important about this museum, and I hope it continues to be important, is that because we are salaried and we have some resources internally, we're not dependent on short term government grants so we can plan really long projects. For example the Amboseli project, which I'm hoping to see through to the 50 year mark. A number of my other research groups have been able to keep going because of the support of the institution and that is what makes the Smithsonian and other museums unique, when they can support research that's long term.

You are one of the leads on the new Deep-Time exhibit, which has been in planning for ten years, what has that been like?

It's been great. It has taken a lot of time off my research, but when you're hired here you're told it's a three legged stool: the collections, research and exhibits. The stool wobbles on those legs through time, depending on what the exhibit schedule is. When I first arrived they had just finished redoing the palaeontology halls, so I thought I wouldn't get a chance at that. People told me that it was really not a fun experience to be involved in exhibits. I couldn't imagine why that would be because I went to museums as a kid and it seemed like working at a museum, and understanding things and putting them out for people to look at, would

be the greatest career. I never dreamed at that point that I'd actually be able to do that, here. The Deep-Time exhibit has really been the most intense and prolonged experience, with taking the science and coming up with the best summary we could of the history of life through time on Earth. To translate that into words, images and concepts that the public can learn from and take messages home from. 2009 is when it started, so it's going to be a ten-year effort, and it's probably 35-50% of my time overall during a year. So it will be great when it's complete and we can bask in the glory of creating this wonderful new thing. The problem is that the collections and everything else have to keep going even when the exhibit is done, but I think all of the principal curators will deserve a sabbatical. I'm definitely going to take off for the field, and maybe I can get back to publishing more.

The career landscape has changed since you first started at this museum, what advice would you give to the people coming up now?

My advice would be to have enough areas of expertise that you can go in different directions depending on the availability of jobs. I tell individuals, just persist; don't give up and don't be diverted. Financially that can be hard sometimes, but I think the community is now becoming stronger with a diversity of people. I went to the Rockford PaleoFest where they had 22 different women palaeontologists talking, and the number of different ways that women had succeeded in becoming professional paleontologists was really impressive. So, if you're adaptable with many different areas of expertise, then you keep the goal in mind that you're going to do science and you're going to discover and you're going to publish. Then you just find a job that will let you do that. Not everybody is going to find their niche, so you kind of have to make it too. However, if there's any advice I would give my younger self it's that I wish I had not gotten into quite so many different things along the way. I'm going to have to live another 120 years to get it all



cleaned up; I can see the chaos, but it's a good chaos. Retirement is not an option for a while, but occasionally it is nice to not do work, even though I love it.

You were recently featured in the Bearded Lady project about women in palaeontology, as well as a book 'She Finds Fossils', and received the Paleontological Society medal. How does it feel to be gaining that kind of recognition?

Well it's very nice, I have to get used to it because I've always been averse to the spotlight. When there was filming going on out in East Africa for instance, Richard Leaky and people assumed that I wanted recognition, but it always seemed like a waste of time to me because I wanted to go do some more science.

It is nice to have the recognition now for my basic descriptive work, observation, discoveries along the way, and being able to publish what others have picked up on and taken forward. I had an interesting experience going to South America a couple of times recently. I had been sending reprints to researchers there for years. The people in Argentina especially, but all over South America, seem to really like taphonomy and have picked up on it. They wanted autographs, it was just like – what's going on here?! It was very gratifying though to see that by propagating those ideas, which of course were not original with me, and showing that you could do the research, I have helped make this a viable subfield of palaeontology. I just want to keep working though, I don't want to spend too much time in the spotlight.

Laura Soul

Smithsonian National Museum of Natural History

Kay has played a key role in the development of the Evolution of Terrestrial Ecosystems (ETE) programme since its inception in the 1980s. More information on the programme is available here: <<https://naturalhistory.si.edu/ete/>>.



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TAXONOMY/NOMENCLATURE UPDATE

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

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

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