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The Palaeontology Newsletter

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Reminder: The deadline for copy for Issue no. 111 is 1st October 2022.

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Guest Editorial for Pride Month

As the pandemic fades and restrictions on in-person gatherings are relaxed in most countries, higher education institution members – from undergraduate students to professors – are gradually resuming conference attendance, Erasmus+ exchange, and other forms of international mobility. Events such as the 66th Annual Meeting of the Palaeontological Association taking place between the 18th and the 24th of July 2022, in Cork, Ireland, offer a valuable chance to build and reinforce professional networks, exchange ideas, and disseminate research results. And it is very important to account for diversity and inclusion at similar in-person events and throughout the academic year.

The Annual Meeting of the Palaeontological Association is taking place shortly after the end of the Pride month of June. June is designated as the Pride month because the first Pride march was held on 28th June 1970, exactly one year after the Stonewall riot. In the last few years the LGBTQ+ community has received more and more attention and awareness of this minority group has increased, albeit in parallel with a rise in discrimination and hate waves. And it is key to publicly show support to members of the LGBTQ+ community.

In 2022, the majority of countries still do not recognize any rights of the LGBTQ+ community. And in several countries, LGBTQ+ people are actively persecuted, jailed and killed. If you live in a country where LGBTQ+ people are generally accepted in society and have gained the recognition of their civil rights or at least part of them, try to remember that this is not the case everywhere in the world. Saying that you and your institution stand for LGBTQ+ rights may sound redundant, but it can really make the difference for a person coming from a discriminating country.

Although Pride month has its historical and social importance, showing support towards members of the LGBTQ+ community should not be limited to June. The academic world must be inclusive all year round, planning and implementing actions to foster inclusion not only for LGBTQ+ people but for all minorities. For decades, Corporate Social Responsibility (CSR), a self-regulating business model that helps a company to be socially accountable to itself, its stakeholders, and the public, has been studied and applied. However, University Social Responsibility (USR) only arose recently to highlight the ethical and moral nature of services that education institutions deliver to society through teaching and development. Pride month is a chance for LGBTQ+ people to be visible, connect to each other and advocate for their rights, but people who are not part of the community can take action too, all year round. Speak with LGBTQ+ people at meetings, workshops, conferences and in your institution, listen to their needs, and work together to create a new culture for our societies.

Nicola Vuolo
Publicity Officer
<publicity@palass.org>

Farid Saleh
Diversity Officer
<diversity@palass.org>

Association Business

Annual Meeting and AGM 2022

Notification of the 2022 Annual Meeting

The 2022 Annual Meeting of the Palaeontological Association will be held at the University of Cork, Ireland, from Tuesday 18th to Sunday 24th July, as an in-person meeting, organized by Professor Maria McNamara and colleagues. See the Association's website for more details.

Information on the 2022 AGM

The Annual General Meeting (AGM) will be held in December 2022. Details of how to attend this event will be communicated to Members in the coming months.

AGENDA

1. Apologies for absence
2. Minutes of the 65th AGM
3. Trustees Annual Report for 2021
4. Accounts and Balance Sheet for 2021 and election of financial examiner
5. Election of Council and vote of thanks to retiring members
6. Report on Council Awards
7. Annual address

DRAFT AGM MINUTES 2021

Minutes of the Annual General Meeting held on Sunday 19th December 2021. This meeting was held virtually because of the Covid-19 pandemic.

1. Apologies for absence. Prof. R. J. Butler.

2. Minutes. The minutes of the 2020 AGM, Virtual Meeting, Oxford were agreed to be a true record by the membership.

3. Trustees Annual Report for 2020. The report was agreed by the membership.

4. Accounts and Balance Sheet for 2020. The accounts were agreed by unanimous virtual poll. The proposal to reappoint M.R. Corfield of Corfield Accountancy Ltd as Association financial examiner was also agreed by unanimous virtual poll.

5. Election of Council and vote of thanks to retiring members.

5.1 Dr P.J. Orr extended a vote of thanks to the following members of Council who were retiring from their positions this year: Dr F.L. Gill (Vice-President); Dr C.T.S. Little (Secretary); Dr S.J. Lydon (Publicity Officer); Prof. M.A. Purnell (Chair of the Editorial Board).

5.2 The following members were elected to serve on Council: Prof. P.M. Barrett (Vice-President); Dr A.R.T. Spencer (Secretary); Dr N. Vuolo (Publicity Officer); Dr P.D. Taylor (Editor-in-Chief).

5.3 Prof. M.E. McNamara and colleagues will organize the Annual Meeting in 2022 at University College Cork, Ireland.

6. Association Awards.

6.1 The Lapworth Medal was awarded to Dr A.C. Milner (Natural History Museum London). The Association was able to inform and present the Lapworth Medal to Angela prior to her death in August 2021.

6.2 The President's Medal was awarded to Professor A. Goswami (Natural History Museum London).

6.3 The Hodson Award was presented to Dr R.J. Garwood (University of Manchester)

6.4 The Mary Anning Award was presented to Mr P.R. Tarrant.

6.5 Honorary Life Membership was presented to Professor G.D. Sevastopulo. Council was able to inform Prof. Sevastopulo of his Honorary Life Membership prior to his death in September 2021.

6.6 Research Grants were awarded to: S. Lautenschlager (£2,395) for 'Changes in functional morphology during ontogeny – a case study in ornithischian dinosaurs'; V. Korasidis (£9,900) for 'Montane refugia – a key to plant survival during the Paleocene–Eocene Thermal Maximum?'; D. Bond (£6,481) for 'Environmental change, evolution and extinction in the Triassic of northwest Pangaea'.

6.7 Under the Small Grants Scheme Council agreed that the following applicants should receive Sylvester-Bradley awards: I. Leonhard (£1,491), G. Serafini (£1,500), A.P. Kaur (£1,500), and L. Pandolfi (£1,185). The Whittington Award was awarded to S. Smart (£549) and the Stan Wood awards to G. Bosio (£1,323) and C.-H. Lin (£1,500). The Callomon Award was made to B.F. King (£1,500).

6.8 Undergraduate Research Bursaries were awarded to: E.M. Kritikos (University College London) for 'A new crocodylomorph specimen from the early Eocene of Morocco and the phylogenetic relationships of Dyrosauridae', supervised by P. Mannion; F. Warren (Durham University) for 'Using $\delta^{13}C_{org}$ to improve the timeline of the Cambrian explosion', supervised by M.R. Smith; M. Wasko (Harvard University) for 'Quantifying rates of pyritization through experimental decay and computed tomography', supervised by J. Ortega-Hernández; E. Campbell (University College London) for 'Palaeobiodiversity analyses of late Palaeozoic and early Mesozoic echinoids', supervised by J. Thompson; M. Derème (University of Bristol) for 'Microvertebrates from the Middle Jurassic of Hornsleasow, Gloucestershire', supervised by Michael Benton; and A. Olaru (Vanderbilt University), for 'Exploring *Tribrachidium heraldicum* and the late Ediacaran rise of suspension feeding', supervised by S. Darroch.

6.9 Engagement Grants were awarded to: Electric voice theatre for 'Voices for the future: Mary Anning' (£5,000); A. Ghilardi (£5,210) for 'Brazil's deep time'; and C. Kuhn (£5,000) for 'Fossils go to school'.

6.10 The 2021 Best Paper Awards were presented to: 'Recognizing pulses of extinction from clusters of last occurrences', by Joshua B. Zimmt, Steven M. Holland, Seth Finnegan and

Charles R. Marshall (*Palaeontology*); and to 'Redescription and phylogenetic affinities of the caimanine *Eocaiman cavernensis* (Crocodylia, Alligatoroidea) from the Eocene of Argentina', by Pedro L. Godoy, Giovanne M. Cidade, Felipe C. Montefeltro, Max C. Langer and Mark A. Norell (*Papers in Palaeontology*).

6.11 President's Prizes were awarded to: James Mulqueeney (University of Southampton; Natural History Museum, London), 'Assessing the impact of climate change on the structural integrity of benthic foraminifera during the Palaeocene Eocene Thermal Maximum – implications for future climate change'; Christopher Stockey (University of Leicester), 'Multivariate dental topographic metrics demonstrate the dietary breadth and specialisms of conodonts'; and Katherine Turk (Vanderbilt University), 'Priapulid trace fossils from the late Ediacaran of Namibia'.

6.12 Council Poster Prizes were awarded to: Nicole Barnes (University of Bristol), 'The Ecological Importance of Ediacaran Stems'; Charlotte Bird (University of Birmingham; Natural History Museum London), 'Variable cynodont brain morphology: a case of natural or modeller bias?'; and Eloise S.E. Hunt (Natural History Museum London), 'The role of habitat density, migration and developmental mode in avian skull evolution'.

6.13 Career Development Grants were awarded to: A. Capobianco, A. Roy, and N. Alvarez Armada.

6.14 PalAss Exceptional Lecturer: it was announced that M. Williams from the University of Leicester has been appointed as the PalAss Exceptional Lecturer for 2022/23.

7. Annual Address. A talk entitled 'Decoding the evolution of form and function in the fossil record: why are animals shaped the way they are?' was given by Prof. Emily J. Rayfield (University of Bristol, UK).

Trustees Annual Report 2021

The Trustees present their report with the financial statements of the charity for the year ended 31 December 2021. The Trustees have adopted the provisions of *Accounting and Reporting by Charities: Statement of Recommended Practice* applicable to charities preparing their accounts in accordance with the Financial Reporting Standard applicable in the UK and Republic of Ireland (FRS 102) (effective 1 January 2015).

1. OBJECTIVES AND ACTIVITIES

1.1 Aims and objectives: The 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; awarding grants and bursaries; and d) by such other means as the Council of charity Trustees may determine.

1.2 General statement about the COVID-19 pandemic: The coronavirus pandemic had a significant impact on Association activities in 2021, particularly on in-person meetings, which continued to be held online (*e.g.* Council meetings, Annual Meeting, Progressive Palaeontology) or were re-arranged at short notice from in-person to remote.

1.3 Grants-in-aid for meetings and workshops: The Association provided funds to support the following meetings and workshops in 2021, totalling £4,250: B.J. Allen (University of Leeds, UK), GSA session 'New perspectives on Phanerozoic mass extinctions and environmental perturbations'; Prof. P.M. Barrett (Natural History Museum, London, UK), 'Fossils, phylogenies, genomes, embryos and the evolution of the deuterostomes' meeting; Dr H.G. Ferrón (University of Bristol, UK), 3rd Palaeontological Virtual Congress; Dr S.M. Kawano (The George Washington University, USA), 'Evolutionary conservation and diversity in a key vertebrate behavior: "walking" as a model system meeting'.

1.4 Public meetings: Two public online meetings were held in 2021, and the Association extends its thanks to the organizers of these meetings.

65th Annual Meeting. The Association's Annual Meeting is its flagship meeting and this year was an online event held 17th – 20th December, hosted by the University of Manchester, UK. The meeting was organized by Dr R.S. Sansom and colleagues, and included a pre-conference workshop: 'Social justice in palaeontology: case studies and future actions' hosted by Dr E.M. Dunne and N.B. Raja. A symposium entitled 'The Problem with Problematica', and The Palaeovision Fossil Contest 2021 were both held on 18th December 2021. There were 310 registrants. The Annual Address was given by Prof. E.J. Rayfield (University of Bristol, UK), entitled 'Decoding the evolution of form and function in the fossil record: why are animals shaped the way they are?'. President's Prizes for best 15-minute oral presentations by early career researchers were awarded to C. Stockey (University of Leicester, UK), K.A. Turk (Vanderbilt University, USA), J.M. Mulqueeney (University of Southampton, UK). Council Poster Prizes for best poster presentations by early-career researchers were presented to E.S.E. Hunt (Natural History Museum, London, UK), N. Barnes (University of Bristol, UK), and C. Bird (University of Birmingham, UK). Palaeovision 2021 was won by the International Masters in Paleobiology programme at Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Germany, with their entry 'Bele-mighty'.

Progressive Palaeontology. This is an annual, open meeting for research students in Palaeontology and its allied sciences to present their work to an audience of their peers. The 2021 meeting was organized by M. Kouvari (co-chair), C.S.C. Nicholl (co-chair) and colleagues at University College London (UCL), UK and held online 17th – 19th June, with over 240 virtual delegates.

1.5 Publications: The journals *Palaeontology* and *Papers in Palaeontology* are produced by Wiley. During 2021, the following volumes were published: *Palaeontology* volume 64, comprising six issues; and *Papers in Palaeontology* volume 7, comprising four issues. The *Palaeontology Newsletter*, consisting of three issues, was also published in 2021. Council thanks Mr N. Stroud for assistance with the typesetting and production of the *Palaeontology Newsletter*.

1.6 Research Grants: A total of 20 valid applications for Palaeontological Association Research Grants were received. Three were recommended for funding in 2021, totalling £18,776, and were awarded to: Dr S. Lautenschlager (University of Birmingham, UK), 'Changes in functional morphology during ontogeny – a case study in ornithischian dinosaurs'; Dr V.A. Korasidis (Smithsonian Institute, USA), 'Montane refugia – a key to plant survival during the Paleocene-Eocene Thermal Maximum?'; and Prof. D.P.G. Bond (University of Hull, UK), 'Environmental change, evolution and extinction in the Triassic of northwest Pangaea'.

1.7 Small Grants Scheme: The scheme received 19 applications, of which eight were recommended for funding in 2021, totalling £10,548. Council agreed that the following applicants should

receive Sylvester-Bradley awards: A.P. Kaur (Indian Institutes of Science Education and Research, India), 'Palaeoecological reconstruction of Quaternary herbivore communities in Siwalik Hills using ecomorphological approaches'; I. Leonhard (University of Warsaw, Poland), 'Holocene growth time series for the giant goby in the Adriatic Sea'; Dr L. Pandolfi (Università degli Studi di Firenze, Italy), 'Taxonomy and phylogeny of enigmatic taxa from the late Miocene of Tuscany'; and G. Serafini (University of Modena and Reggio Emilia, Italy), 'Pelagic deadfalls from Northern Italy: a comparative study on Mesozoic vertebrate taphonomy'. The Whittington Award was awarded to S. Smart (University of Lincoln, UK), 'Scaling relationships between measurements of the foramen magnum and body mass in Neornithes'; Stan Wood awards were made to Dr Giulia Bosio (Università degli Studi di Milano Bicocca, Italy) 'Petrography, mineralogy and geochemistry of fossil mammal bones from Mio-Pliocene marine depositional settings'; and Dr Chien-Hsiang Lin (Academia Sinica, Taiwan ROC), 'A diverse early Pleistocene shark teeth assemblage from southern Taiwan'. The Collomon Award was made to B.F. King (Imperial College London, UK), 'Body size change in burrowing decapods through the Cenomanian–Turonian boundary event'.

1.8 Undergraduate Research Bursary Scheme: The scheme attracted eight applications, of which six were recommended for funding in 2021, totalling £14,033.25. The awardees were as follows: E. Campbell, University College London, UK, supervised by Dr J.R. Thompson, 'Palaeobiodiversity analyses of late Palaeozoic and early Mesozoic echinoids'; M. Derème, University of Bristol, UK, supervised by Prof. M.J. Benton, 'Microvertebrates from the Middle Jurassic of Hornsleasow, Gloucestershire'; E.M. Kritikos, University College London, UK, supervised by Dr P.D. Mannion, 'A new crocodylomorph specimen from the early Eocene of Morocco and the phylogenetic relationships of Dyrosauridae'; A. Olaru, Vanderbilt University, USA, supervised by Dr S.A.F. Darroch, 'Exploring *Tribrachidium heraldicum* and the late Ediacaran rise of suspension feeding'; F. Warren, Durham University, UK, supervised by Dr M.R. Smith, 'Using $\delta^{13}C_{org}$ to improve the timeline of the Cambrian explosion'; and M. Wasko, Harvard University, USA, supervised by Dr J. Ortega-Hernández, 'Quantifying rates of pyritization through experimental decay and computed tomography'.

1.9 Publicity, outreach and engagement: The Association continues to promote Palaeontology and its allied sciences to print and online media, radio and television. The Association is a major financial supporter of the Lyme Regis Fossil Festival and the Yorkshire Fossil Festival. Face-to-face engagement activities were prevented during 2021 by the coronavirus pandemic. The Lyme Regis Fossil Festival took place as an online event. 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 (£19,000 for 2021), supporting recurring festival activities and Engagement Grants.

1.10 Engagement Grants: The scheme received a total of seven applications in 2021, of which three were recommended for funding, totalling £15,210. These were awarded to: F.M. Lynch (Electric Voice Theatre, UK), 'Voices for the future: Mary Anning'; Dr A.M. Ghilardi (Universidade Federal do Rio Grande do Norte, Brazil), 'A journey into Brazil's deep time'; and Dr C.E.S. Kuhn (Universidade Estadual Paulista, Brazil), 'Fossils go to school'.

1.11 Diversity Group: The Diversity Group continues to implement the recommendations of the Diversity Study completed by Parigen Ltd in 2018, led by the Diversity Officer. In 2021, the Diversity Group issued a statement of support for palaeontologists living in zones of economic, social and political crises. The year 2021 will be excluded from the eligibility period of our grants and awards for those living in such zones, in addition to early-career researchers and people with

caring responsibilities. The mentoring scheme has continued to be developed. Diversity continues to be covered in the *Palaeontology Newsletter*, particularly in the section 'Spotlight on Diversity'. Membership fees to the Association will be waived for people from low-income countries (as designated by the World Bank), starting in the summer of 2022. In 2021, the Association Council introduced a new grant scheme, the Career Development Grant. This grant aims to financially support early-career palaeontologists transitioning from a PhD to a palaeontological career. Furthermore, in 2021 the Diversity Group started working on a general code of conduct for members of the Association.

1.12 Palaeontological Association Exceptional Lecturer scheme: Dr E.G. Mitchell (University of Cambridge, UK) was selected in a competitive process to become the Palaeontological Association Exceptional Lecturer for 2021/2022. Under the Innovations in Palaeontology Lecture Series, Dr Mitchell agreed to deliver a talk entitled 'Using ecology to unlock the secrets of early animal evolution' at six institutions: University of Plymouth, UK; University of Leicester, UK; Yale University, USA; University College London, UK; University of Leeds, UK; and Athénée Saint Joseph Antsirabe, Madagascar.

1.13 Online activities: The Association continues to be the sole host for the online-only journal *Palaeontologia Electronica* and support *Carnets Geol.*, as well as continuing to host websites for other societies (The Palaeontographical Society, International Organisation of Palaeobotany), palaeontological online resources (EDNA fossil insect database, the Kent Fossil Database, SPIERS Software), palaeontological networking sites (European Coalfield Conservation Opportunities) and online outreach projects (Palaeontology [Online]). The listserver PaleoNet also continues to be hosted. The Association continues to run its Internet activities on cloud-based services provided by AWS, located on EU-based servers, whilst e-mail, file hosting and internal e-mail lists are operated on GoogleWorkspace through its non-profit provision, and code versioning is achieved through GitHub non-profit provision.

1.14 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 Dr Angela C. Milner (Natural History Museum, London, UK). 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 Professor Anjali Goswami (Natural History Museum, London, UK). 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 Russell J. Garwood (The University of Manchester, UK). The Mary Anning Award, for an outstanding contribution by an amateur palaeontologist, was made to Mr Peter R. Tarrant (Shropshire, UK). Honorary Life Membership was awarded to Professor George D. Sevastopulo. The 2020 Best Paper Awards in *Palaeontology* and *Papers in Palaeontology* were given respectively to 'Recognizing pulses of extinction from clusters of last occurrences' by J.B. Zimmt and colleagues, and 'Redescription and phylogenetic affinities of the caimanine *Eocaiman cavernensis* (Crocodylia, Alligatoroidea) from the Eocene of Argentina' by Dr P.L. Godoy and colleagues. Council also awards undergraduate prizes to outstanding students in university departments worldwide where Palaeontology is taught beyond Level 1; a total of 14 were awarded throughout the year.

1.15 Forthcoming plans: The Association will continue to make substantial donations from General and Designated funds to promote the charitable aims of the Association. Resources will be made

available to continue a similar programme of grants, meetings, outreach and public engagement activities. The 2022 Progressive Palaeontology meeting will be hosted by the University of Lincoln, UK, in June and the 66th Annual Meeting will be hosted by University College Cork, Ireland, in July 2022 – both are planned as in-person meetings. The Diversity Group will continue to implement the recommendations of the Diversity Study, removing barriers to participation and increasing access to palaeontology for under-represented groups. Upcoming surveys of the membership will aid with monitoring progress.

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

2. ACHIEVEMENTS AND PERFORMANCE

2.1 Meetings support: During 2021, the Association agreed to support a total of four palaeontological meetings, symposia or workshops worldwide. Due to the majority of meetings being held virtually in 2021, no applications for the Postgraduate Travel Fund were received in 2021. The Association's support enabled the worldwide dissemination of research to the benefit of the global palaeontological community.

2.2 Publications: During 2021, the final 'traditional' issues of both the Association's journals were published in November 2021. From January 2022 onwards, an issue will close every two months (for both journals) and include all articles published since the last issue was closed. Volume 64 of *Palaeontology* included 47 papers. Volume 7 of *Papers in Palaeontology* was artificially inflated by including all of the accumulated backlog of Early View papers and, as such, comprised 93 papers. Each volume included 19 Gold Open Access articles.

2.3 Support for research: In 2021 the Association agreed to fund the research activities of 19 early-career researchers and undergraduates. 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 be the case. Compared to 2020, applications for Research Grants decreased from 22 to 20, and thus the success rate increased from 13% to 15%. The applications to the Small Grants Scheme increased (from 15 to 19), and the success rate consequently decreased from 47% to 42%. In 2021 three Career Development Grants were awarded from a total of 26 applications. Applications to the Undergraduate Research Bursary Scheme decreased slightly in 2021 compared to 2020 (from eight to seven applications) and the success rate increased to 85% from 75%.

2.4 Mentoring scheme for early-career palaeontologists: In 2017 the Association established a mentoring scheme. Priority areas were identified and in the first instance the focus was on the transition from postdoctoral positions to permanent jobs, but the scheme was expanded in 2020 to also cover postgraduate researchers studying for a PhD. In 2021 a total of 21 palaeontologists in permanent positions offered to act as mentors and, to date, 33 early-career palaeontologists have either been enrolled, or have taken part, in the scheme (26 currently). The Association mentoring scheme is via direct mentoring, via e-mail, video call or other forms of communication with the scheduling and nature of these meetings at the discretion of the paired mentor/mentee.

2.5 Outreach, education and public engagement: During 2021, the Association provided £3,000 to support the online Lyme Regis Fossil Festival and £3,000 to the hybrid Yorkshire Fossil Festival.

Both were very successful events. In 2021, PEG awarded three Engagement Grants (see 1.10). The Association's Twitter and Facebook accounts continue to enable engagement with wider audiences, and rapid dissemination of news about research, events and palaeontology outside the academic world. The Association's YouTube channel (accessible at <**https://www.youtube.com/thepalaeontologicalassociation**>) hosts videos for a general audience as well as recordings of talks from this year's PalAss Exceptional Lecturer. At the end of 2021 members of the Association Facebook group numbered 2,397 and the Facebook page had 636 followers. The Association Twitter account had 8,563 followers.

3. FINANCIAL REVIEW

3.1 Reserves: As of 31st December 2021, the Association holds reserves of £991,870 in General Funds, which enable the Association to generate additional revenue through investments, and thus to keep subscriptions to individuals at a low level, whilst still permitting a full programme of meetings to be held, publications to be produced, and the award of research grants and Grants-in-aid. They also act as a buffer to enable the normal programme to be followed in years in which expenditure exceeds income, and allow new initiatives to be pursued. The Association holds £123,701 in Designated Funds, which contribute interest towards the funding of the Sylvester-Bradley, Hodson, Callomon, Whittington and Stan Wood awards and towards the Jones-Fenleigh Fund. Total funds carried forward to 2022 totalled £1,115,571.

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 2021 was £299,120. Governance costs were £9,462. Total resources expended were £346,402. The Association continues its membership of the International Palaeontological Association and remains a Tier 1 sponsor of *Palaeontologia Electronica*, and the *Treatise on Invertebrate Paleontology*.

4. STRUCTURE, GOVERNANCE AND MANAGEMENT

4.1 Nature of the governing document: The Palaeontological Association was originally formed on 27th February 1957 as an unincorporated association, which was established as a registered charity (number 276369) on 21st August 1978. At an Extraordinary General Meeting on 16th March 2016, the membership voted in favour of the Association becoming a charitable incorporated organization (CIO) under the Charities Act 2011. All contracts and assets were transferred to the new organization on 1st January 2017. As a CIO the charity is an independent legal entity and, in the unlikely event of its being wound up, the members (including the Trustees) will have no liability for any outstanding contractual debts that the CIO cannot meet. However, the Trustees will continue to have the normal trustee liability for negligence or fraudulence in managing the charity's affairs. The charitable objectives of the Association remain unchanged. The change in legal status means that there has been a different registration number (1168330) and constitution since 2017. The governing document of the Palaeontological Association is the Constitution adopted at the AGM on 15th December 2016 and updated 17th December 2020.

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 set out in the Constitution.

4.3 Membership: Membership on 31st December 2021 totalled 1,183. Of these, 584 were Ordinary Members, 188 Retired Members, 19 Honorary Members and 392 Student Members.

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

5. REFERENCE AND ADMINISTRATION

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

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

5.3 Trustees: The following members were elected at the AGM on 17th December 2020 to serve as Trustees in 2021:

Dr P.J. Orr	President
Dr F.L. Gill	Vice President
Prof. R.J. Butler	Vice President
Dr C.T.S. Little	Secretary
Dr M. Sakamoto	Treasurer
Prof. M.A. Purnell	Chair of the Editorial Board
Prof. N.J. Butterfield	Editor Trustee
Dr S.C.R. Maidment	Editor Trustee
Dr R. Garwood	Internet Officer
Dr E.B. Jarochowska	Newsletter Editor
Dr T.G. Clements	Book Review Editor
Ms Z.E. Hughes	Outreach Officer
Dr S.J. Lydon	Publicity Officer
Mrs E.C. Sinclair	Education Officer
Dr F. Saleh	Diversity Officer
Dr U. Balthasar	Meetings Coordinator
Dr S. Giles	Ordinary Member
Dr T.H.P. Harvey	Ordinary Member
Dr E.A. Hide	Ordinary Member
Mr R.J. Theodore	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, Senator House, 85 Queen Victoria Street, London EC4V 4AB.

Approved by order of the Board of Trustees on 28th June 2022.

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

Independent examiner's report to the Trustees of The Palaeontological Association ('the Charity')
I report to the Charity Trustees on my examination of the accounts of the above charity for the year ended 31 December 2021 set out on pages 9 to 17.

This report is made solely to the Charity's Trustees, as a body, in accordance with Section 145 of the Charities Act 2011. My work has been undertaken so that I might state to the Charity's Trustees those matters I am required to state to them in an Independent Examiner's report and for no other purpose. To the fullest extent permitted by law, I do not accept or assume responsibility to anyone other than the Charity and the Charity's Trustees as a body, for my work or for this report.

Responsibilities and basis of report
As the Charity's Trustees, you are responsible for the preparation of the accounts in accordance with the requirements of the Charities Act 2011 ("the Act"). You are satisfied that the accounts of the Charity are not required by charity law to be audited and have chosen instead to have an independent examination.

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

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

I have completed my examination. I confirm that no matters have come to my attention in connection with the examination giving me cause to believe:

1. accounting records were not kept in respect of the Charity as required by section 130 of the 2011 Act; or
2. the accounts do not accord with those records; or
3. the accounts have not been prepared in accordance with the methods and principles of the Statement of Recommended Practice for accounting and reporting by charities (applicable to charities preparing their accounts in accordance with the Financial Reporting Standard applicable in the UK and Republic of Ireland (FRS102)) and the 2011 Act.

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

Ms M. R. Corfield ACA ACMA
Corfield Accountancy Limited
Chartered Accountants
Myrick House
Hendomen
Montgomery
Powys
SY15 6EZ

Date: 28 June 2022.

THE PALAEONTOLOGICAL ASSOCIATION

Statement of Financial Activities for the Year Ended 31 December 2021

	Notes	Unrestricted funds £	Designated funds £	31.12.21 Total funds £	31.12.20 Total funds £
INCOME AND ENDOWMENTS FROM					
Donations and legacies		33,135	2,121	35,256	57,080
Charitable activities					
Public Meetings		31,284	—	31,284	10,730
Publications		317,787	—	317,787	325,339
Investment income	**2**	13,266	1,510	14,736	12,214
Total		395,432	3,631	399,063	405,363
EXPENDITURE ON					
Raising funds	**3**	37,820	—	37,820	32,445
Charitable activities					
Public Meetings		22,100	—	22,100	17,597
Grants & Awards		23,034	5,283	28,317	30,616
Administration		51,652	—	51,652	48,052
Publications		197,051	—	197,051	219,392
Governance Costs		9,462	—	9,462	13,131
Total		341,119	5,283	346,402	361,233
Net gains on investments		79,350	—	79,350	25,466
NET INCOME/(EXPENDITURE)		133,663	(1,652)	132,011	69,596
RECONCILIATION OF FUNDS					
Total funds brought forward		858,207	125,353	983,560	913,964
TOTAL FUNDS CARRIED FORWARD		991,870	123,701	1,115,571	983,560

The notes form part of these financial statements.

THE PALAEONTOLOGICAL ASSOCIATION

Balance Sheet
31 December 2021

	Notes	Unrestricted funds £	Designated funds £	31.12.21 Total funds £	31.12.20 Total funds £
FIXED ASSETS					
Investments	**6**	670,374	123,701	794,075	708,724
CURRENT ASSETS					
Debtors	**7**	190,472	—	190,472	190,350
Cash at bank		147,113	—	147,113	101,384
		337,585	—	337,585	291,734
CREDITORS					
Amounts falling due within one year	**8**	(16,089)	—	(16,089)	(16,898)
NET CURRENT ASSETS		321,496	—	321,496	274,836
TOTAL ASSETS LESS CURRENT LIABILITIES		991,870	123,701	1,115,571	983,560
NET ASSETS		991,870	123,701	1,115,571	983,560
FUNDS					
Unrestricted funds	**9**			1,115,571	983,560
TOTAL FUNDS				1,115,571	983,560

The notes form part of these financial statements.

The financial statements were approved by the Board of Trustees and authorised for issue on 28th June 2022, and were signed on its behalf by Dr M. Sakamoto – Trustee.

THE PALAEONTOLOGICAL ASSOCIATION

Notes to the Financial Statements for the Year Ended 31 December 2021

1. ACCOUNTING POLICIES

Basis of preparing the financial statements

The financial statements 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 2019)', Financial Reporting Standard 102 'The Financial Reporting Standard applicable in the UK and Republic of Ireland' and the Charities Act 2011.

The Palaeontological Association meets the definition of a public benefit entity under FRS102. Assets and liabilities are initially recognized at historical cost or transaction value unless otherwise stated in the relevant accounting policy.

Income

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

All income is recognized 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.

Expenditure

Liabilities are recognized 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 PALAEONTOLOGICAL ASSOCIATION

Notes to the Financial Statements – *continued* for the Year Ended 31 December 2021

1. ACCOUNTING POLICIES – continued

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

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

2. INVESTMENT INCOME

	31.12.21 £	31.12.20 £
Deposit account interest	16	123
Investment Income	14,720	12,091
	14,736	12,214

3. RAISING FUNDS

	31.12.21 £	31.12.20 £
Voluntary Income Costs: Administration	32,870	30,578
Investment Management Costs: Stockbroker Fees	4950	1,867
	37,820	32,445

4. TRUSTEES' REMUNERATION AND BENEFITS

There were no Trustees' remuneration or other benefits for the year ended 31 December 2021 nor for the year ended 31 December 2020.

Trustees' expenses

The total travelling expenses reimbursed to 20 Members of Council (2020:20) was £71 (2020: £3,799).

THE PALAEONTOLOGICAL ASSOCIATION

Notes to the Financial Statements – *continued* for the Year Ended 31 December 2021

5. STAFF COSTS

Analysis of Staff Costs and Remuneration

	£ 2021	£ 2020
Salaries	93,536	89,956
Social Security Costs	6,467	5,998
Pension Costs	9,354	8,996
Total	109,357	104,950

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

	2021	2020
Publications	1	1
Administration	1	1
	2	2

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

6. FIXED ASSET INVESTMENTS

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

7. DEBTORS: AMOUNTS FALLING DUE WITHIN ONE YEAR

	31.12.21 £	31.12.20 £
Sundry Debtors	190,472	190,350

8. CREDITORS: AMOUNTS FALLING DUE WITHIN ONE YEAR

	31.12.21 £	31.12.20 £
Trade creditors	6,294	5,475
Subscriptions in advance	9,795	11,423
	16,089	16,898

THE PALAEONTOLOGICAL ASSOCIATION

Notes to the Financial Statements – *continued* for the Year Ended 31 December 2021

9. MOVEMENT IN FUNDS

	At 1.1.21 £	Net movement in funds £	At 31.12.21 £
Unrestricted funds			
General fund	858,207	133,663	991,870
Sylvester-Bradley	14,586	(2,169)	12,417
Jones-Fenleigh	28,403	477	28,880
Hodson	112	—	112
Callomon	1,322	287	1,609
Whittington	15,982	(965)	15,017
Stan Wood	64,948	718	65,666
TOTAL FUNDS	983,560	132,011	1,115,571

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	395,432	(341,119)	79,350	133,663
Sylvester-Bradley	514	(2,683)	—	(2,169)
Jones-Fenleigh	477	—	—	477
Hodson	112	—	—	112
Callomon	287	—	—	287
Whittington	535	(1,500)	—	(965)
Stan Wood	1,818	(1,100)	—	718
TOTAL FUNDS	399,063	(346,402)	79,350	132,011

THE PALAEONTOLOGICAL ASSOCIATION

Notes to the Financial Statements – *continued* for the Year Ended 31 December 2021

9. MOVEMENT IN FUNDS — *continued…*

Comparatives for movement in funds:

	At 1.1.20 £	Net movement in funds £	Transfers between funds £	At 31.12.21 £
Unrestricted Funds				
General fund	783,352	74,672	183	858,207
Sylvester-Bradley	17,608	(3,022)	—	14,586
Jones-Fenleigh	28,376	27	—	28,403
Hodson	295	—	(183)	112
Callomon	2,433	(1,111)	—	1,322
Whittington	15,823	159	—	15,982
Stan Wood	66,077	(1,129)	—	64,948
TOTAL FUNDS	913,964	69,596	—	983,560

Comparative 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	401,923	(352,717)	25,466	74,672
Sylvester-Bradley	600	(3,622)	—	(3,022)
Jones-Fenleigh	27	—	—	27
Hodson	—	—	—	—
Callomon	344	(1,455)	—	(1,111)
Whittington	598	(439)	—	159
Stan Wood	1,871	(3,000)	—	(1,129)
TOTAL FUNDS	405,363	(361,233)	25,466	69,596

THE PALAEONTOLOGICAL ASSOCIATION

Notes to the Financial Statements – *continued* for the Year Ended 31 December 2021

9. MOVEMENT IN FUNDS — *continued…*

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

	At 1.1.20 £	Net movement in funds £	Transfers between funds £	At 31.12.21 £
Unrestricted funds				
General fund	783,352	208,335	183	991,870
Sylvester-Bradley	17,608	(5,191)	—	12,417
Jones-Fenleigh	28,376	504	—	28,880
Hodson	295	—	(183)	112
Callomon	2,433	(824)	—	1,609
Whittington	15,823	(806)	—	15,017
Stan Wood	66,077	(411)	—	65,666
TOTAL FUNDS	913,964	201,607	—	1,115,571

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

	Incoming resources £	Resources expended £	Gains and losses £	Movement in funds £
Unrestricted funds				
General fund	797,355	(688,886)	99,866	208,335
Sylvester-Bradley	1,114	(6,305)	—	(5,191)
Jones-Fenleigh	504	—	—	504
Hodson	—	—	—	—
Callomon	631	(1,455)	—	(824)
Whittington	1,133	(1,939)	—	(806)
Stan Wood	3,689	(4,100)	—	(411)
TOTAL FUNDS	804,426	(702,685)	99,866	201,607

THE PALAEONTOLOGICAL ASSOCIATION

Notes to the Financial Statements – *continued* for the Year Ended 31 December 2021

10. RELATED PARTY DISCLOSURES

There were no related party transactions for the year ended 31 December 2021.

11. INVESTMENT GAINS AND LOSSES

All gains and losses are taken to the Statement of Financial Activities as they arise. Realized 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.

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

Investment Gains/Losses	31st December 2021	31st December 2020
	£	£
Realized Gain/(Loss)	18,839	(26,637)
Unrealized Gain/(Loss)	60,511	52,103
Total per Statement of Financial Activities	79,350	25,466

INVESTMENT PORTFOLIO 2021

In July 2020 the Association investments held with Quilter Cheviot Ltd were transferred to their Global Income and Growth Fund for Charities launched early in 2020. The funds held by Quilter Cheviot represent approximately 60 % of the Association's investment portfolio. The remaining 40 % of invested assets are with CCLA Investment Management and of these approximately 20 % are held in a COIF Charities Fixed Interest Fund and the remaining 80 % were transferred in July 2021 to their COIF Charities Ethical Investment Fund. The combined portfolio movements are shown below.

	£
Opening balance 01.01.2021	708,723.51
Purchases	240,844.37
Sales	(229,892.37)
Gains/(losses)	79,350.00
Stockbroker fees	(4,950.00)
Balance at 31.12.2021	794,075.51

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

Detailed Statement of Financial Activities for the Year Ended 31 December 2021

	31.12.21 Unrestricted funds £	31.12.20 Total funds £
INCOME AND ENDOWMENTS		
Donations and legacies		
Donations	2,307	4,636
Subscriptions	32,949	52,444
	35,256	57,080
Investment income		
Deposit account interest	16	123
Investment Income	14,720	12,091
	14,736	12,214
Charitable activities		
Scientific Journals	308,307	319,314
Special Papers	416	298
Field Guides	8,391	5,346
Distribution	673	381
Scientific Meetings	31,284	10,730
	349,071	336,069
Total incoming resources	**399,063**	**405,363**
EXPENDITURE		
Raising donations and legacies		
Administration	32,870	30,578
Investment management costs		
Stockbroker Fees	4,950	1,867
Charitable activities		
Scientific Journals	48,520	61,721
Field Guides	—	11,390
Newsletters	20,060	19,540
Marketing	215	600
Publication Costs	84,205	85,769
Editorial Costs	44,051	40,372
Public Meetings & Costs	22,100	17,597
Grants & Awards	9,541	21,309
Research Grants	18,776	9,307
Administration	51,652	48,052
	299,120	315,657
Support costs		
Governance costs		
Trustees' expenses	71	3,799
Accountancy and legal fees	595	595
Administration	8,796	8,737
	9,462	13,131
Total resources expended	**346,402**	**361,233**
Net income before gains and losses	**52,661**	**44,130**
Realized recognized gains and losses		
Realized gains/(losses) on fixed asset investments	79,350	25,466
Net income	**132,011**	**69,596**

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

Nominations for Council

At the AGM in December 2022, the following vacancies will occur on Council:

- Vice President
- Outreach Officer
- Meetings Coordinator
- Internet Officer
- Deputy Internet Officer (new position)
- Early Career Researcher Officer (new position)
- Ordinary Member

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 sub-committees, particularly those tasked with making recommendations for the awards of grants.

Outreach Officer (three-year term)

The Outreach Officer works closely with the Publicity Officer and the Education Officer in the Public Engagement Group (PEG). The PEG has responsibility for all of the Palaeontological Association outreach activities. Currently they include organizing the Association's presence at the Lyme Regis and Yorkshire fossil festivals, co-coordinating the Engagement Grants, answering relevant enquiries, and initiating other activities that promote and develop palaeontological outreach and education for the Association. PEG members work closely together and their roles often overlap, but specific responsibilities associated with the Outreach Officer include devising and implementing new outreach activities for the Association.

Meetings Coordinator (three-year term)

The Meetings Coordinator ensures the Palaeontological Association is present at most of the major international meetings in the wider Earth Sciences domain, mainly by soliciting and/or organizing symposia that are hosted or sponsored by the Association, and via other initiatives. The Meetings Coordinator chairs the Annual Meeting Review Committee and interacts with the Annual Meeting organizers regarding the topic of the symposium at the Annual Meeting, and with other conveners of Palaeontological Association-sponsored symposia to avoid overlaps and enhance the visibility of a wide range of palaeontological topics. The Meetings Coordinator is also responsible for the evaluation of applications to and the administration of the Association's Postgraduate Travel Fund. The Meetings Coordinator may volunteer to sit on one or more of the Association sub-committees to review grants and awards.

Internet Officer (three-year term)

The Internet Officer position is one of the more time-consuming and rewarding roles, with year-round responsibilities. The Internet Officer interacts throughout the year with the numerous members on and off Council. In particular, they work closely with the Executive Officer, Secretary, Annual Meeting and ProgPal organizers. The main tasks are: running the Association's Amazon Web Services (AWS) cloud-based resources; administering the Association's internal ICT requirements (*e.g.* Google Workspace); updating the PalAss website content; maintaining the website's Drupal code-base (HTML, CSS, JavaScript, PHP and MySQL), custom website modules, and online payment systems; versioning these with Git/GitHub; and running the Association's online store. The role extends to ensuring the website meets current standards for accessibility, and that the Association's electronic data infrastructure meets current regulations. In addition they liaise with PalAss-hosted external websites (*e.g. Palaeontologia Electronica*). The busiest times of the year are in the lead up to ProgPal and the Annual Meeting (registration and abstract submissions) and during periods where major systems require replacing, upgrading, or fixing. The Internet Officer also serves as the 'line manager' for the Deputy Internet Officer. For more information please contact the current Internet Officer (e-mail <**internet@palass.org**>).

Deputy Internet Officer (three-year term; new position)

The new position of Deputy Internet Officer is an exciting opportunity to support the Association and develop transferable skills. As a Trustee they will have a direct say in how the Association is run. As the title suggests, the holder will support the Internet Officer in their role and provide cover in the unlikely event that they are unavailable. They will also have a direct influence on the direction, aesthetic and functionality of the Association's online resources. During the three-year term there will be numerous opportunities to learn and develop new skills, and build upon those already held, as well as opening the possibility to stand as the Internet Officer in the future. Experience of any of the following **is not essential** but would be beneficial: basic knowledge of one or more of the following: HTML, CSS, Javascript, MySQL and PHP; code versioning with Git/GitHub; experience with command-line terminals (Windows, Linux or Mac OS); experience with a large-scale content management system (CMS) such as Drupal; experience of using Google Workspace (*e.g.* Google Doc/Sheets/*etc.*) and cloud-based hosting of applications such as Amazon Web Services (AWS). The Deputy Internet Officer will be supported in any area where additional knowledge and training are required by Association, for instance training to undertake the industry-recognized AWS certification (if desired). Many of the transferable skills imparted during the term in office are highly sought after in research and industry, and may be particularly beneficial for those in an early-career position. For more information please contact the current Internet Officer (e-mail <**internet@palass.org**>).

Early-Career Researcher Officer (three year term; new position)

An important cohort of the Palaeontological Association's membership are early-career researchers (ECRs). Historically there has not been an ECR-specific role on the Association's Council; however, in 2022 we are looking to convert one of the Ordinary Member positions specifically for this purpose The ECR role, as with the other Ordinary Member positions, is a three-year term and does not have a formal portfolio. They will attend Council meetings and contribute to discussion, decision-making and future planning. They will have the opportunity to participate in sub-committees, such as those tasked with reviewing and making decisions on grant applications. Importantly, they will act as a liaison for the ECR community to Council, allowing for ECR perspectives and feedback to directly

influence decision-making within the Association. This role also looks to take the lead on initiatives specifically to help the Association better serve our ECR members.

We define an ECR as any researcher within ten years (exclusive of career breaks, full-time equivalent) post-PhD thesis submission who has not found permanent employment. Should this member gain permanent employment during their tenure, they would continue in the role until their tenure ends, whereupon they could not stand again as the ECR Ordinary Member.

Ordinary Member (three-year term)

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

Awards and Prizes

The Palaeontological Association recognizes excellence in our profession by the award of medals and other prizes. The Association sees its lists of medals 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. Members considering making nominations should first read the Palaeontological Association 'Statement of Diversity' below.

Statement of Diversity

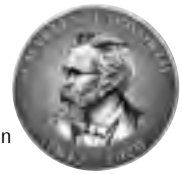
The Palaeontological Association has an Unconscious Bias document (available on the Association website), the recommendations of which will be adhered to at all times. All decision-making for Palaeontological Association awards and prizes will be carried out objectively and professionally. The Association is committed to making award and prize decisions purely on the basis of the merit of the individual(s). No nominee for awards or prizes will receive less favourable treatment on the grounds of: gender, marital status, sexual orientation, gender re-assignment, race, colour, nationality, ethnicity or national origins, religion or similar philosophical belief, spent criminal conviction, age or disability. Equally, all nominations will be assessed on equal terms, regardless of the sex, age and/or ethnicity of the nominee. Nominations will therefore be assessed and graded on their merits, in accordance with the criteria and the aims and objectives set for each award or medal. Due consideration will be given to any period away from science due to parental leave, illness or any other such career break. Nominators are reminded that neutral language (*e.g.* gender neutral) should be used in all nominations.

Palaeontological Association Awards/Medals selection procedures

The Palaeontological Association Council discusses Awards and Medals at the May Council meeting and votes to select awardees. The benefit of using Council to select awardees, rather than a dedicated awards committee, is that it draws on the wider experience of the entire Council. Voting

is preceded by an introduction from the President that: (i) includes a diversity statement to remind Council of their responsibility in terms of fairness and diversity issues (including impact of non-standard careers *etc.*); (ii) outlines the remit and selection criteria for each award; (iii) considers the impact of awardees in terms of increasing the diversity of recipients. Each award is considered in turn with every application considered except those that clearly fall outside of the remit. Each Council Member will vote by listing their three preferred candidates in rank order. The candidate with the most votes as preferred candidate will be awarded the award/medal. If there are only two candidates and they are tied the President shall have the casting vote. If there are three or more candidates and there is a tie the vote will be recounted including the second ranked candidate for all of the votes. If the vote remains a draw after second and third ranked candidates are considered the President will cast the deciding vote.

Lapworth Medal



The Lapworth Medal is the most prestigious honour bestowed by the Association to a palaeontologist who has made a highly significant contribution to the science of palaeontology by means of a substantial body of research and service to the scientific community. It is not normally awarded on the basis of a few good papers: Council will look for breadth as well as depth in the contributions in choosing suitable candidates.

The candidate must be nominated by two members of the Association (proposer and seconder; names and contact details required). The nomination must consist of: (i) a two-page career summary (font-size 12); (ii) a list of ten papers that demonstrate significance and breadth of research. The two-page career summary should outline the significant contribution to the science in terms of research and also other activities such as outreach, teaching, mentoring and administration (including that relevant to palaeontology at their home institutions, scientific societies and at higher levels, such as funding bodies and government advisory panels). We are looking for evidence of both depth and breadth in research with clearly identified achievements and breakthroughs. Relevant honours and awards may be mentioned. If a candidate has taken time out from their professional career for family or other purposes this should be highlighted. Nominations must be compiled into a PDF file of less than 10 MB and uploaded via the webpage before the deadline.

The award will be considered by Council at its May meeting and awardees will be invited to a ceremony at the Annual Meeting in December. Awards will also be announced in the *Newsletter*, on the Association website and through social media. Council reserves the right to not make an award in any particular year.

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

President's Medal

The President's Medal is a mid-career award given by Council to a palaeontologist who has had between 15 and 25 years of full-time experience after their PhD (excluding periods of parental or other leave, but not excluding periods spent working in industry) in recognition of outstanding contributions in his/her earlier career, coupled with an expectation that they will continue to

contribute significantly to the subject in their further work. Please note that, in recognition of the disruption caused by the COVID-19 pandemic, Council has decided that 2020 should be discounted when calculating the years of full-time experience.

The candidate must be nominated by two members of the Association (proposer and seconder; names and contact details required). The nomination must consist of: (i) a statement of when the PhD was awarded; (ii) a two-page career summary (font-size 12); (iii) a list of ten papers that demonstrate significance and breadth of research. The two-page career summary should outline significant contribution to the science in terms of research and also other activities such as outreach, teaching, mentoring and administration. We are looking for evidence of significance of research with clearly identified achievements and breakthroughs. If a candidate has taken time out from their professional career for family or other purposes this should be highlighted. Nominations must be compiled into a PDF file of less than 10 MB and uploaded via the webpage before the deadline.

The award will be considered by Council at its May meeting and awardees will be invited to a ceremony at the Annual Meeting in December. Awards will also be announced in the *Newsletter*, on the Association website and through social media. Council reserves the right to not make an award in any particular year.

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

Hodson Award

The Hodson Award is conferred on a palaeontologist who has had no more than ten years of full-time experience after their PhD (excluding periods of parental or other leave, but not excluding periods spent working in industry) and who has made a notable contribution to the science. Please note that, in recognition of the disruption caused by the COVID-19 pandemic, Council has decided that 2020 should be discounted when calculating the years of full-time experience.

The candidate must be nominated by two members of the Association (proposer and seconder; names and contact details required). The nomination must consist of: (i) a statement of when the PhD was awarded; (ii) a two-page career summary (font-size 12); (iii) a list of ten papers that demonstrate significance and breadth of research. The two-page career summary should provide evidence of outstanding contribution in career so far. If a candidate has taken time out from their professional career for family or other purposes this should be highlighted. Nominations must be compiled into a PDF file of less than 10 MB and uploaded via the webpage before the deadline.

Nominations will be considered by Council at its May meeting and awardees will be invited to a ceremony at the Annual Meeting in December. Awards will also be announced in the *Newsletter*, on the Association website and through social media. Council reserves the right to not make an award in any particular year.

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

Mary Anning Award

The Mary Anning award is open to all those who are not professionally employed in palaeontology but who have made an outstanding contribution to the subject. Such contributions may range from the compilation of fossil collections and their care and conservation, to published studies in recognized journals. The candidate must be nominated by two members of the Association (proposer and seconder; names and contact details required). The nomination must consist of: (i) a statement confirming that the nominee is NOT professionally employed in palaeontology; (ii) a one-page career summary (font-size 12). The one-page career summary should outline the nominee's contribution to palaeontology. This should include details of the sorts of activities pertaining to development of fossil collections, curation, care and maintenance of fossil collections, publications relating to these fossil collections, evidence for outreach activities associated with these fossil collections. Nominations must be compiled into a PDF file of less than 10 MB and uploaded via the webpage before the deadline.

Nominations will be considered by Council at its May meeting. Awardees will be invited to a ceremony at the Annual Meeting in December, although the award may be presented at another time and place on request of the awardee. Awards will be announced in the *Newsletter*, on the Association website and through social media. Council reserves the right to not make an award in any particular year.

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

Gertrude Elles Award

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

Nominations must consist of a one-page supporting case (font-size 12) and a portfolio of up to four images. The supporting case must outline:

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

Self-nominations are permitted, and the nominators (names and contact details required) and proposed recipients do not need to be members of the Association. Nominations will be considered relative to the scale of the institution and the available project budget. The supporting case and the portfolio of images must be compiled into a PDF file of less than 10 MB and uploaded via the webpage before the deadline.

The award will be considered by Council at its May meeting and winners will be invited to the award ceremony at the Annual Meeting in December. Awards will also be announced in the *Newsletter*, on the Association website and through social media. Council reserves the right not to make an award in any particular year. Nominations are invited by **31st March** each year.

Honorary Life Membership

Honorary Life Membership recognizes individuals whom Council deems to have been significant benefactors and/or supporters of the Association. Recipients will receive free membership for life. The candidate must be nominated by two members of the Association (proposer and seconder; names and contact details required). The nomination must consist of a one-page statement (font-size 12) outlining the nature of their support for the Palaeontological Association. This should be uploaded via the webpage before the deadline. The award will be considered by Council at its May meeting and announced at the AGM. The award will also be announced in the *Newsletter*, on the Association website and through social media. Nominations are invited by **31st March** each year.

Annual Meeting President's Prize and Council Poster Prize

The President's Prize is awarded for the best talk and the Council Poster Prize 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 is announced immediately after the oral sessions at the end of the Annual Meeting. Winners will receive an official certificate and free membership to the Association for one year.

Best Paper Awards

The aim of these awards is to recognize papers published in either *Palaeontology* or *Papers in Palaeontology* and reward excellence in our field of science. The selection criteria are as follows: scientific breadth and impact; novelty of approach; and quality of writing and illustration. The awards are open to all authors irrespective of age and nationality; membership of the Association is not required. Frontiers reviews, rapid communications and regular research articles are all eligible. The selection procedure is that a list of all papers published in the year will be drawn up in October (when papers for the final part are allocated) and circulated around the science editors. The science editors are asked to nominate any paper that stands out, providing 2–3 sentences explaining why it is deserving. The Editor-in-Chief will draw up a shortlist of no more than five papers with supporting statements to circulate to the Editorial Board. The Editorial Board will then select winners by vote. Corresponding authors of winning papers will be offered 'Gold open access' paid for by the Association for one nominated paper submitted to *Palaeontology/Papers in Palaeontology* within the following 18 months (and subsequently accepted). In the case of joint authorship papers, the corresponding author can, by agreement, transfer the prize to one of the co-authors. The Editor-in-Chief will contact the winning authors and write short synopses for the *Newsletter*. An announcement of the awards will also be made at the AGM.

Undergraduate Prize Scheme

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

Departments may use any criterion for selection, though most prefer to use the scheme as an acknowledgement of best performance in a relevant exam or project. Only one nomination will be accepted from any one institution in each calendar year. The nominee must be an undergraduate student, not a postgraduate, when they are selected. Normally the award is made to a student in their penultimate year of study, but a final-year candidate may be chosen if this is deemed more appropriate for the department in question.

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

Innovations in Palaeontology Lecture Series and the PalAss Exceptional Lecturer

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

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

Format of the scheme:

- One PalAss Exceptional Lecturer will be selected each year in a competitive process.
- The PalAss Exceptional Lecturer will be expected to give five lectures at five different institutions over a nine-month period.
- The successful applicant will receive the Innovations in Palaeontology Lecture Series Grant, which will be administered by the home institution of the PalAss Exceptional Lecturer.
- The Innovations in Palaeontology Lecture Series Grant may only be used to pay the reasonable travel costs incurred by the PalAss Exceptional Lecturer to visit each of the host institutions (up to £2,000 for the total Innovations in Palaeontology Lecture Series with a maximum of £500 for any individual lecture). The host institutions will cover costs for accommodation (where necessary) and hospitality.

- Any academic institution (universities and/or museums) from any country can apply to participate in the Innovations in Palaeontology Lecture Series as a host institution.
- Any unused funds must be returned to PalAss after delivery of the final lecture. Should the PalAss Exceptional Lecturer move institutions within the timeframe of the lecture series, any unspent funds must remain available to the PalAss Exceptional Lecturer.
- Applications to be a PalAss Exceptional Lecturer will be strengthened if the applicant agrees to submit a paper as a review article for possible publication in *Palaeontology*.

Eligibility and selection process of the PalAss Exceptional Lecturer:

- Eligible candidates will have a PhD in palaeontology or a related field.
- Applicants can reside in any country, but must be members of the Association.
- Candidates must self-nominate.
- To self-nominate, a two-page CV, full list of publications, and statement of motivation (max. 300 words) must be submitted via the Association's webpage as a single PDF file (max. 8 MB). In addition, a 60 second video summary (in MP4 format; max. size 30 MB) of a proposed seminar topic must be submitted via the Association's webpage.
- The PalAss Exceptional Lecturer will be chosen based on 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 timeframe within which the lecture should be given.
- The PalAss Exceptional Lecturer will receive the list of potential host institutions after the 1st May deadline, and will choose their preferred hosts and liaise directly with them. Applications after 1st May will be considered depending on the remaining availability.

Expectations for host institutions:

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

Deadlines each year:

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

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 (<**https://www.palass.org/awards-grants**>). Those with deadlines in the next six months or that run throughout the year 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.

NEW: The Association will, via the Grants-in-Aid programme, consider applications to financially support workshops to be held as part of the Annual Meeting and Progressive Palaeontology. Further details on this are below.

General Regulations for all applications.

- The Association will consider applications up to £2,000 GBP.
- Applications must be received by the deadline of either 1st March or 1st September each year.
- Application must be made in good time. The proposed event must commence no earlier than six months after the application round deadline applied to.
- All applications are to be made by the scientific organizer(s) of the meeting using the online application form at <**https://palass.org/awards-grants/grants/grant-aid-application-form**>.
- Applications will be considered by Council at either the May or the October Council Meeting each year.
- Applicants will normally be informed of the application outcome by the end of May or October (*i.e.* 2-3 weeks after the May or October Council meeting).
- If the application is successful, we require that the support of the Association is acknowledged, preferably including reproduction of the Association's logo, in the meeting/workshop/short course literature and other media.
- Any monies granted must only be used for the specified purposes stated in the original grant application. Should circumstances change and the monies cannot be used then it is expected that all unspent amount is returned to the Association.
- Retrospective changes to grant applications, *i.e.* after the proposed event, are not allowed.
- In the event of unforeseen changes in circumstances prior to the start of the proposed event (*e.g.* due to the COVID pandemic, illness of keynote speakers, *etc.*) advice should be sought from the Association's Executive Officer and/or the Secretary.

Presubmission enquiries may be made to the Secretary (e-mail <**secretary@palass.org**>).

Financial support via the Grants-in-Aid programme for workshops at the Annual Meeting and Progressive Palaeontology

Workshops have been an important part of both the Annual Meeting and Progressive Palaeontology in recent years. These have typically been held the day before the meeting.

The workshops are arranged in consultation with the local meeting organizer; the local organizer having the final decision as to how many and which events to select for inclusion in any workshop programme. It may be possible (subject to the local organizer being able to facilitate it) to arrange a hybrid event. Our preference, however, is to run the workshop as either an in-person or a virtual event. We especially welcome suggestions for workshops that help the Association advance its commitments to EDI-related issues.

We invite those organizing workshops at either the Annual Meeting or Progressive Palaeontology to apply for competitive funding via the Grants-in-Aid programme to help offset costs (*e.g.* travel, accommodation) incurred by those delivering the workshop, and/or to provide an honorarium (to a maximum of £250.00 GBP) for contributors. An honorarium may be appropriate to support ECR/ precariously-employed workers, others not in full-time, permanent employment, or where the contributions are by subject specialists on topics that do not necessarily form part of their core research activities. These examples are not exhaustive.

Before applying for funding, please liaise with the local meeting organizer and secure their support for the proposed activities. You should confirm in your application that this support is in place. This is to avoid potential issues such as there not being the infrastructure available locally (rooms, *etc*.), or time in the schedule, to accommodate the workshop.

The Association would support a maximum of two workshops at each of the Annual Meeting and Progressive Palaeontology.

Making an application for meeting or workshop/short course support

Applications must be made through the online submission form, for which you will need the following information:

- Title of meeting / workshop / short course
- Date and Place of proposed event
- 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 1: If funds are requested to support one or more keynote speakers, then full details of their names, affiliations and titles of presentations must be included.

Note 2: The application will be strengthened if the keynote speaker(s) agrees to submit their paper as a review article for possible publication in *Palaeontology* or *Papers in Palaeontology*.

Deadlines are **1st March** (for events commencing on or after 1st September in the same year) and **1st September** (for events commencing on or after 1st March the following year).

Engagement Grants

Awards are made to encourage educational outreach, public engagement and related initiatives in palaeontological themes. Normally, the budget for an individual grant would be less than £5,000 GBP (or equivalent currency in the applicant's country at the time the funds are disbursed). Under exceptional circumstances, a budget of up to £8,000 GBP 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. Applications from any country and applicants of any nationality are welcomed to apply.

Applications for salary costs are permitted, providing a full justification is given, but if awarded all legal and financial liability will lie with the applicant (see: Categories of expenditure for which the Palaeontological Association does not provide support, below).

Other conditions:

- Proposals must fit with the charitable aims of the Association.
- 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. We also encourage applications aimed at supporting under-represented groups in palaeontology (see the Diversity Study for more details).
- If the principal applicant is a member of the Association they should be signed into the website when submitting the form. Applicants can contact the Executive Officer Dr Jo Hellawell (e-mail <**executive@palass.org**>) for further information regarding membership.
- Preference will normally be given to candidates who have not previously won an award. The application deadline is **1st September** and funds will normally be available from 1st November each year. The awards will be announced at the Annual General Meeting.

Proposals will be ranked on the following criteria:

- Fit to the charitable aims of the Association
- Imaginative quality, innovation, and likely spread and impact of the proposal
- Feasibility, value for money and cost effectiveness
- Track record of the investigator in engagement and education initiatives

At the end of the award period a final report (including receipted accounts) will be submitted for review by the Trustees or, where appropriate, external referees. Appropriate parts of the final report will be published in the Association *Newsletter*. Any publicity associated with the activity must mention the support of the Association.

Applications must be submitted electronically via the webpage (see below for details of the Required Supporting Information). Feedback on unsuccessful applications will be provided upon request to the Secretary.

Categories of expenditure for which the Palaeontological Association does not provide support:

Applicants are advised that the Association does not offer funding for the following costs, and hence none of these items may be included in any budget proposal submitted to the Association.

- Core funding or overheads for institutions. The Association will fund the directly-incurred costs of the engagement/educational initiative but, as a charity, we expect the general running costs (*e.g.* indirect costs, estate costs, support services, directly allocated staff costs) to be otherwise covered. We will therefore not fund on a proportion of full economic costs (fEC) basis. Attention is drawn to paragraphs 3.31 to 3.37 of the Science and Innovation Investment Framework 2004–2014, HM Treasury (July 2004), which explains arrangements for the provision of overheads linked to charity funding to academic institutions.
- Individual items of equipment over £1,000 GBP, sites, buildings or other capital expenditure. Artwork and similar specially-commissioned outreach tools are not considered to be equipment, and will be considered for funding.
- A shortfall resulting from a withdrawal of or deficiency in public finance.
- Student tuition fees and summer research bursaries. If you would like to support a summer research project see the Undergraduate Research Bursaries for more detail.

The application deadline is **1st September** and funds will normally be available from 1st November each year. The awards will be announced at the Annual General Meeting. For more information please contact the Association's Outreach Officer (e-mail <**outreach@palass.org**>).

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 is one online application form with a deadline of **1st November**. The successful applications will be reported at the December Council meeting, and at this meeting Council will decide on the allocation of the awards based upon the nature of the project made in the application. The awards will be announced at the AGM, and funds will normally be available from 1st January.

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

Further information, including eligibility criteria and a full list of terms and conditions for the Small Grants Scheme, can be found on the appropriate page of the Association's website. Enquiries may be made to the Secretary (e-mail <**secretary@palass.org**>).

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

FROM GONDWANA TO LAURASIA

The 6th International Palaeontological Congress

Monday 7th to Friday 11th, November 2022
Khon Kaen, Thailand

JOIN US IN THAILAND

33 scientific sessions 8 fieldtrips

CONTACT
Mongkol Udchachon
Palaeontological Research and Education Centre, Mahasarakham University
Email: generalchair_ipc6@msu.ac.th; mongkol.c@msu.ac.th

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https://ipc6.msu.ac.th

Palaeontological Association Postgraduate Travel Grant for IPC6 – Thailand

The Palaeontological Association is running a programme of travel grants to assist student members of the Association (doctoral and earlier) to attend the 6th International Palaeontological Congress in Thailand in order to present a talk or poster.

Terms and Conditions

Please read the following notes before applying:

- Applicants must be delivering a presentation (poster or oral) that falls within the scope of the Association's charitable aims.
- The maximum amount awarded will be £700 GBP.
- Applications can only be accepted from Student Members of the Association.
- Applications are to be made through the Association website before the 1st September 2022 deadline, and should include the personal details of the applicant and their career stage, the title of the accepted abstract, and details of other funding obtained towards the cost of the meeting. Two letters must also be attached, in PDF format: a letter of confirmation from the meeting convenor which states the acceptance of the applicant's abstract, and a short status-confirming letter from the applicant's supervisor.
- The grants can only be used for travel and accommodation and only one grant will be awarded per applicant. Multiple applications are not allowed.
- Funding from the Association must be acknowledged on your poster or in your presentation.
- Applications which fulfill these Terms and Conditions will be selected by a pooled lottery system (see below).
- Successful awards will be paid retrospectively on the submission of receipts for reasonable travel and accommodation costs.

Application selection process

Applications will be collated into two pools:

1. The first pool will be made up of applicants from low-middle income countries as defined by the World Bank. A minimum of nine applications will be drawn by lottery and awarded. In the event that there are fewer than nine applicants all applications will be grants without a lottery.
2. The second pool will be made up of all other applications not contained in the first pool, plus all applications not granted an award that were previously in the first pool. Applications will be drawn by lottery and awarded. The lottery will cease once the total amount awarded from both pools reaches the budget limit for the IPC6 travel fund as set by Council.

The deadline for this fund is **1st September 2022**. Enquiries should be made to the Meetings Coordinator (e-mail <**meetings@palass.org**>).

Association announcements

Palaeontological Association Mentoring Scheme: new application process and a call for new mentors

The Palaeontological Association administers a mentoring scheme that links experienced mentors with postgraduate (PhD) and postdoctoral researchers in order to share experiences and provide advice on career development. To date, the scheme has paired 33 mentors and mentees, drawn from a wide range of academic institutions worldwide, and has been successful in offering support to early-career researchers with a wide range of different interests.

Call for new mentors

In order to enhance this scheme, and provide as much relevant support as possible, we would like to expand and diversify our current pool of mentors. We are particularly interested in recruiting new mentors from outside the UK, who will bring knowledge of other international academic environments, and mentors in non-academic roles who make frequent use of their palaeontological expertise (*e.g.* museum roles, scientific publishing, geological and environmental consulting, science communication, *etc.*).

The frequency and nature of mentoring meetings are determined by discussion between the mentor and mentee and usually involves regular meetings held every few weeks, either in person or online. The application process requires new mentees to nominate potential mentors from the available pool; mentors are able to work with whatever number of mentees best suits their availability. The Association has formal guidelines governing the scheme that both parties are expected to follow and which are provided to all new mentors and mentees in advance of entering the scheme formally.

Any members who would like to serve in the role of a mentor should contact the relevant Vice-President, Dr Paul Barrett (e-mail <**vicepresident1@palass.org**>), to indicate their willingness to help. The following information should be provided: contact details (current position, institution/department, e-mail address); a brief summary of academic background (degrees held, from where, in which subject); a brief statement (<100 words) on their skills and interests as a mentor (*e.g.* previous experience, particular research or professional interests); mention of their preferred mentoring method (in person, online, by e-mail, *etc.*); and a statement of which cohort of mentees they would be best placed to advise (early-stage PhD/late-stage PhD/postdoc/any combination of these). This information is shared with mentees and helps them to identify mentors with the backgrounds and experience most relevant to them.

New online application process

PhD students and postdocs who wish to take advantage of the Mentoring Scheme need to be members of the Association. Expressions of interest in joining the scheme can be made via a new web form that can be found on the Association's website (https://www.palass.org/careers). Alternatively, enquiries can be sent to Dr Paul Barrett direct if more information on the scheme is desired before making an application.

Paul M. Barrett
Vice-President
<**vicepresident1@palass.org**>

Supporting diversity, equity and inclusion initiatives

The Diversity Group would like to introduce a donation scheme aimed at supporting diversity, equity and inclusion (DEI) initiatives. This scheme consists of voluntary donations towards supporting students and under-represented groups. The funds will be used towards: sponsoring PalAss membership for students, with priority given to under-represented groups and those from LMI countries; and – if enough funds are collected – supporting attendance at the Annual Meeting of students and ECRs on temporary contracts who would otherwise not be able to attend, even if awarded a travel grant.

Members will be able to donate, publicly or anonymously, if they wish, when renewing their memberships. Donations will be collected over the course of one year, and will then be used during the following year. Applicants will be able to benefit from this scheme when renewing their memberships or registering for the Annual Meeting.

Once a year, a page in the *Newsletter* will be added, listing the donors who wish to reveal their identities, plus the number of anonymous donors. The names of the beneficiaries will remain anonymous.

We expect the implementation of this scheme on our online platform later this year. Donation collection for the first cycle of this scheme will continue during 2023. Donations will be used towards DEI actions in 2024.

Farid Saleh
Diversity Officer

Applications for support for initiatives not fitting any of the grants and awards schemes

The Palaeontological Association will consider requests from external applicants, both institutions and individuals, for in-kind support of initiatives that fall within the charitable aims of the Association. The support may take the form of letters of support to be used in applications for funding and sponsorship, publicizing events and other activities via the Association's media channels and the *Newsletter*, or having events reported on by our correspondents.

Requests will be considered on a case by case basis, and should be submitted at least eight weeks in advance of *e.g.* any scheduled event or a grant application deadline. Short (<400 words) requests for support should be submitted via the web form, with details under the following headlines: Goals of the initiative; Activities proposed; Form of support requested; Target group; and Anticipated reach of the initiative. The request should specify the person responsible for managing the support, and provide their contact details.

We encourage submission of a short report listing the outcomes of the initiative for possible publication in the *Newsletter*. Newsletter materials should be sent to Dr Emilia Jarochowska (<**newsletter@palass.org**>).

Emilia Jarochowska
Newsletter Editor

ASSOCIATION MEETINGS

66th Annual Meeting of the Palaeontological Association
University College Cork, Ireland *18 – 24 July 2022*

The 66th Annual Meeting of the Palaeontological Association will be held at University College Cork, in Cork, Ireland. The organizing committee is chaired by Prof. Maria McNamara. The e-mail address for all meeting-related matters is <**annualmeeting2022@palass.org**>.

Information about the meeting is provided in the yellow supplement at the back of this Newsletter and on the PalAss website at <**https://www.palass.org/meetings-events/annual-meeting/2022/annual-meeting-2022-cork-ireland-overview**>.

The abstracts for the talks and posters will be available on the PalAss website and will be included in the conference pack at the Meeting. We look forward to seeing you in Cork!

Abstract of Annual Address

The Annual Address will be given on Thursday 21st July.

What – if anything – can palaeontology contribute to understanding our climate crisis?

Prof. Daniela N. Schmidt
University of Bristol, UK

The Intergovernmental Panel for Climate Change in the 6th Assessment stated that historical and palaeontological records show that climatic variability has high potential to affect biodiversity and human society and that "… global biodiversity crises [are] often triggered by rapid warming". Often these records of change occur over millennia and are only studied regionally or at limited taxonomic levels in incomplete records. This is raising the question what the contribution of the geological record can be to answering questions on impacts and risks of climate change on natural systems. We draw on the fantastic records in our archives and museums around the world, but these have gaps that are both geographic and temporal. Most recently, the climate crisis is not seen in isolation any more but strongly coupled to the biodiversity crisis. In this presentation I will draw on examples of links between environmental change and biotic response in the fossil record, and highlight the power of our methodologies working with challenging records and our experience in combining climate and biological records. I will argue that, while we cannot say much about the risks of climate change in the coming decades, the fossil record has fundamental contributions to make via the analysis of ecosystem resilience and responses.

Meeting support

The organizers of the Annual Meeting gratefully acknowledge the support of the sponsors:

College of Science, Engineering and Food Science, UCC

Cork Convention Bureau

Environmental Research Institute, UCC

Failte Ireland

Geological Society of London

Geological Survey of Ireland

Geological Survey of Northern Ireland

Irish Centre for Research in Applied Geosciences

Irish Geological Association

Institute of Geologists of Ireland

Ireland's Fossil Heritage

JEOL

Lampert

Mason Technology

Niton UK

National Museum of Ireland

Perkin Elmer

Renishaw

Royal Irish Academy

School of Biological, Earth and Environmental Sciences, UCC

The Paleontological Institute

The Royal Society

Wiley

news

A series of (un)fortunate events

What's the best way to be sure to be remembered in history forever? You can do something very good (like discovering new medicines), or something very creative (like poetry or art), or you can do something very bad (tyrants, dictators and serial killers, to name a few). However, there is one other potential option: you might just be extremely unlucky.

In fact, if you died in extraordinary circumstances, possibly with all your family and friends and in the middle of a global crisis, there are good chances that a palaeontologist will find your remains, consider them very interesting, write articles about you and even display your fossil in a museum.

In the last few months, mainstream media have broadcast four histories of tragedy and extremely unlucky deaths of ancient organisms.

The Tanis tragedy

The Tanis fossil site is located in the US, in southwestern Dakota. It is well known for the long list of Upper Cretaceous and Lower Paleocene fossil discoveries and it seems that this site recorded the events of the asteroid impact at the K–T boundary in great detail. This is a wonderful place for palaeontologists to be, even if the Late Cretaceous creatures that were wiped out by the asteroid impact may have had a different opinion.

Breaking a leg wasn't enough for the protagonist of our story to survive, but it was more than enough for everlasting fame. The palaeontologists working at the Tanis site found a very well-preserved limb of a dinosaur that had died on the same day the giant asteroid hit the Earth ending the Mesozoic era.

The story of this unlucky dinosaur and other fossils was narrated by Sir David Attenborough in the BBC TV show "Dinosaurs: The Final Day". Have you seen it? We'll be happy to hear your opinion through our social media (Twitter, Facebook).

The ill-fated ichthyosaur

For our second story, let's move away from dinosaurs. We're not going too far, but we need to take a dip in a Cretaceous sea to meet a different kind of reptile: the *ichthyosaur*.

The fossil of our unlucky *ichthyosaur* was found in Chile, near the Tyndall glacier in Patagonia. Not only is this the first *ichthyosaur* discovered in Chile, but it is also the fossil of a pregnant female. She was medium-sized, around 4 metres long, and lived around 129–139 million years ago.

The specimen was named 'Fiona' after the character from *Shrek*, because of the green colour of the fossil's oxide coating. Fiona was found in 2009, but it took 13 years for palaeontologists to finally excavate her remains and study them, something that isn't uncommon in these kinds of studies. This is even more true for fossils in remote locations, where it is difficult, and sometimes dangerous, to access the site and fossil transport can be very expensive.

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

A pregnant fossil like Fiona is crucial to understanding the life cycle of extinct animals such as *Ichthyosaurus* and the hope is that this will foster interest in South American fossils that have been traditionally overlooked with respect to the North American, Russian, Chinese and European ones.

The picturesque pterosaur

We already talked about pterosaurs in the last issue of this *Newsletter*, but these winged reptiles keep getting the attention of mainstream media. They may be slightly less popular than dinosaurs, and often confused with them, but their charm is undeniable.

This story is less about tragedy and more about fashion; palaeontologists have been discussing for a very long time whether or not pterosaurs had feathers.

The final answer to this dilemma comes from the analysis of the fossilized headcrest of *Tupandactylus imperator*, a pterosaur that lived in Brazil 115 million years ago. Upon closer inspection, the bottom of the huge crest of this creature showed a rim made of two kinds of feathers. One kind was short and wiry, more like hairs than feathers, while the second one was fluffier and branched like the feathers of modern birds.

The research teams studied the pterosaur's feathers using an electron microscope and discovered that there were preserved remains of melanin, known as melanosomes, of different shapes. Colours in modern birds are tightly related to melanosome shape and finding the same variability in pterosaur melanin strongly suggests that their feathers could have had different colours, like birds do today.

The studied fossil originally came from Brazil and was repatriated to its home country.

The torn trilobite

Trilobites are an iconic group of Palaeozoic fossils. They were very successful between 521 and 250 million years ago, resulting in a very rich fossil record.

However, trilobite behaviour is largely unknown. Luckily, a specimen of *Olenoides serratus* gave a big hand – or maybe it is more correct to say 'clasper' – to palaeontologists in understanding the

possible level of complexity of the behaviour of this group.

The specimen of *Olenoides serratus* we're talking about was twice unlucky. Not only was it buried in underwater sediments after death, but it also broke after becoming a fossil. Broken fossils aren't usually palaeontologists' favourite thing, but this case is different.

In fact, the break in the fossil revealed the presence of two pairs of appendages interpreted as claspers. Those appendages could have played a role during the trilobite's reproduction, helping the male to grab onto a female like living horseshoe crabs do.

Traditionally trilobites are looked on as primitive animals, but thanks to a very unlucky creature that is both dead and broken, palaeontologists are now exploring the hypothesis that trilobites could have displayed a complex reproductive behaviour.

Nicola Vuolo
Publicity Officer

FURTHER READING

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Mary Anning comes home

In the UK there are more statues of men called John than there are statues of women or of people of colour. In London there are more statues of animals than there are of women or of people of colour.

It would be easy to dismiss these as shocking but irrelevant statistics to us in the PalAss, but as an organization striving to be inclusive and diverse, we know that representation matters. The presence of statues – in the same way as we might think about named awards and prizes – sends clear messages about who is considered important and who is not. The crowds at the recent unveiling of the new (and only) statue of nineteenth-century fossil collector Mary Anning stand as persuasive evidence that statues do still matter. Amongst more than 2,000 people in Lyme Regis last Saturday, there were countless girls proudly wearing their Mary Anning Rocks T-shirts who'd come along to see the statue of their heroine. These are the palaeontologists of the future.

The Mary Anning Rocks campaign is inspiring in itself. Dorset-born fossil-mad Evie Swire, then ten years old, indignantly asked her mum why there was no statue to their local fossil hunter. Her mum Anya shared her frustration at the lack of women scientific role models, and the Mary Anning Rocks crowdfunding campaign was born. Four years and £100,000 later, the statue has finally become a reality. Along the way it has gathered support from individuals and organizations including David Attenborough, Alice Roberts, author Tracey Chevalier, the Geological Society and ourselves at the Palaeontological Association. Sculptor Denise Dutton was commissioned to produce a bronze likeness of Mary Anning and her dog Tray, which has been sited at the foot of Church Cliffs at the east end of Lyme Regis looking out across the Blue Lias to Golden Cap. The statue was unveiled by Evie herself, accompanied by inspiring speeches by Anjana Khatwa, Alice Roberts, Tracey Chevalier, Dean Lomax and Tori Herridge, and with a performance of a song about Mary Anning by singer-

Photo: Liz Hide.

songwriter Iona Lane. It was an incredibly moving day: clearly Anning remains a huge inspiration for many. People were queuing up to photograph themselves next to the statue well into the night and others were up at dawn the next day to capture the sunrise on Anning's face.

Photo: Liz Hide.

Alongside this event, Lyme Regis Museum has launched a new exhibition called, appropriately, Mary Anning Comes Home. In itself, this exhibition is an important landmark: Anning specimens can be found in many museum collections across the country, but there are none in Lyme Regis itself. Displayed in the exhibition is a specimen of *Icthyosaurus breviceps*, sold by Anning to Adam Sedgwick for £35 in 1832, currently on loan from the Sedgwick Museum, while the 1850 portrait by Benjamin Donne is on loan from the Geological Society of London. The exhibition also showcases the work of current collectors, including the Charmouth Crocodile, a thalattosuchian crocodylomorph discovered by Paul Turner and Lizzie Hingley and exquisitely prepared by Lizzie.

On what would have been Mary Anning's 223rd birthday, the events in Lyme Regis were partly about looking back and celebrating history. But the enthusiasm and excitement of the young crowds show that they were much more about encouraging and supporting palaeontology and women palaeontologists in the future. In the words of Tori Herridge: "when we see Mary, we see our own stories".

Liz Hide
Ordinary Member
Sedgwick Museum of Earth Sciences, Cambridge, UK

More about the Mary Anning Rocks campaign: <**https://www.maryanningrocks.co.uk/**>.

Lyme Regis Museum: <**https://www.lymeregismuseum.co.uk/**>.

A new Fellow of the Royal Society

Professor Rachel Wood (University of Edinburgh, UK) has been elected Fellow of the Royal Society. Fellowship of the Royal Society (FRS) is an award granted by judges at the Royal Society in London, UK to individuals who have made a "substantial contribution to the improvement of natural knowledge, including mathematics, engineering science and medical science". In May 2022 there were 51 new Fellows selected to receive this significant honour recognizing their outstanding contributions to science.

Photo courtesy of Rachel Wood.

Prof. Rachel Wood FRS is a field-based geologist and palaeontologist, with research interests in the Cambrian radiation of animals, early biomineralization, mass extinctions and the evolution of reefs. Her research has focused on integrating the unique biological, geological and geochemical characteristics of ancient biotas, which had previously been studied in isolation, to understand the co-evolution of life and Earth. Prof. Wood is currently President Elect of the Association, and gave the Annual Address online at PalAss 2020 (which can still be viewed on the Association's YouTube channel).

Jo Hellawell
Executive Officer

Is there some news that you think belongs to **Palaeontology in the News**, *that you would like to see included in the* **Newsletter**? *Let us know by e-mailing Nick at* <**publicity@palass.org**>, *sending a link to the news and explaining why it should be included in the 'News' section.*

news

Featured Articles

The situation for palaeontologists in Ukraine

Two palaeontologists in Ukraine, Yevheniia Yanish and Leonid Gorobets, answer our questions on the situation of our field in a war-torn country.

1. Could you briefly introduce yourself and your research?

Yevheniia Yanish (YY): I am a researcher at the I. I. Schmalhausen Institute of Zoology in the National Academy of Sciences of Ukraine. I study the remains of animal origin from archaeological excavations. In particular, I make palaeoclimatic and palaeoecological reconstructions based on finds of stenotopic species (those tolerating a small range of environmental conditions).

Leonid Gorobets (LG): I am a Doctor of Biological Sciences, Leading Researcher in the Department of Palaeontology at the National Science and Natural History Museum of the National Academy of Sciences of Ukraine (Kyiv). My research interests focus on the study of the natural history of birds in Eastern Europe (from the Palaeogene to the Holocene inclusive), combining palaeontology and zooarchaeology.

Leonid Gorobets at the excavations in Ikovo in 2012. Leonid says "This is a very interesting Eocene location in the Luhansk region, where two new species of birds are described, the remains of turtles, sharks and bony fish have been found". Photo. E. Zvonok.

2. How has the outbreak of war affected your professional situation?

YY: I was forced to take the children and move from Kyiv to a safer place. Now we are refugees in Western Ukraine, in the city of Chernivtsi, and I work remotely.

LG: The first stage of the war in 2014 was more influential. In 2012–2013, I conducted excavations of Eocene sediments in the Luhansk region, but I haven't been able to do this since 2014. In

February 2022, I was working on a popular science book. Therefore, the beginning of the war did not significantly affect my work. I finished the manuscript on 16th April, now I am making plans for the future.

Yevheniia Yanish. Photo: Y. Yanish.

3. What is the situation of palaeontological collections you are involved with?
YY: All the collections with which I worked remained in Kyiv, now I have no opportunity to work with them. The collections from the basement, the comparative collection at the Paleontological Museum, and my private collection are now inaccessible to me. I was able to remove only a part of my field diaries with unpublished data and a few individual bones from the comparative collection.

LG: The palaeontological collection in the Natural History Museum in Kyiv is intact.

4. If you teach, what has happened to your students? Do you have contact with them?
YY: I have a student and a graduate student, as well as my former students. I am in touch with them; many were and still are in hot spots, some of them survived by a miracle. Students in the territorial defence are waiting to be sent to the front.

LG: I have no palaeontology students. In addition to scientific work I teach at a school, and since the beginning of the war I have been doing it online. After the start of the war, I was asked to teach the natural history of the animal world online to the Masters programme of the Department of Zoology at the Taras Shevchenko National University of Kyiv. I work as a volunteer as I think it is important to help Masters students get an education.

5. Are you aware of any palaeontologists being killed or injured in the war until now?
YY: So far, thank God, there are no fatalities among our fellow palaeontologists.

LG: I have not heard of palaeontologists being killed. There are very few specialists in vertebrate palaeontology in Ukraine and most of them work in Kyiv. In the 2010s, another centre began to form in eastern Ukraine in Luhansk. There were three palaeontologists who studied fossil vertebrates – three specialists in one city is a lot for Ukrainian palaeontology. Moreover, each of them was a unique specialist in their field (in Ukraine). There was a chance that there would be two centres of vertebrate palaeontology in Ukraine – Kyiv and Luhansk – but the first stage of war with Russia (in April 2014) stopped this. Two specialists left, their scientific activity decreased, and one specialist went on to work at a local university. In 2014–2016, he was offered several positions to leave Luhansk but he refused, remaining in the occupied territories as an associate professor at the university. I have not been in contact with him since 2017, but his scientific works of 2021 are known. I heard that a Russian programme of mobilizing male university teachers into the army had begun. It can be stated that the war made it impossible to form a scientific paleontological centre in Luhansk..

The Ikovo locality. Photo: L. Gorobets.

6. How can the international community support palaeontologists in Ukraine? What can they do to help preserve the national expertise and scientific capacity in the country? Is brain drain a substantial threat? What forms of help are most needed so that palaeontology can thrive after the war?

YY: Now the scientific community can help Ukrainian palaeontologists directly with money. The programmes through which palaeontologists who have not left Ukraine can receive financial support are very important. Now, according to martial law, men under 60 cannot leave Ukraine at all, even if they are not drafted into the army. It means that only women can leave and apply for a scholarship. However, many scientists, both men and women, cannot leave for personal reasons, such as the inability to leave elderly parents. Therefore, the opportunity to receive financial support for their work and preferably for sustaining a family is very important, especially for those who stayed in Ukraine.

Brain drain for Ukrainian science is always relevant. But right now, however paradoxical it may seem, most scientists (not only palaeontologists, even those who are in Europe) do not plan to stay in other countries forever, but want to return to Ukraine as soon as it is safe and work in our country.

After the war, assistance will probably be needed to restore the destroyed museums and funds, whilst there will still be a need to receive financial assistance individually for research. We have almost all now lost our homes – temporarily or permanently. Even now, salaries will not be paid in full, many researchers are being issued only a base salary as a result of the war. This is two thirds of the rate without surcharges. Before the war, the salary of a researcher at our Institute, with bonuses for seniority and a doctorate degree, was about 8,000 hryvnias (€244 / £217) per month. Accordingly, two thirds of approximately UAH 6,000 (amount without surcharges) will be approximately UAH 4,000 (€122 / £108) per month, provided that the Institute can still pay salaries. After the war, the situation will not improve for a long time, because in Ukraine, unfortunately, science is financed on a residual basis. And today, the real financing of all science in Ukraine (before the war) was only 0.6% of GDP. Some women scientists are divorced and support themselves and their children on the same salary.

LG: With the beginning of war, my colleagues in Bulgaria, Slovakia and Poland offered help and were ready to accept my family, including meeting at the border. I am grateful to them, but fortunately, it is not necessary – my family left for the west of Ukraine.

I will instead talk about the direction: research on birds. In this case, 'scientific capacity' does not need to be saved, but created. Ukraine is a large territory, there are many promising locations and there are materials in the museum. There have been very few researchers, no scientific school, no exchange between generations. We have only a rough idea of how the diversity of birds has changed in this part of Eurasia and this is a white spot for modern science.

There will be no great brain drain in Ukrainian palaeontology, as there are very few palaeontologists. War is much worse than COVID-19, but in Ukrainian palaeontology more people died from COVID-19, as there were many elderly palaeontologists. Palaeontologists known to me do not plan to leave; one colleague was thinking of moving to Poland, but he had such plans long before the war.

After the war, I will need the same help as before the war – travel grants for conferences. In Ukraine prices and salaries are lower than in much of the rest of Europe, so there are problems with travel. In addition, it will be useful for palaeontologists to learn the following, that in eastern Europe, there is Ukraine – a large area that has been little studied by palaeontologists.

Yevheniia adds in her e-mail:
During air raids, when we and our neighbours were sitting in the basement, I drew "rock" drawings on the concrete. They are based on real drawings by ancient people in such famous caves as Altamira and Chauvet, as well as the Ukrainian archaeological site Kamennaya Mohyla. There is also a photo of my kids in the basement during an air raid. If it lasts a long time at night, the children are put to sleep there. The basement is cold even now, when spring and summer are here.

Copies of ancient cave drawings made by Y. Yanish and her children, hiding from shelling in a basement. Photos courtesy of Yevheniia Yanish.

Compiled by Emilia Jarochowska

The original answers have been edited by removing several sentences.

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 Niklas Hohmann and Elizabeth Dowding.

Niklas Hohmann is a German in Poland and a PhD student at the University of Warsaw.

Photo: Emilia Jarochowska.

Q1: How did you end up in Poland?
During my Masters I helped design a project that would include a PhD position for me, but it wasn't funded. Going to Warsaw was my lifeline because it has some obvious advantages: I have a lot of academic freedom and can work on my own research project, I have four years to finish my PhD, and there were no breaks between my Masters and my PhD.

Q2: How is your position funded?
As a PhD student at a doctoral school, I get a small scholarship of around 2100 PLN (approx. €450) per month. This is around 70% of the minimum wage in Poland and barely enough to cover basic living expenses. It gets really problematic if I want to travel to conferences. Most attendance fees are more than a month's rent and that's before I have paid for travel, accommodation and food. I do get reimbursed by the University, but that does not help me bridge the financial gap between privately paying for the conference upfront and getting reimbursed after the conference. Poland is a country with a weak currency and high inflation, which makes international travel even more difficult.

Q3: What is your project about?
I examine how time is distributed in the rock record and how this changes our perception of past ecological and evolutionary change. On short timescales, I focus on the effects of time-averaging, on long timescales I examine how age-depth models affect reconstructions of trait evolution and phylogenetic relationships.

I especially enjoy the interdisciplinary aspects of my project. Working with advanced mathematical models that are informed by geological and biological knowledge is great.

Q4: What observations do you have about living in Poland?
I was expecting a divided country, but I did not expect it to be that extreme. At university, there are many liberal and open-minded people that put a lot of work into making it an inclusive environment. Fridays for Future Warsaw are great fun to go to and there are many young queer people in Warsaw. On the other hand, there are trucks driving through Warsaw with posters that

say that LGBTQ+ rights lead to paedophilia, the situation for trans people is disastrous and in the tram there are ads running constantly about abortion politics. Essentially everything is much more polarized and politicized than in Germany.

As a neighbouring country of Ukraine, Poland is directly affected by the war and it shows every day. When the war started, many of my colleagues put all their efforts into humanitarian help. Some PhD students invested all their free time to provide help, be it driving trucks with humanitarian aid to the border or acting as translators in refugee camps. The solidarity for Ukrainians in Poland is incredible, but the number of refugees is overwhelming. Within weeks, there were more than 300,000 refugees in Warsaw alone and the initial support for them was mainly organized by private initiatives.

The war has changed the appearance of Warsaw. Ukrainian flags are sold on every street corner and have become a part of the cityscape. Within weeks, advertisements in Cyrillic letters appeared. Healthcare providers and social care services now offer all information in Polish and Ukrainian and public transport turned bilingual too. The support refugees from the Ukraine get in Poland is incredible, but I'm worried about the long-term effects of the war. More than 5% of people in Poland are now refugees and I'm not sure whether this level of support can be maintained in the long run.

Q5: Apart from friends and family, what do you miss most about Germany?
I miss being a fluent speaker in a common language. People in the Polish administration rarely speak English, which makes every interaction with them difficult. Essentially I need assistance from a native speaker for every interaction with the authorities, which is a huge effort. Not being able to speak Polish also has some more subtle effects. It makes it really difficult to befriend people from outside academia and to establish a healthy work-life balance. Inside academia, all hard facts are available, but a lot of the informal conversations and networking are happening in Polish and I feel I'm at a disadvantage there. Being fluent in a language is such an under-appreciated superpower.

Niklas Hohmann tweets at `@HohmannNiklas`

Elizabeth M. Dowding is an Australian in Norway, employed as a postdoc at the University of Oslo at the Centre for Earth Evolution and Dynamics (CEED).

Q1: How did you end up in Norway?
CEED advertised an open position in Earth Evolution and Dynamics. I am very interested in the relationships between Earth and life and so, even though I did not fit the description, I applied. I submitted a research proposal that highlighted how I would fit in to the team and its aims whilst also pointing out (gently I hope) that they could benefit from an in-house palaeontologist. The position is fantastic and I am ecstatic to be part of the team.

Q2: How is your position funded?
The Research Council of Norway funds ten-year Centres of Excellence. CEED is currently in its last year and the competitive process for new centres is starting anew.

Q3: What is your project about?
I was able to set up my own project. I call it 'LIPSynch' and I aim to create 4D transects through the formation of large igneous provinces (LIPs), characterize biotic and abiotic conditions, then contrast and compare the patterns between different LIPs. Biogeography is my weapon of

choice and I have been having a lot of fun collecting data and learning about terrestrial systems during the Devonian. I primarily work on marine systems and trilobites, so it has been fun and exciting to follow in the footsteps of tetrapods and scramble out of the oceans.

Photo: E. Dowding.

Q4: What surprised you most about living in Norway?
The Scandinavian inhale 'hja'! That aside, I was actually incredibly surprised by the love of crisps and corn chips on frozen pizza. I tried it. It was OK but bemusing. The 'pineapple-on-pizza' debate has nothing on the oddities I have found in the frozen food aisles of Oslo.

Q5: Apart from friends and family, what do you miss most about Australia?
Australian brunch culture. You can't beat the Aussies for coffee and a good sit-down meal. Brunch isn't so much a thing here and as much as I love knekkebrød, it's far less flexible than a brunch menu.

Oh, and the birds in Europe sing, not scream. So that's new. Check out a Cockatoo, Gang-Gang, or Rainbow Lorikeet if you're confused.

Q6: How has the pandemic affected your situation as a palaeontologist abroad?
I love fieldwork and will happily jump on any opportunity to be out and about. The project that I planned was one that didn't require fieldwork and could be completed with the assistance of museum staff if I could not come myself. I planned it this way because Sydney, Australia, had a hard lockdown for over 100 days and travel was impossible. I had to get special dispensation from the government to come to Europe and, once I arrived, it was illegal for me to return for a minimum of six months. There were difficult moments, but I am so chuffed to be here and to have the opportunity to pursue my ideas and passions.

Elizabeth M. Dowding tweets at `@FairestFowl`

Behind the Scenes at the Museum

Fossil collections stored in the National Natural History Museum in Kyiv

Figure 1. (a) The view of the hall; (b) Sample of the presentation collection of Cretaceous mollusks. Photos: O. Ivannikov.

Introduction

The Geological Department of the National Natural History Museum of the National Academy of Science of Ukraine (NNHM of NAS of Ukraine) has a long and complicated history. The modern history of the Museum started in 1966 when – by decree of the Presidium of Academy of Science – the Central Natural History Museum was created. It joined five museums of natural history disciplines into one building, which is now a National Monument of Architecture. The complex of five museums, which includes Archaeology, Geology, Palaeontology, Zoology and Botany, received national status (NNHM NAS of Ukraine) and soon the management was transferred to the Department of Biology. Igor Iemelianov, a biologist, was elected as its director.

History of the Geological Department and the completion of palaeontological collections

All of the museums in the complex have long histories, dating back 80 to 90 years. Plans for the festivities for their jubilees have been interrupted because of the war with Russia.

The Geological Department was founded in 1927. At that time it was part of the Institute of Geological Sciences of the Academy of Sciences of Ukrainian Soviet Socialist Republic. The first collections were materials collected by the academician Pavlo Tutkivsky, the first director of the Museum. Important petrographic and mineralogical collections by famous Ukrainian geologists Mykolay Bezborodko and Volodymyr Luchitsky were added over time.

In 1967 the Geological Department was included in the Central Natural History Museum. Now it preserves and exhibits more than 50,000 specimens of rocks, minerals, meteorites and mostly invertebrate and plant fossils (Figures 1, 2 and 3). The complex "gave birth" to a new unit –

the Palaeontological Department, which is named after a famous Ukrainian scientist, Ivan Pidoplichko. The Museum was created in December 1935 as an exposition within the Zoological Museum. The exposition has soon grown out into an independent Department of Vertebrate Palaeontology.

Scientists and professors at educational schools have collected samples of fossils since the nineteenth century and, more intensively, since 1919 – the year the Ukrainian Academy of Sciences was created. The first samples of fossils appeared in the Geological Department as a result of the reorganization of the Kyiv Imperial University of Saint Volodymyr and closing its successor, Kyiv Institute of Public Education.

Vertebrate fossils were transferred from the Geological Department to the Vertebrate Palaeontology Department in exchange for invertebrate fossils. The most famous of them are collections purchased from the Kranz company before 1917, important only from an historical point of view. Others have been gathered since the end of the nineteenth century by researchers of Kyiv Imperial University of Saint Volodymyr. The collections by I. F. Shmalhauzen are the oldest and are described by him (Shmalhauzen 1884), while the second oldest collections were made by Malevsky and described by P. M. Venyukov (1899) in a classical monograph.

The mission of the Department today

The Department's aims are to preserve collections and provide access for scientists. We have exhibition areas and professional staff for the preservation of collections and scientific materials. We also aim to engage with the public about life on Earth in geological history (Figures 1a-b, 2a-c, 3a-b).

The monographic collections of Ediacaran (Vendian) algae from the historic regions of Podolia and Volhynia, gathered by Olena Aseeva and Alla Ischenko, are displayed in a dedicated hall of our Museum. The collection is worth thorough study and description but the work has stopped now due to the dangers of the war.

In the last ten years, we acquired collections made by outstanding Ukrainian palaeontologists but the authors did not have time to process collections properly and describe them fully. In particular, this material includes a huge collection of belemnites, mostly from Cretaceous

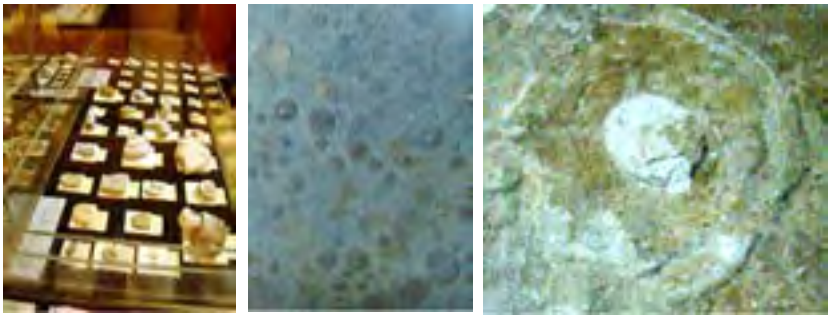

Figure 2. (a) Collection by Zernetskaya; (b) Nemiana simplex *Palij from the Yampil Member of the Mohyliv Suite, Bernashivka quarry; (c)* Kaysalia *Gureev – the same member and quarry.*

deposits, gathered by Volodymyr Nerodenko from Taras Shevchenko National University in Kyiv. The inventory of the memorial collection shows over 10,000 stored specimens.

The memorial monographic collection of trilobites is very important from the point of view of palaeontology, stratigraphy and correlation of Podolian reference sections for the Silurian system with the International Stratigraphic Scale. The author Leonid Konstantinenko gathered this collection over his entire life after graduation from Kyiv formerly State and now National University. Specimens in the collection have been mostly identified and some of them have been described in articles and books.

The Department also stores large collections of graptolites gathered by Vadim Krandievsky and described in his monographs (Krandievsky 1963, 1966). Microfossils in our possession include materials analyzed by Victor Kiryanov from boreholes and outcrops in Podolia and Volyhnia, which allowed him to identify Cambrian-aged deposits, previously considered as Silurian (Kiryanov 1968).

Twenty-eight important collections by different authors remain undescribed.

Statistics

The analysis of palaeontological collections faces multiple problems. There have been interruptions in the replenishment of the Museum's financial resources and a sharp decline in revenues in the last decade of the previous century and the first decade of the millennium, which resulted from a reduction of funding for geological research. Declining numbers of researchers and the retirement of many palaeontologists have played a negative role too. As a result, certain groups of fossils, regions and geological time intervals are represented disproportionally in the collections. This also partly reflects the range of geological structures in Ukraine, as well as specific research requests from industry.

Micropalaeontological specimens, especially index fossils, are of major importance, but in the Museum they carry less weight, literally as well as figuratively. But recently we have seen a positive trend: two years ago, the collection of Quaternary ostracods by Natakia Dykan, consisting of 834 storage units, was acquired by the Museum.

Table 1. Number of collections in the Museum by chronostratigraphic units

Unit	Monographic collections	Other collections
Quaternary	8	16
Neogene	13	17
Palaeogene	39	17
Cretaceous	22	6
Jurassic	21	16
Triassic	6	3
Permian	4	3
Carboniferous	95	30
Devonian	13	9
Silurian	15	10
Ordovician	3	4
Cambrian	7	3
Vendian/Ediacaran	7	3

Table 2. Contents of the collections by systematic groups

Systematic group (SG)	Number of collections		
	Including SG	Monographic collections containing SG	SG only
Flora	86	63	61
Fauna:			
Foraminifera	89	53	33
Archaeocyatha	2	0	0
Porifera	9	3	0
Cnidaria:			
Hydrozoa	5	1	1
Conulatae	3	2	2
Anthozoa	40	25	30
Vermes	10	1	0
Mollusca	125	64	57
Arthropoda:			
Chelicerata	2	1	1
Trilobita	11	2	1
Crustacea	12	6	3
Insecta	1	0	0
Bryozoa	19	14	12
Brachiopoda	51	28	23
Echinodermata	24	4	1
Graptolithina	7	4	4
Pisces	13	3	2
Reptilia	1	0	0
Mammalia	2	0	0
Problematica	6	0	0

The lithological and palaeontological collections from Podolian Silurian, Ordovician, Cambrian and Ediacaran (Vendian) reference sections are especially important and valuable. The sections are located in the flooding zone of the Dniester Pumped Storage Power Station. These collections were acquired by the staff of the Institute of Geological Sciences (Petro Tsegel'nyuk, Leonid Konstantinenko, Alla Ishchenko, Viktor Kiryanov, Yuriy Gureev and others), the Geological Department of Taras Shevchenko National University of Kyiv, and the Geological Museum of NNHM NAS of Ukraine (Volodymyr Grytsenko). I have concentrated on the Department collections of fossil Cnidarians from the Silurian deposits of the reference section on the Dniester River and entire Volyno-Podolian platform (Ukraine and Moldova), Podlasie-Brest depression (Belarus), which I have collected from outcrops and boreholes since 1966. The boreholes were studied in cooperation with colleagues mentioned above.

A unique collection of vendobionts was collected from outcrops in Podolia. Now this collection is being intensively processed and prepared for storage. The significance of the Vendian collection is indicated by the fact that most of it was collected in the Bernashivsky quarry, where the lower part of the Mohyliv Suite, rich in fossil remains, was exposed, but is now flooded by the Dniester Pumped Storage Power Station. The last trip to the field took place in September 2019 before the quarry was flooded.

A huge (up to 3,000 specimens) collection of Vendian (Ediacaran) fossils from Podolia, including impressions of soft-bodied organisms and their traces, is partially described in a number of publications (Grytsenko 2016, 2020; Ivantsov *et al.* 2014), but some have not been published and are expected to be published soon.

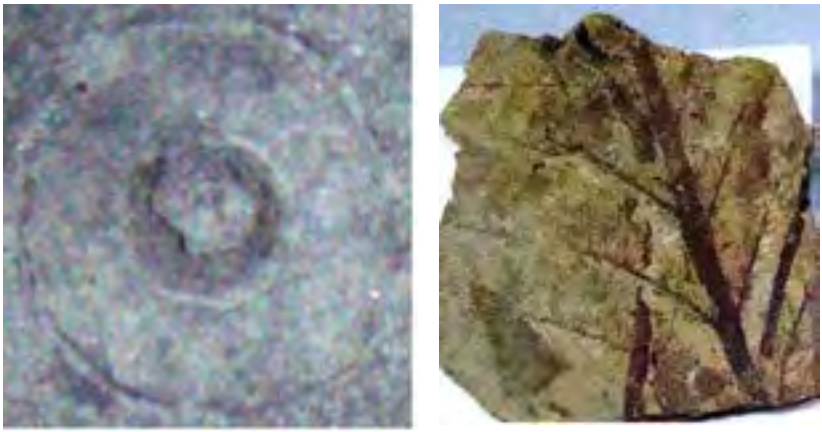

Figure 3. (a) Paliella petalliformis *Fedonkin, Lomoziv Member of the same suite and quarry; (b)* Archaeopteris fissilis *Shmalhauzen, coll. 1684/138.*

Conclusions

The diversity of monographs and work collections stored in the Geological Department has great scientific importance, particularly owing to the holotypes and type collection of Podolian Silurian and Vendian reference sections in Ukraine.

Specialists in palaeontology from around the world have used the services of the Museum. They include famous scientists from Ukraine – Vladislav Poletaev and Victor Ogar, USA – Andrew Becker and Gordon Love, Canada – Murray Gingras, Poland – Emilia Jarochowska, former USSR – Oleksiy Kim, Oleksiy Amitrov, Andrey Ivantsov and many others. We have also been visited by guests from the University of Poitiers (France) under the guidance of Abderrazak El Albani, who was interested in the collections of the Vendian deposits of Podolia. We are open to cooperation and look forward to continuing our work with international colleagues after the war.

Collections of the Geological Department of NNHM NAS of Ukraine have the status of National Heritage.

Acknowledgements

The author is sincerely grateful to the Palaeontological Association and in particular to Emilia Jarochowska for the invitation to publish this piece and correcting the translation into English. This contributes to the popularization of our collections among scientists around the world.

I am deeply grateful to Alla Ishchenko for transferring her collection to the Museum. Deep thanks also to Galina Anfimova, curator of palaeontological collections at the Geological Departments, for providing statistics, valuable comments and assistance.

Volodymyr Grytsenko (he, his)
National Natural History Museum, Kyiv, Ukraine

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The address of the Museum: 15 Bohdan Khmelnitsky Street, 01601 Kyiv, Ukraine.

Museum website: <**https://museumkiev.org/indexeng.html**>

Tel: +380 4423 56266
+380 9644 83813.

Scratching the Surface

How do you fossilize the thoughts of the greatest mathematician[1] who ever lived? In the most celebrated case, it was by carelessness, followed by some astute observation. The usual technological wizardry was later wheeled in, but it was really the carelessness and the observation that counted.

The philosophical glories of Ancient Greece – what remains of them – mostly come down to us by copying and recopying ancient manuscripts, with centuries of lying forgotten in remote monasteries in between. In those days, though, good quality, durable parchment was scarce, and old stories could be scraped away so that new, more fashionable ones could be written in their place. And so it was, in the thirteenth century, a tenth century copy of a sixth century copy of Archimedes' *On Floating Bodies* and other works was scraped away (this was just after the sack of Constantinople by the crusaders, a thin time for the appreciation of ancient wisdom) for some solid liturgical text to be put in its place. Only the scraping was done a little carelessly, so relics of Archimedes' recopied words could still be seen beneath the new text. Seven centuries later, a keen-eyed scholar found it among the routine cataloguing of such material and, remarkably, recognized it for what it was and began to decipher the partly obliterated text – a job finished in more recent years (following a rather melancholic episode involving forging some pictures on top of the text, to increase its resale value) with the help of X-rays, spectral analysis and such like.

It is, thus, a palimpsest – the Archimedes Palimpsest – a parchment that contains, on the same surface, multiple narratives that with luck and skill can be separately disentangled. Now, 'palimpsest' is a beautiful word in itself (from the Greek for 'to scrape again') and derives from the time when such practice was not misplaced cultural vandalism, but commonplace and practical. The Greeks of Archimedes' time themselves used wax-coated tablets to write on, that could be scraped clean and used again, many times over. A blackboard works to similar principles. With a little evolution in meaning, the term has come to recall the kind of old and much-used blackboard which picks up a variety of over-enthusiastically applied and more or less indelible marks from not only chalk but crayons, pencils, fingernails and (on particularly vigorous occasions) shoe-leather, fossilizing these on that one surface as fragments of that blackboard's working history. And from then on to parchments and their use by historians, and then yet further, as this concept took root among different scholarly communities.

The term is widely used by archaeologists, to convey the various cultures that may have occupied a surface, to leave a scattering of flints here, a post-hole there, a hearth dug into part of both and then a ditch cutting through all of them. It has also become part of the culture of soil science, and here it has become something of a theoretical cornerstone that helps underpin the whole discipline – indeed to such an extent (Richter, in press) that it has been suggested that the Earth, and all of the historical record it contains, may be considered as one gigantic palimpsest. Now there's a bold idea! Just what kind of combustive effect might it have, one wonders, when tossed into the archives of stratigraphy and palaeontology?

Soil as palimpsest has been perhaps most influentially developed by Victor Targulian (*e.g.* Targulian and Goryachkin 2004), who carried on the tradition of Vasilii Dokuchaev, the geologist/

[1] Fighting talk, I know. But a case has been made by those who understand numbers.

geographer who arguably founded soil science and who was also a considerable influence on Vladimir Vernadsky and the biosphere concept. Targulian took Dokuchaev's dictum 'soil is a mirror of landscape' and adjusted its focus to say that 'soil is the memory of landscape and its development', adding the rider that it is basically an *in situ* memory, very local to its particular place. That memory is expressed as what is left of the transformations undergone as the land surface is altered by the chemical effects of percolating groundwater, by the addition or removal of mineral material by wind, rain and runoff, by the infinitely complex biology of soils expressed by the dense networks of plant roots, the laceworks of fungal hyphae, and all the denizens of the micro-, meio-, meso- and macrofaunas for which the soil is a habitat to be energetically developed. It is much more than a two-dimensional surface, of course: it is a layer of modest thickness that ramifies downwards into bedrock and has continual exchange with the atmosphere above. It is now the heart of what has been called the 'critical zone' of Earth, that thin pellicle that supports life, and through which that life expresses its gigantic effects on the planet as a whole (Richter and Billings 2015). As a soil develops over thousands – sometimes millions – of years, the processes taking place within its limited thickness continually create new kinds of physical evidence while effacing others – and hence that palimpsest, which soil scientists do their best to read.

How might the soil palimpsest translate into stratigraphy and palaeontology? Well, soils, or their preserved relics as palaeosols, are something of a niche area within geology, with traditionally something of the air of poor relations about them, often largely ignored as the workings of volcanoes, say, or the building of mountain belts or the unfolding of mass extinctions took the spotlight. One remembers that sideways sneer from the past, of the geology of the Ice Ages (and, to the diehards, the geology of anything post-Mesozoic) being labelled dismissively as 'gardening'. These dinosaurian attitudes are fading fast, thank the heavens, but soils can still often wear something of the cloak of invisibility within geology.

Palaeosols are studied, of course, for their own sake, but often what most comes to mind is their kind of oblique usefulness, indeed well-nigh indispensability, in some kinds of stratigraphic successions. In volcanic successions, for instance, they are the means by which the individual volcanic eruptions are separated in a classic relationship where geological time and rock volume are inversely related. In an eruption, all kinds of volcanic hell may break loose over the course of hours or days, to give pumice ashfall layers metres or even tens of metres thick and valley-filling pyroclastic ashflow layers that may pile up to hundreds of metres. And then, literally when the dust settles, this newly constructed landscape begins to form a soil, the biological response to the brief but total devastation. That soil develops, thickens, matures in true palimpsest fashion for as long as the volcano sleeps, traversed by roots, breaking down the fresh volcanic minerals, accumulating humus, and sometimes also strange and wonderful fossils: I particularly recall clusters of the acorn-shaped nests of solitary wasps, built from tiny pumice fragments, in such layers. The next major eruption may not be for many thousands of years – and then the soil palimpsest is instantly and brutally frozen, buried beneath the next thick ash downpour.

Such soils can be preserved remarkably well, and remarkably continuously too. The violence of a major eruption may intuitively suggest that widespread erosion should inevitably follow. But it ain't necessarily so. The sheer bulk of volcanic sediment galvanised into that blur of incandescent motion generally promotes burial, even of delicate structures. This is almost universally the case beneath ashfall layers. And, commonly, even thick, boulder-packed pyroclastic flow deposits can

come to rest on top of a delicate land surface, rather than ploughing deep into it: such a flow is simply carrying more material than it can hold, no matter how fast it is thundering along, so the last thing it is able to do is to erode yet more sediment from beneath. The mighty Vulcan seems inclined to preserve the eloquent palimpsests that clothe his domain.

And it is palimpsests definitively in the plural, given the kind of wide-angle view that stratigraphic study of a volcano gives, and the huge span of geological time. To any field stratigrapher, the most visceral and lasting impression of any such study is generally of how the strata just go on, and on, and on. A single big quarry or high cliff section might show half a dozen eruptive units, each neatly separated by a soil, fossil wasps' nests and all, and as one picks one's way along the landscape, others are soon tacked on above and below, and very soon the emerging stratigraphic column will show dozens. Now, Targulian was quite aware of this profligacy, so he contrasted the 'palimpsest-wise' memory of soils with the 'book-wise memory' of geological strata, making a further distinction in suggesting that the stratal memory is dominated by long-distance components (those far-travelled volcanic ash particles, or the sand grains in a sandstone) relative to the site-specific nature of the soil palimpsest.

So far, so good, and so a succession like this can interleave those two kinds of memory. How far can one take this pattern? And, can one take it underwater, into the marine realm that, on Earth, has yielded most of the book-like memories which collectively build up stratigraphy's library? Soils seem to be phenomena of the land, at least as their study within soil science goes. However, words being words and humans being tribal, the term 'marine soil' does crop up now and again, but generally within the literature of engineering geologists, where it seems that 'soil' can be anything reasonably soft and diggable, so even the London Clay of Eocene age, a perfectly respectably ancient stratum, can be a soil in those circles. Hair-splitting over words apart, a sea floor can show parallels to a soil on land, and an example comes to mind that seems uncannily close in pattern to those terrestrial volcanic-palaeosol alternations. The Silurian hills of central Wales are classic turbidite terrain, that formed as turbidity current after turbidity current left carpet above carpet of graded sand and mud on a deep sea floor, to pile up as strata kilometres thick, and that now seem absolutely interminable as one follows their crumpled remains across those hillsides.

This, of course, is a book-wise memory to a T, with a quite alarming number of pages. But look at the top of any individual turbidite layer, and more often than not you will see a pale layer, a few centimetres thick, usually with dark burrow-fills and here and there with a yet paler strip where it contacts with the dark turbidite mudstone beneath. This is the layer that formed in the calm interludes between turbidity currents, as the seafloor was colonized by local burrowing animals, that simultaneously effaced any fine primary sedimentary layering, while oxygen diffusing down from the water above progressively burnt away the sediment's dark organic carbon content, aided and abetted by growing microbial colonies; that palest basal layer is a phosphate concretion that formed at the moving redox interface as it burnt down through the sediment. Now, this seems to have many of the characters of a terrestrial soil and, like the soils of that volcanic landscape, its processes were stilled when it was abruptly buried by the sediment dropped from the next turbidity current that came along, a few years or decades later. It is a palimpsest frozen in place, like a pressed leaf within the pages of a book.

One can carry on exploring this analogy much further, of course, entertainingly and perhaps even profitably: on the rocks variously formed by a growing reef, at non-sequences and unconformities – the beach boulder beds of Lewisian gneiss in Scotland's Torridonian Sandstone are worth puzzling over here – at an ice front, and so on. But the really intriguing exploration is the one of that vertiginous upscaling, to suggest that the whole Earth is a palimpsest, in that its rocks are 'continually being laid down, but also erased and over-written' (Richter, in press). If so, we would have a neat symmetry: multiple palimpsests can be interleaved within the stratal book memory, as we have seen, but here those books themselves would be part of one monstrous planetary palimpsest.

If it is just a question of scale, that would be so, for the Earth's crust is relatively thinner compared to the whole planet than is the skin of an apple. But zoom in just a little, and the structure of that skin does not quite have the same structure as a soil, or the burrowed and oxidised top of a turbidite layer. Nonetheless, there are some eerie resonances in the comparison. Parts of that memory-laden crust are worn away by erosion (to form layers of memory elsewhere), though that is mostly a patchy surface attenuation, leaving stratigraphic memories intact in what is left. More tantalizingly, one can look at memory loss from the bottom up, by the effects of magma and melting, and then upwards through the various metamorphic and diagenetic zones, as these redistribute patterns of chemistry and mineral texture across many-kilometre-scale thicknesses. Mostly, these whole-crust processes do grievous harm to palaeontological memories too, though sometimes they help bring them to light, as in the mineral growths that give the shine to aristocratic Burgess Shale fossils and the common graptolite alike (Page *et al.* 2007). An intriguing path, hence, that deserves following a little further yet.

It may seem a stretch from Archimedes' ancient mathematical conjectures to a planet-spanning mechanism, but in the spirit of symmetry and of matters of scale one might end this essay with his one (as far as I am aware) sedimentary contribution. It is a work called the 'Sand Reckoner', which sounds rather like something devised to help the builders' merchants of ancient Greece. But it's nothing like this. He wanted, in this study, to count the number of sand grains that would fit into the universe[2]. What is more, he succeeded, coming up in eight pages of mathematical logic with a number that made considerable sense and was based on a model of the cosmos that is not quite as archaic as one might initially think.

The number is most prosaically described as one followed by eighty quadrillion zeros, a quadrillion being ten to the power of fifteen. To do this, Archimedes had to find a way of expressing big numbers, which he did by building up from the largest number then known: the myriad – not just a vague expression meaning 'lots', but a precise ten thousand. He started by making a new unit of a myriad myriads, and went on from there, until he had enough mathematical elbow room to accommodate those sand grains.

The next move was working out the size of the cosmos, and this was really ingenious. Firstly, he took a heliocentric model[3] (*i.e.* one with the Earth orbiting the Sun) and then deduced that the stars were very far out, as they appeared in the same position regardless of which end of its orbit the Earth was at. Plugging in some estimates of the diameter of the Earth, Moon and Sun, he calculated a diameter of the cosmos of (in modern terms) about two light years, giving a

[2] The story is told more fully, and far more coherently, in <**https://en.wikipedia.org/wiki/The_Sand_Reckoner**>.

[3] One by Aristarchus of Samos. The work itself is lost – no surviving palimpsest here, alas – but it survives in Archimedes' reference to it.

sphere capacious enough to hold 10^{83} sand grains. It was a magnificent, and logically coherent, intellectual adventure, even if his sedimentology was just a little lax: mathematicians have calculated since that those sand grains must have had a diameter of 18.3 microns, putting them firmly into the fine silt category. Archimedes, therefore, had filled his universe with loess!

It is nicely capricious that the thoughts of a man who looked on things so much in the round were to be preserved in such a two-dimensional fashion. Even more so, perhaps, that those two dimensions could later be stretched out in so many directions.

Acknowledgements: My thanks to Dan Richter of Duke University, North Carolina, for sparking this chain of thought and for his most useful adjustments to this text – though he of course is not responsible for by how far his ideas have been blown off course in this essay – and to Adrian Rushton, for (as ever) illuminating discussion.

Jan Zalasiewicz
University of Leicester, UK

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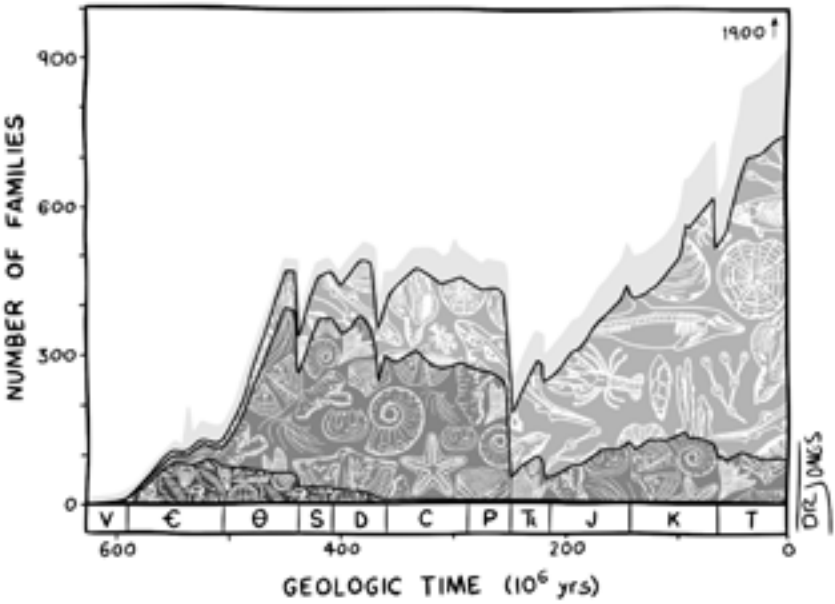
Palaeontology's greatest ever graphs

Sepkoski's Evolutionary Faunas – zooming out to appreciate the greatest picture of marine life



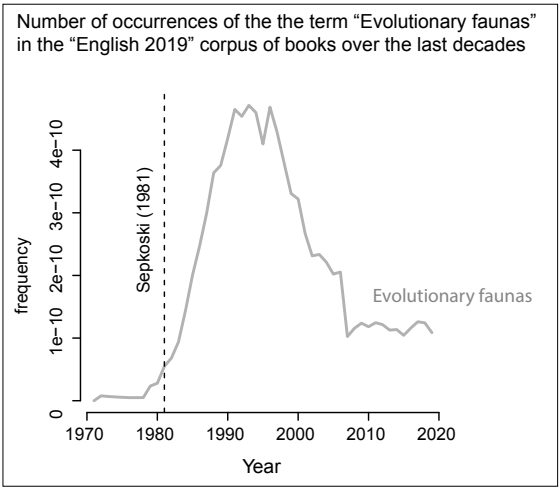
The hypothesis of three great faunas dominating Phanerozoic oceans represents a central concept of macroevolutionary research. This hypothesis postulates that the major groups of marine animals preserved in the sedimentary record were non-randomly distributed through time and can be statistically grouped into Cambrian, Palaeozoic and Modern evolutionary faunas (Sepkoski 1981). Jack Sepkoski (1948–1999) originally formulated this three-phase model using a factor analysis of family-level diversity (see Alroy 2004 for a detailed explanation) and summarized his findings through the graphic examined here (Sepkoski 1981, figure 5). While the great evolutionary faunas continue to serve as a conceptual framework for palaeobiology (Brayard *et al.* 2017; Rojas *et al.* 2021), some questions remain open. For instance, is the three-phase model an artifact of how evolutionary faunas were delineated? When did modern evolutionary faunas actually rise to global dominance? In addition, what have we learned from Sepkoski's famous graphic and where are we going?

The graphic considered here is without doubt one of palaeontology's greatest ever graphs. It shows stacked factor loadings for the first three factors retained after a Q-mode factor analysis, rescaled to the total Phanerozoic diversity and plotted through that time scale. The loadings were derived via factor analysis of the numbers of marine families within 90 metazoan classes

distributed in 63 stratigraphic intervals ranging from the Cambrian to Plio-Pleistocene. The three factors shown in the figure explain 90.8 % of the total information and are interpreted as evidence that "three great evolutionary faunas" have sequentially dominated the Phanerozoic oceans (Sepkoski 1981). However, Sepkoski recognized that factor retention is an arbitrary decision, which has significant consequences for reduction and interpretation of information in the underlying data (Hayton *et al.* 2004). In other words, the number of evolutionary faunas describing the large-scale structure of the Phanerozoic marine diversity in Sepkoski's model is somewhat arbitrary.

There are a couple of elements in Sepkoski's graphic that have been overlooked but might have had some influence on how palaeontologists have thought about evolutionary faunas during the last decades. First, the three retained factors, originally listed in the order of the variance they explain, were re-labelled in the graphic to emphasize temporal shifts in dominance. Second, the graphic listed the animal classes contributing the most to each retained factor, including some, but not all, classes with factor scores >0.1. It is not clear if they actually represent the same volume for each factor. Although taxonomic overlap between factors is evident when considering up to 93 % of their volume (Sepkoski 1981, table 1), the classes listed for each factor seem to represent evolutionary faunas as discrete entities without overlap. For instance, Gastropoda, the class contributing the most to the factor III (score >0.5) but also contributing to the factor II (score >0.1), was not listed for the latter. These graphical decisions did not affect the integrity of the information but might have influenced how scientists outside palaeontology, some palaeontologists themselves and the general public perceive the great evolutionary faunas.

Despite limitations of the data at the time and methodological decisions required to delineate the three evolutionary faunas, the key message from Sepkoski's figure, a visual testament of his entire work (*e.g.*, Sepkoski 1978, 1979, 1984, 1996; Sepkoski & Miller 2014), remains central to palaeobiology: Phanerozoic marine diversity is highly structured with higher taxa organized into mega-assemblages that successively dominated the oceans. Nevertheless, the most fruitful macroevolutionary research over the last decades has been focused on understanding the continuous trajectory of the diversity through the Phanerozoic (*e.g.*, Alroy *et al.* 2008), somehow abandoning the question of describing evolutionary faunas (Figure 1). Recently, network-based analyses of the occurrence data from the Paleobiology Database (PaleoDB;Peters & McClennen 2016) showed that evolutionary faunas are unlikely to represent artifacts of factor analysis (Muscente *et al.* 2018; Rojas *et al.* 2021), re-opening the question of how many faunas are required to describe the Phanerozoic marine diversity.



In particular, network science provides a framework for delineating taxonomically overlapping communities at varying spatiotemporal scales, making it possible to reveal the optimal number of evolutionary faunas that best describe the Phanerozoic marine diversity at the largest possible scale (*i.e.*, when zooming out to the maximum) but at the same time to capture finer-scale structures not addressed by Sepkoski's single-scale model. Rojas *et al.* (2021) combined a multilayer network representation of the Phanerozoic fossil record (PaleoDB) in which layers represent ordered geological stages, with a multiscale n-clustering, to accomplish that. Their results confirmed Sepkoski's hypothesis and showed that four evolutionary faunas have sequentially dominated Phanerozoic oceans. They showed that the Modern evolutionary fauna (Fauna IV) first emerged during the early Mesozoic but did not become dominant until the mid-Cretaceous. This four-tier structuring of the Phanerozoic marine faunas resolves the apparent conflict between two central hypotheses in macroevolution, the great evolutionary faunas (Sepkoski 1981) and the Mesozoic Marine Revolution (Vermeij 1977), making Sepkoski's research on large-scale diversity structure and dynamics even more important. By revealing the optimum macroevolutionary pattern, network-based studies will help us to uncover the underlying processes shaping the evolutionary faunas originally depicted in one of palaeontology's greatest ever graphs.

Alexis Rojas
University of Helsinki, Finland

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Spotlight on Diversity

Hiring and job interviews in palaeontology

The Palaeontological Association is committed to supporting early-career researchers (ECRs) in their endeavour to find stable employment. The hiring process is often perceived as opaque and regulations as well as hiring cultures vary between countries. This is why we reached out to collect insights from people who have served on hiring committees. The purpose of the article is to demystify the hiring process and help ECRs to be more competitive in the job market. It is a follow-up to the article written from the job applicants' perspective, which you can find in the previous issue of the *Newsletter*.

We sent out personal invitations to multiple senior palaeontologists from several regions and advertised the initiative on Twitter. Respondents were offered the possibility of keeping their answers anonymous. Only five people have answered and their answers are compiled and integrated here.

General trends over the past decade

It is clear that academic positions are becoming more and more scarce, considering the demand. Ten years ago, it was more likely to find a postdoc following a PhD in palaeontology than it is now. Every day, there is a growing realization that there are far more people looking for positions than there are positions. Permanent positions become vacant and filled subsequently. It almost never occurs that a new permanent position emerges from scratch. This happens mostly in small institutions with limited funding. At large institutions, new permanent positions may emerge but are still rare. In industry, positions are also rarer than before. Formerly, there were numerous positions for micro- and invertebrate palaeontologists in industry, but many have been replaced by freelancers. One should also note that some institutions also prefer to replace systematists and biostratigraphers with broader profiles in other fields such as geochemistry or molecular biology. However, this trend is not happening everywhere, and many institutions prefer to replace a previous lecturer/professor with someone with the same expertise, particularly to be able to maintain the same curriculum and fieldwork capacities. Evidently, taxonomists and systematists are still needed as curators outside universities.

In the very moment a nation or region introduces stricter laws to protect their palaeontological heritage, it gains responsibility for taking care of that heritage. Logically, it should hire palaeontologists to do this work, but unfortunately this is often not the case. Instead, the fossils are left to rot away. *WE* have to raise awareness of this inconsistency / paradox (one of our respondents).

Publication record and fitting the job description

Although having high impact papers certainly helps to land a permanent job, this is not taken as the sole hiring criterion. Many hiring committees consider both the impact of the paper in concert with its quality and the number of papers produced by the applicant. The extent to which an applicant fits the job description is also important. And it is unlikely that someone with an extended publication record will take a position in another palaeontology sub-field based on the impact/number of their publications. Both the publication record and the fit to the job description are equally considered in the hiring processes (and should not be contradictory).

Community building effort

Community building efforts are indicators of communication and social skills and show that an applicant is ready to take responsibility for a community. Many institutions started to focus on these skills recently because they show that the applicant picked up keys that will help them properly and politely deliver ideas while teaching. For example, people having this experience can correct others without embarrassing them. For a museum position, science communication is very important, especially at small regional museums without strong research profiles. One of our correspondents wrote:

I would recommend early-career scientists **abstain from** *very time-consuming tasks, especially from editorial work, and rather use the time to do research. These tasks should be taken by people who have permanent positions already. Also at a young age, intelligence and creativity are usually highest and therefore, I think, young people should use most of their time (our most precious resource) for original research.*

Career and application mistakes

Some applicants are too specialized for many positions (*e.g.*, focusing on one animal group from one geological period and from a single geographical locality). Others have a very limited skillset, with no experience in modern methodology. Moreover, many applicants fail to read the advertisement properly and address some requirements, such as the teaching language at the department or to justify why they are applying for this particular position. Being at the interface between biology and geology, palaeontologists are also often unable to adapt their communication strategy according to the targeted public. One of our respondents reported participating on a committee where the decision may have been "rigged", but all of them noted witnessing such situations or being interviewed by such committees. They reported spending between one hour to a full week on an application. Doing 'pre-application work' such as being visible in conferences and seminar series is appreciated by the committees, because they will then have some familiarity with the applicant.

Work, life and family balance

This is of utmost importance, although many employers do not care enough about it. Any kind of work is only sustainable if this balance is kept. It makes a good impression when you realize

that applicants have broad interests that keep them busy in their spare time. Additionally, diverse interests spark creativity, which is essential for academic productivity. Employers handle this differently, so one has to get a feeling for their expectations. Nevertheless, an applicant does not want to work in a place where the employer is not willing to let them take time off as is their right. Many universities started new offers for childcare or programmes for funding women researchers who paused for childcare to come back; however, they are as yet very rare. Importantly, past family and health issues are more and more taken into account during the hiring process.

Recommendations

- Use your PhD to learn skills in other areas such as statistics or coding.
- Apply a set of state-of-the-art methods.
- Do not be afraid to try new approaches or methods.
- Develop multidisciplinary projects.
- Avoid extreme specialization.
- Tackle the big themes, such as mass extinctions, climate change, conservation palaeobiology.
- Think of yourself from both a biological and a geological perspective (avoid labelling).
- Publish actively and visibly at the same time.
- Consider teaching and outreach activities
- Develop an expanded network of collaborators.
- Consider international mobility during your PhD and postdocs.
- Apply for permanent positions both nation- and world-wide if possible.
- Read the job description properly and make sure to fit the required criteria.
- State clearly what's new and original in your research.
- Propose a feasible project within the timeframe of the fellowship/position.
- Know your audience and explain your research accordingly.
- Focus on both previous and future work in your application.
- Explain why you are choosing this job/city/country to apply to.
- Express your motivation clearly.
- State clearly how past family or health issues impacted your career.
- Be honest, realistic, and open when discussing future work/life balance.

Farid Saleh (he/him)
Diversity Officer
<diversity@palass.org>

Emilia Jarochowska (she/her)
Newsletter Editor
<newsletter@palass.org>

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

18th International Nannoplankton Association Meeting (INA 18)
Avignon, France *28 August – 3 September 2022*

The INA brings together the world's approximately 200 nannofossil and nannoplankton (coccolithophore) scientists, and this biennial meeting is their main venue for the exchange of information. The meeting rotates amongst different continents and is back in Europe for the first time since Athens in 2017. Registration is open until 19th August.

For more information please see <**https://ina18.sciencesconf.org/**>.

Bridges
Gandía, Valencia, Spain (hybrid virtual / in-person) *12 – 16 September 2022*

The main aim of this conference is to bridge the gap between what have been thought of as separate and decoupled fields of knowledge, namely the STEM subjects and the social sciences, and also to think about gender differences in Science(s) from an intersectional perspective. There are multiple forms of inequality and discrimination in academia. But, how are these experiences of difference addressed in terms of scientific knowledge production? Are we thinking in terms of interdisciplinary understanding and action? What are we doing in our respective disciplines? How is this affecting the science we produce? All these questions have informed this initiative which aims to go further in terms of common horizons and transformative action. By bringing STEM and social sciences together this meeting intends to interrogate gender and science from a comprehensive understanding of differences and diversity.

For more information please see <**https://bridges2022.com/**>.

11th International Symposium on Cephalopods Present and Past
Natural History Museum, London, UK *12 – 16 September 2022*

The international Symposium on Cephalopods happens every 3-4 years and brings together experts and enthusiasts on fossil and extant cephalopods from around the world to discuss current topics on everything cephalopod. The conference includes a pre-conference field-trip to SW England (7–11 September) and a post-conference field-trip to Yorkshire (16–20 September).

Registration and more information is available via <**https://www.geocurator.org/events/155-11th-international-symposium-on-cephalopods-present-and-past**>.

If you have further questions please e-mail <**ISCPP11@nhm.ac.uk**>.

SVPCA 2022
Natural History Museum, London *21 – 23 September 2022*

#SPPC2022 will take place at the Natural History Museum, London, in conjunction with the Symposium on Vertebrate Palaeontology and Comparative Anatomy. Platform presentations will take place in the mornings, with time during tea breaks and lunches for delegates to view posters. Tours of the Conservation Centre and collection highlights will take place in the afternoons, bookable on a first-come-first-served basis. The Jones-Fenleigh Fund provides travel grants of up to £200 to help those who have no other source of funding to attend the conference.

The conference website is at <**https://svpca2020.com**>.

European Conodont Symposium 2022
Utrecht, the Netherlands *22 – 23 September 2022*

The European Conodont Symposium will take place at the Department of Earth Sciences, Utrecht University. Considering the impact of COVID-19 on networking opportunities for early-career researchers and the difficult funding situation for blue-skies research in palaeontology, the meeting organizers are focusing on keeping the costs low and facilitating participation for students and those who do not have funding to attend meetings.

For more information please see <**https://www.uu.nl/en/events/european-conodont-symposium**>.

6th International Palaeontological Congress (IPC6)
Khon Kaen, Thailand *7 – 11 November 2022*

The 6th International Palaeontological Congress will be held in Thailand in November, with various field-trips adding several extra days. The organizers aim to assemble an exciting and highly informative programme, including all aspects of our science and its connections to biology and Earth and planetary sciences, from the Archean to the Holocene, and covering work from all continents. Workshops will be organized on palaeontological techniques, probably as one-day mid-conference events. Details of scientific sessions and symposia are available online; registration and abstract submission are open until 15th August.

For more information please see <**https://ipc6.msu.ac.th**>.

New and Old Worlds (NOW) database 25th Anniversary Meeting
Sabadell, Barcelona, Spain *16 – 18 November 2022*

The NOW database of fossil mammals started as a small joint initiative of a few researchers in 1996, but over three decades it has grown and evolved into a thriving community including mammal palaeontologists from all over the world. After a year's delay because of the pandemic, the database

will be celebrated at its 25 year milestone. This will be a face-to-face meeting with two days of talks and workshops plus a one-day field-trip. There will be various thematic sessions devoted to different topics ranging from systematics and biochronology to palaeobiogeography, palaeobiodiversity and ecometrics. The field-trip will visit major mammal sites of the Vallès-Penedès basin, one of the best Miocene continental records worldwide. Contributions will be restricted to oral presentations and extended abstracts will be peer-reviewed and published in a special issue of the journal *Paleontologia i Evolució*. The deadline for abstract submission is expected to be the end of August.

For more information please see <**https://now25.icp.cat**> or e-mail <**now25@icp.cat**>.

14th Conference on Mesozoic Terrestrial Ecosystems
Salt Lake City, Utah, USA *8 – 10 June 2023*

Postponed from June 2022, this conference will feature all aspects of Mesozoic terrestrial palaeontology, palaeoecology, palaeoclimatology and palaeogeography. Generally held every four years, the pandemic has caused the meeting to be delayed. First time in the USA, Utah has been a major centre for new discoveries in its nearly complete Mesozoic terrestrial section over the past 25 years. MTE14 includes pre-meeting field-trips to local museums, a four-day trip up and down through Mesozoic areas of Utah and a post meeting trip to the region around Dinosaur National Monument.

Meeting website: <**https://utahpaleo.org/mte14/**>.

XV International Palynological Congress and XI International Organization of Palaeobotany Congress (XV IPC-XI IOP)
Clarion Congress Hotel Prague, Czech Republic *25 – 31 May 2024*

The Congress celebrating 200 years of modern palaeobotany, postponed from September 2020, was due to take place in May 2021. After reviewing the various levels of coronavirus infections and the processes implemented by various countries, the organizers did not believe that travel and a physical meeting could take place while safeguarding all attendees. They therefore made the decision to move the event to 2024. This date has also been chosen to reflect the decisions of the parent organizations (IFPS and IOP), and the fact that the online European Palaeobotany and Palynology Conference in Stockholm has taken place in 2022. These conferences are held biannually and usually alternate between European and world events.

For more information please see <**https://www.prague2020.cz/**>.

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

Lyme Regis Fossil Festival
Lyme Regis, UK *1 May 2022*

The Lyme Regis Fossil Festival is an annual event right on the Jurassic Coast in the south of England, free to attend and open to the public. The weekend is full of family-friendly fun, lectures and talks about current research, exhibit stalls from museums, palaeontological-themed art and guided fossil walks. This year, the Palaeontological Association had its own stall with various activities aimed at introducing palaeontological concepts to children, including a fossilization board game and a mix-n-match creature creation area using arthropod body parts. The creatures created were then put to the test with a spin of the 'Wheel of Misfortune' to see if they could survive extinction events, a great way to help kids consider themes of natural selection and evolution.

Photo: Shane Gausden.

I really enjoyed all aspects of volunteering at the Fossil Festival with the Palaeontological Association. It was brilliant to be able to reach out not only to children but to people of all ages and get them invested in palaeontology. Making research and knowledge accessible to the public is such an important aspect of the field and being able to contribute to the outreach was really heartening. In particular, it was nice to raise interest about invertebrate palaeontology, as vertebrate palaeontology dominates a lot of the media despite there being a wealth of exciting species of invertebrates. There were some very creative prehistoric arthropod creations at our stall! So many children and adults were really engaged in the material (in particular the trilobite specimens we had on the table) and we were asked many times to explain what trilobites were, how they lived and what their adaptations were. Many people were shocked to hear that they could be found in the UK.

The other element of volunteering was the amazing opportunity to be surrounded by curators, researchers, lecturers, PhD students and other people in the field of palaeontology. It was a great way to connect with people in a non-academic setting and to be on the same level, as I previously missed out on these experiences due to most of my undergraduate degree being impacted by lockdowns over the past few years. It really solidified my desire to have a career in palaeontology and was a fantastic experience.

Shane Gausden (he/they)
University of Southampton, UK

Developing a taxonomic framework for the Ediacaran macrobiota
University of Oxford, UK *3 – 5 October 2021*

In early October we held a discussion meeting looking at aspects of Ediacaran taxonomy and systematics at the University of Oxford. Determining the patterns and processes that governed the early evolution of animals is one of the foremost areas of current palaeobiological research. After more than two billion years of exclusively microbial life, the rise of animals to ecological dominance following the Cambrian Explosion fundamentally changed the trajectory of the evolution of the biosphere. The Ediacaran Period encompasses this transition, and records the first evidence of complex macroscopic life, including remains of some of the earliest animals the fossil record gives up. Many aspects of the biology of these enigmatic Ediacaran biota remain contentious and their classification remains in a state of flux, hampering our understanding of this critical interval in the history of life. Without robust taxonomic descriptions of these first animals, even basic ecological and diversity studies of these organisms and their communities cannot be reliably conducted.

These fossils present a suite of anatomies that are sometimes bizarre and have never again been repeated since their ultimate extinction, some 540 million years ago. This has meant that work towards the production of a taxonomic scheme has been fraught with difficulty, with many leading researchers in the field having published their own independent attempts at rationalizing these organisms within wider Neoproterozoic diversity. To address this, we held a workshop on the classification of the iconic soft-bodied Ediacaran biota to produce a new taxonomic framework for interpreting an enigmatic fossil biota.

The Grant-in-aid generously awarded by the Association (grant number PA-GA202002) supported early-career researchers who did not have, or were not able to use, funding, in order to broaden participation beyond those with access to fellowship monies. The Company of Biologists also

All Souls College, Oxford, UK, where the meeting took place.

provided generous support for a similar package for PhD students. Together, we hope the support we offered increased the diversity of delegates and made for a more robust and interesting discussion. We are extremely thankful to the PalAss for supporting our meeting in this way.

Our meeting was completely hybrid, meaning that international researchers could attend despite COVID-19 restrictions (or other concerns) impacting international travel, and we had delegates from Canada, the USA and China. The workshop started with a tour of highlights of the Brasier Collection, donated to the Museum by the late Prof. Martin Brasier. More information about the Brasier collection can be found here: <**https://oumnh.ox.ac.uk/brasier-collections**>. This was followed by a keynote talk from **Prof. Mary Droser**, of the University of California, Riverside, USA, who spoke to conference delegates and members of the public in the Oxford University Museum of Natural History about the discoveries she and her collaborators have been making in the Ediacaran of South Australia. Mary took questions from the conference delegates as well as from the public, serving as an excellent ambassador for the field.

On the first day of the conference proper we had six talks from researchers on aspects of Ediacaran taxonomy and systematics, and from researchers at different stages in their careers (from PhD student to professor) who were using a variety of different techniques. **Dr Emily Mitchell** spoke about spatial analyses and their application to Ediacaran macrofossils; **Dr Jen Hoyal Cuthill** spoke about the evolutionary trajectory of Ediacaran macrofossils; **Prof. Nick Butterfield** spoke about an Ediacaran 'bag-world' and anatomical insights from rare taphonomic regimes; **Daniel Pérez Pinedo** spoke about how taphonomy is crucial to understanding the fine details of anatomy; **Dr Scott Evans** talked about the growth dynamics of populations of the iconic fossil *Dickinsonia*; and **Dr Latha Menon** talked about the fraught taxonomic history of Ediacaran discoidal fossils.

These talks served as starting points for the conversation and were followed by break-out sessions where attendees were able to discuss aspects of Ediacaran palaeobiology in a broadly open format. Several recurring themes came up which centred around the kinds of characters we use to inform our taxonomic (and systematic) hypotheses. These included the utility of previously supposed informative characters (*e.g.* symmetry state) and the integration of facets of internal anatomy – for the first time – in a holistic taxonomic regime. We are preparing a list of titles suggested by conference delegates on topics ranging from the impact of palaeoart on how the Ediacaran macrobiota has been viewed through time to the anatomical detail of different groups. Everyone who attended the meeting will have the option to be on all papers produced, in the hope that these articles will represent the field as a whole and will pave the way for future, broader analyses of Ediacaran life.

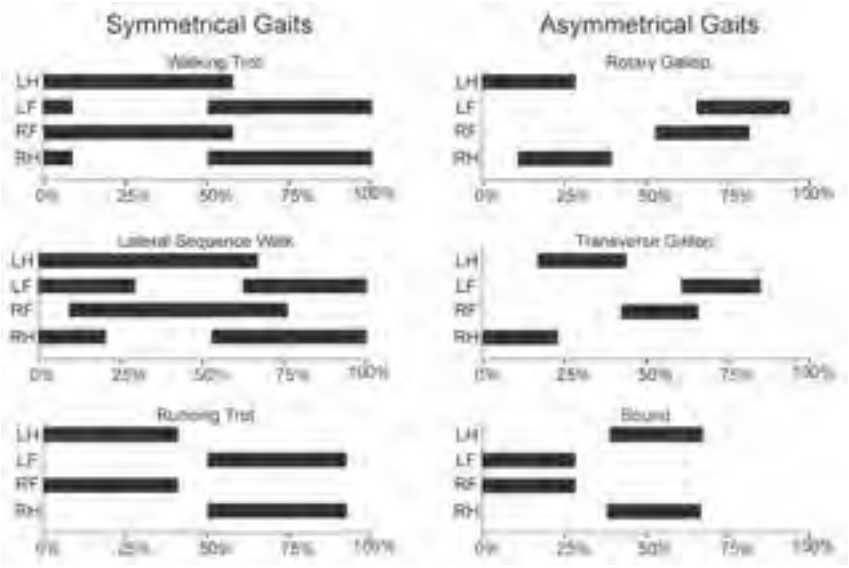
While it was a shame that not everyone who wanted to was able to attend in person, we thoroughly enjoyed talking to colleagues and sharing ideas in a more informal setting. We also enjoyed hosting the conference dinner at All Souls College, Oxford, ably chaired by Ross Anderson!

Frankie S. Dunn and Charlotte G. Kenchington
University of Oxford, UK

Evolutionary conservation and diversity in a key vertebrate behavior: 'walking' as a model system (SICB symposium)
Phoenix, AZ, USA *3 – 7 January 2022*

The 2022 national meeting of the Society for Integrative and Comparative Biology (SICB) was held in Phoenix, Arizona, USA. The meeting included 1,323 abstracts submitted as contributed talks, posters and symposium talks for the in-person component of the meeting from 3rd to 7th January 2022, with close to 1,000 recorded talks available via an online streaming platform (SICB+) from 14th to 31st January 2022. SICB selected to host 11 symposia at the meeting, including our symposium entitled "Evolutionary conservation and diversity of a key vertebrate behavior: 'walking' as a model system".

The term "walk" predates modern experimental biology and was originally applied to slow-paced human movements (Baker 2007). Early scientific work expanded this term to other vertebrates, and Milton Hildebrand established a paradigm for documenting the footfall patterns of mammals, subsequently termed gait diagrams (reviewed in Struble and Gibb (accepted)). Yet walking has been identified across the evolutionary spectrum in vertebrates: from underwater fishes to bipedal birds to quadrupedal primates. Today, walking is one of the most well-studied gaits; however, comparative analyses (*e.g.* 'walking' fish, walking on soft substrates, underwater walking) have revealed that it is far more complex than previously appreciated and cannot be characterized by gait diagrams alone (Struble and Gibb (accepted)). In fact, many seemingly well-established locomotor gaits may actually be subdivided into distinct subtypes based on their functional diversity (Jayne 2020).



Example of Hildebrand gait diagrams that illustrate footfall patterns in different locomotor gaits. Image credit: Mokele (CC BY-SA 4.0).

Our symposium combined multiple disciplines and a variety of approaches to address the surprisingly complex question: "what is walking?" Our invited speakers represented a variety of fields and approached this fundamental question using a range of model systems (from water to land, from extinct to extant) and by employing a diversity of approaches (from direct observation to robotic modelling, from palaeontology to neurobiology). By calling attention to and discussing this important question, we hoped to develop a comprehensive and systematic framework in which to identify, quantify and explain factors that drive or constrain functional diversity within a ubiquitous locomotor behaviour.

This topic was particularly relevant to palaeontologists because scientists commonly model how extinct taxa may have walked by extrapolating from extant animals. Unfortunately, attempts to model walking are confounded by the lack of a clear definition of walking. For instance, 'walking' fish that serve as modern analogues of tetrapodomorphs have independently evolved multiple times (Quigley *et al.* accepted) and may use other structures (*e.g.* tail, spines) as a surrogate for a limb so are they really walking? Indeed, the foundations and assumptions of such models could crumble if we do not properly characterize the patterns of consistency and diversity in 'walking' behaviours of extant animals.

Several important contributions to science emerged from our symposium that are of interest to palaeontologists. First, a comprehensive literature review was used to redefine a walk as a locomotor gait that is primarily driven by the appendages, has appendages of the same girdle out of phase, follows an inverted pendulum model of energy recovery, and has a duty factor greater than 0.5 (Struble and Gibb accepted). Second, helmeted guineafowl walking in mud exhibited subsurface movements of their feet that more closely resembled swimming, thereby expanding the functional diversity of walking to include relatively atypical behaviours and providing new insights into interpreting ichnofossils (Turner *et al.* 2022). Third, recent advances in palaeontological reconstructions of joint mobility have increased in complexity and incorporated more quantitative frameworks, and user-friendly computer scripts are now available to increase accessibility and enable more collaborative efforts to advance this science (Manafzadeh and Gatesy 2022). Fourth, computer simulations were used to demonstrate how musculoskeletal models of locomotor biomechanics can be used to provide new insights into whether Dinosauria was more successful than Crocodylomorpha during the Early Triassic because dinosaurs had better locomotor performance (so dubbed the 'locomotor superiority hypothesis' or LSH) (Cuff *et al.* 2022). Together, these and other studies in the symposium highlight that there is tremendous diversity in the form and function of locomotor gaits and point towards new avenues to explore how and why different locomotor behaviours evolve.

Our symposium was funded by SICB (Divisions of Comparative Biomechanics, Vertebrate Morphology and Animal Behavior), Micro Photonics Inc., a Company of Biologists Scientific Meeting Grant, and Palaeontological Association Grant-in-aid (grant number PA-GA202104). The latter was used to provide travel funds for Prof. John Hutchinson (Royal Veterinary College, UK) to attend and present at the symposium.

Sandy Kawano
The George Washington University, USA

Haley Amplo
New Jersey Institute of Technology, USA

Alice Gibb
Northern Arizona University, USA

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QUIGLEY, Z. M. G., BLOB, R. W. and KAWANO, S. M. accepted. Kinematic comparisons between mudskipper fins and salamander limbs during terrestrial locomotion. *Journal of Experimental Zoology Part A: Ecological and Integrative Physiology*.

STRUBLE, M. and GIBB, A. C. accepted. Do we all walk the walk? A comparison of walking behaviors across tetrapods. *Integrative and Comparative Biology*.

TURNER, M. L., FALKINGHAM, P. L. and GATESY, S. M. 2022. What is Stance Phase on Deformable Substrates? *Integrative and Comparative Biology*, icac009.

OBITUARY

Alain Blieck
1949 – 2022

Image courtesy of Vachik Hairapetian.

Our esteemed colleague and friend, Alain Robert Maurice Blieck-Cazeau of Haubourdin, France, former CNRS senior scientist, and professor emeritus of the Université des Sciences et Technologies de Lille, Campus de Villeneuve d'Ascq, succumbed to COVID-19 in early February. Alain, a true northern Frenchman with Dutch/Belgian/Walloon connections, conducted research over a wide range of areas in evolutionary biology, palaeobiology and systematics (taxonomy, nomenclature, phylogeny), palaeoecology, biostratigraphy and palaeobiogeography. His main focus was the earliest vertebrates and, in particular, the Palaeozoic jawless Pteraspidomorphs that are known from the Ordovician to the Devonian, but he also contributed on Palaeozoic microvertebrates, and sharks to tetrapods. He was "in the van" of cladistics applied to early vertebrates (Gee 2000).

Alain made major contributions to the biodiversity, biostratigraphy and palaeobiogeography of Devonian pteraspidomorphs in the UK. These included heterostracans from the Welsh Borderland and Northern Ireland (*e.g.* Blieck 1982; 1984; 1991; Blieck and Tarrant 2001) and organizing important conferences on western European palaeogeography (*e.g.* Blieck and Meilliez 1992; Servais *et al.* 2003). Alain's body of work spans nearly 50 years. His last as his first is on heterostracans pteraspidomorphs, and is currently in press. He brought new rigour to our understanding of early vertebrates, especially their first appearance in the early/mid-Ordovician and the Early Devonian faunas from the Old Red Sandstone Continent (Spitsbergen, Arctic Russia and Canada, Europe, USA). He was one of the first to press the idea that vertebrates were a group fundamental to the biostratigraphy of the Middle Palaeozoic.

Alain was both a field man in the classic style, with expeditions as far afield as Spitsbergen and Iran; an active member of geological societies in France and further afield; a teacher who fostered many students, taking field courses to Wimerieux on the northeast French coast, and most generous to many visiting researchers and students. 'Papa Blieck' (as he became known after this label was placed on his group table in a French restaurant during a conference) worked on several international projects, especially on mid-Palaeozoic geological problems related to vertebrates and notably UNESCO-IUGS IGCP 328, when we were co-leaders from 1993 to 1996; this was voted one of

the best projects by the Earth Sciences Division and Board of IGCP. We edited several conference proceedings together, such as the Gross Symposium series and the Final report for IGCP 328 (*e.g.* Blieck and Turner 2000). During this time, he hosted a major field excursion across northern France and Belgium as the last in the series in 1995, fittingly finishing in a Champagne cave near Reims. His generosity, intellect, his sense of fun will be missed by colleagues and friends. Alain was supported throughout his career by his partner Dr Edmonde Razafimahaleo and their two sons and family.

The 16th International Symposium on Early/Lower Vertebrates held in Valencia in mid-June provided a memorial page:

<**http://iselv.uv.es/in-memory-of-dr-alain-blieck/**>

Susan Turner
Queensland Museum, Australia

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Research Grant REPORT

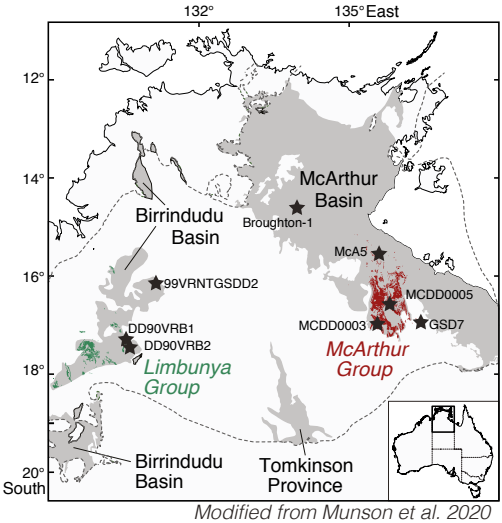
Eukaryotic evolution in heterogeneous Proterozoic seas

Leigh Anne Riedman
Department of Earth Science, University of California, Santa Barbara, USA

Introduction

Although the Precambrian fossil record extends well into the Archean Eon, the earliest occurrences of likely eukaryotic fossils are reported from units of the late Palaeoproterozoic Era. Determining a prokaryotic or eukaryotic affinity is often not straightforward, but characters like vesicle ornamentation and presence of branching processes are interpreted as evidence of a sophisticated cytoskeleton and thus at least stem-eukaryotic affinity (*e.g.* Javaux *et al.* 2003). This character is seen in early eukaryotes (~1.67–1.64 Ga) such as *Valeria lophostriata*, which bears concentric circles etched upon the vesicle interior; *Satka favosa*, whose vesicle is composed of individual concave plates; and *Tappania plana*, a complex form with asymmetrically distributed, hollow, branching processes and occasional neck-like extensions.

Despite the appearance of eukaryotes by ~1.65 Ga, fossils displaying characters assignable to modern (crown group) eukaryote clades are not seen until the late Mesoproterozoic and early Neoproterozoic (Butterfield *et al.* 1994; Butterfield 2000; Porter and Knoll 2000; Loron *et al.* 2019) when eukaryotic species richness (Knoll *et al.* 2006; Cohen and Macdonald 2015) and atmospheric oxygen (Lyons *et al.* 2021) also increased. A leading hypothesis for this apparent evolutionary delay is that eukaryotic innovation and diversification were constrained by widespread oceanic anoxia that limited habitat and key nutrients. However, it has also been suggested that early eukaryotes were anaerobic, and the ability to respire oxygen could have evolved much later, perhaps just prior to the first appearance of crown group forms (Porter *et al.* 2018; Porter 2020). One way to test these ideas is to determine the redox habitats of early eukaryotes. Here I present organic-walled microfossil data and preliminary iron-speciation palaeoredox data for Palaeoproterozoic and Mesoproterozoic units in the McArthur and Birrindudu basins of northern Australia (Figure 1).



Modified from Munson et al. 2020

Figure 1. Map shows the extent of the McArthur and Birrindudu basins and the drillcore locations.

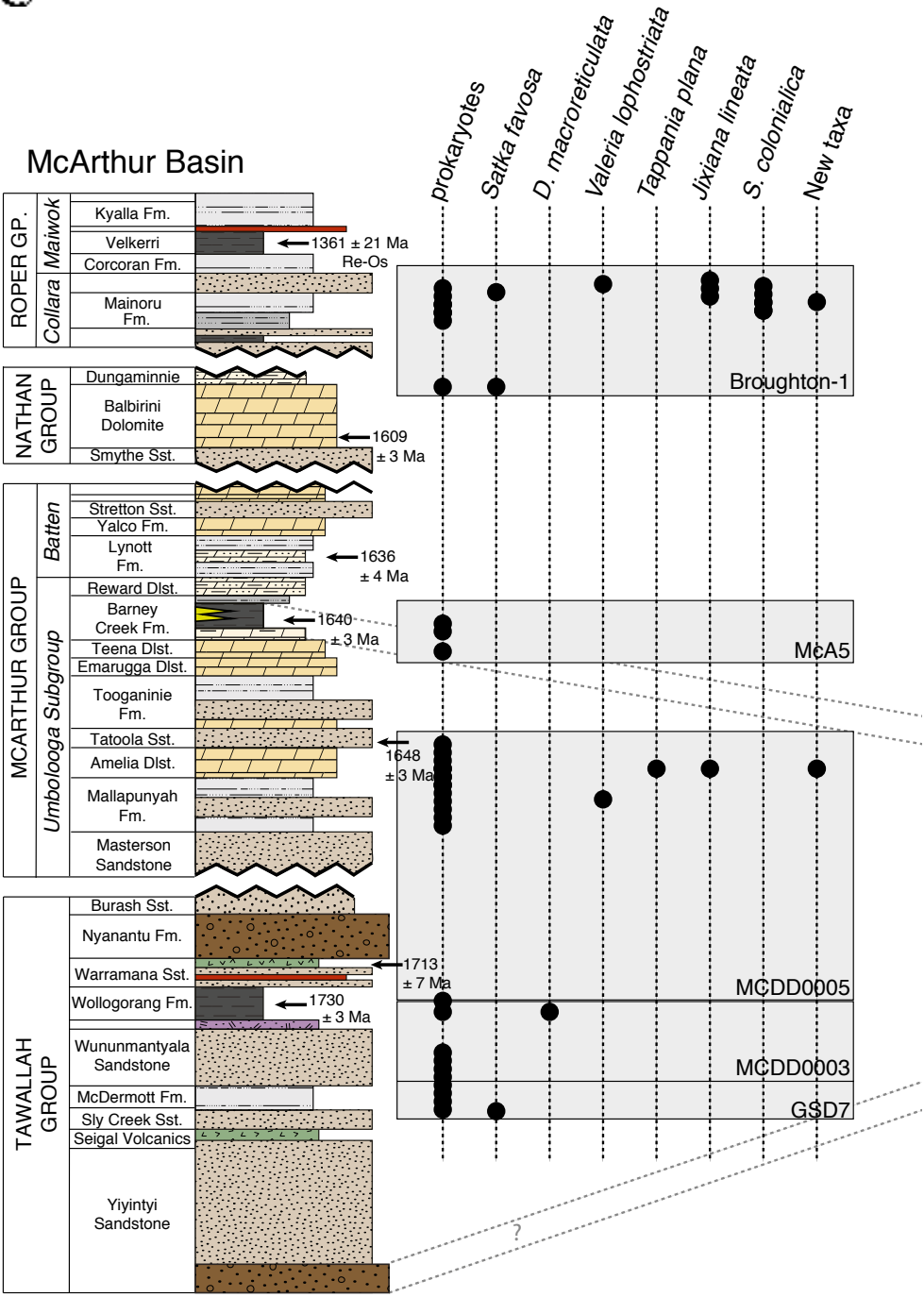
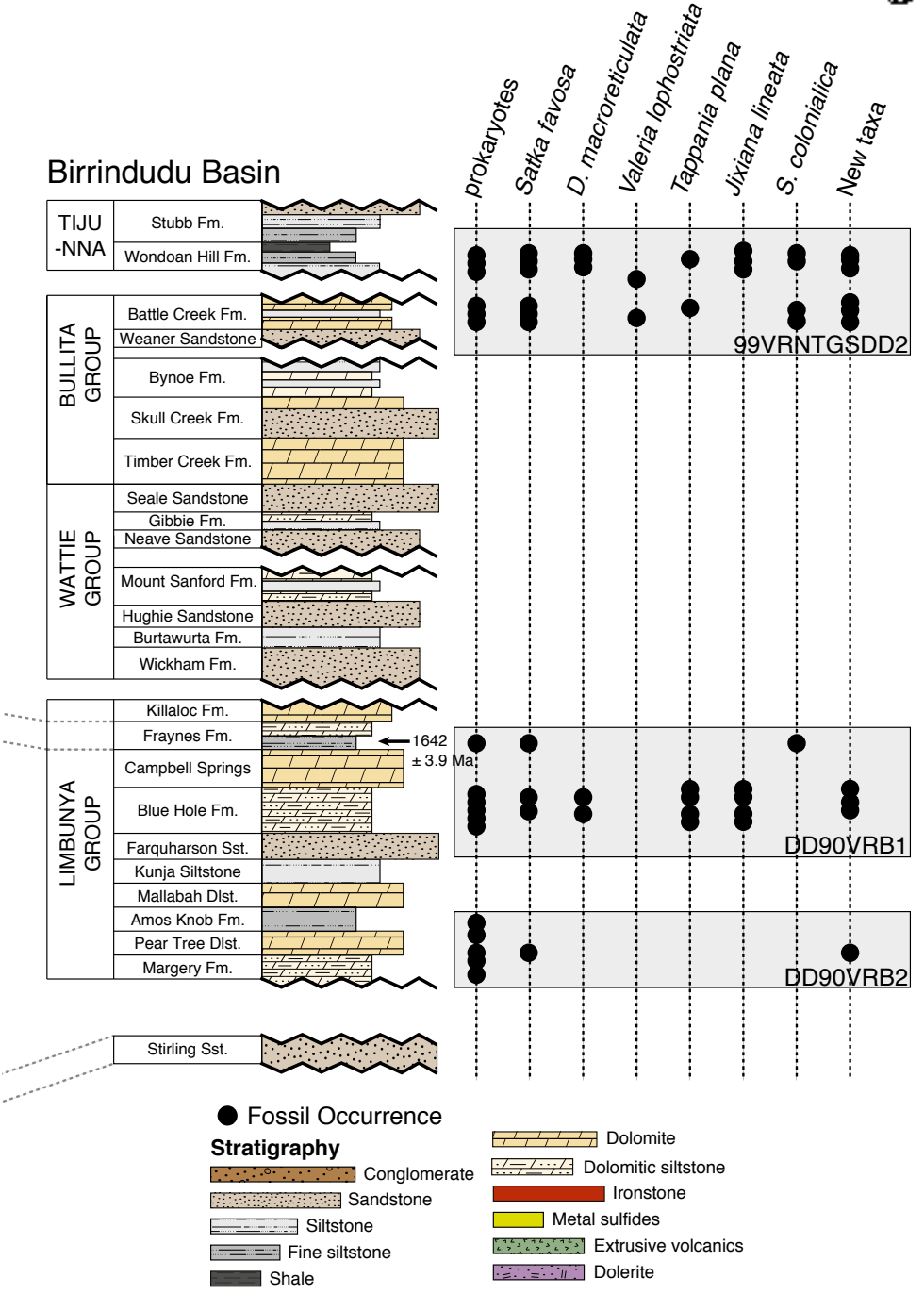


Figure 2. Stratigraphic columns for McArthur and Birrindudu basins; occurrences of selected fossils, grey boxes denote sampled drillcore intervals.


Birrindudu Basin
prokaryotes
Satka favosa
D. macroreticulata
Valeria lophostriata
Tappania plana
Jixiana lineata
S. colonialica
New taxa
TIJU -NNA
Stubb Fm.
Wondoan Hill Fm.
BULLITA GROUP
Battle Creek Fm.
Weaner Sandstone
Bynoe Fm.
Skull Creek Fm.
Timber Creek Fm.
WATTIE GROUP
Seale Sandstone
Gibbie Fm.
Neave Sandstone
Mount Sanford Fm.
Hughie Sandstone
Burtawurta Fm.
Wickham Fm.
LIMBUNYA GROUP
Killaloc Fm.
Fraynes Fm.
1642 ± 3.9 Ma
Campbell Springs
Blue Hole Fm.
Farquharson Sst.
Kunja Siltstone
Mallabah Dlst.
Amos Knob Fm.
Pear Tree Dlst.
Margery Fm.
Stirling Sst.
99VRNTGSDD2
DD90VRB1
DD90VRB2
Fossil Occurrence
Stratigraphy
Conglomerate
Sandstone
Siltstone
Fine siltstone
Shale
Dolomite
Dolomitic siltstone
Ironstone
Metal sulfides
Extrusive volcanics
Dolerite

Results and discussion

The 1815–1450 Ma McArthur and ~1812–1400 Ma Birrindudu basins both comprise thick successions of relatively unmetamorphosed fluvial to shallow marine carbonate and siliciclastic rocks across northern Australia (Figure 2). Fossiliferous intervals occur throughout both successions, occasionally recording only prokaryotes, but usually preserving likely eukaryotes (Figure 2). Palaeontological and iron-speciation data are available for 88 samples: 41 oxic, 23 ferruginous, one anoxic and sulfidic (euxinic), and 23 equivocal samples for which the redox state cannot yet be resolved. Most (70 %) fossil specimens (prokaryote+eukaryote) come from oxic samples, whereas only 1 % from ferruginous samples and 28 % of fossils come from equivocal samples (the only euxinic sample was barren). Eukaryotes are even more likely to be found in oxic samples – 91 % of eukaryote specimens occur in oxic samples, 3 % in ferruginous samples and 6 % in equivocal samples.

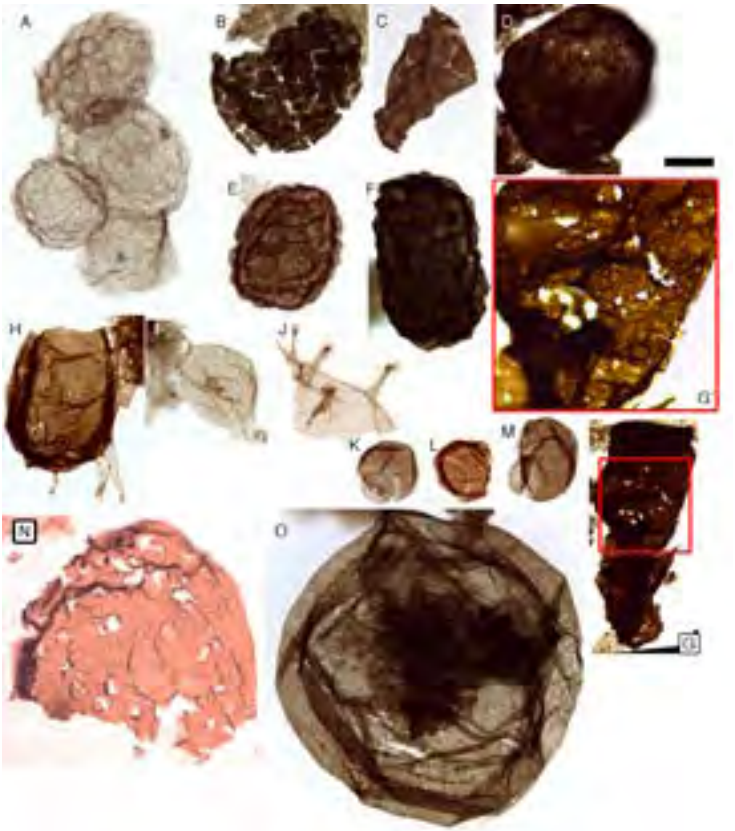


Figure 3. Organic-walled microfossils (A-C) Satka favosa*, (A-B) Battle Creek Fm, (C) McDermott Fm; (D)* Dictyosphaera macroreticulata*, Wondoan Hill Fm; (E-F)* Squamosphaera colonialica*, Battle Creek Fm; (G, G') Jixiania lineata, Amelia Dolostone; (H-J)* Tappania plana*, (H) Amelia Dolostone (I-J) Blue Hole Fm; (K-M) New operculate taxon, Blue Hole Fm; (N-O)* Valeria lophostriata*, (N) Mallapunyah Fm, (O) Battle Creek Fm. Scale bar near D is 20µm for all except G, for which it is 50µm.*

Satka favosa (Figure 3 A–C), *Valeria lophostriata* (Figure 3 N–O), *Tappania plana* (Figure 3 H–J), *Dictyosphaera macroreticulata* (Figure 3 D), *Jixiania lineata* (=*Lineaforma elongata*, Figure 3 G) and *Squamosphaera colonialica* (Figure 3 E–F) are probable eukaryotes common in Palaeoproterozoic-Mesoproterozoic fossil assemblages and are well represented in the units described here. We found *Satka favosa* apparently favoured shallow subtidal, oxic settings (96 % of specimens), and its range extended into the >1730±3 Ma McDermott Formation, which not only increases its stratigraphic range, but also pushes the age of the oldest reported eukaryotic fossils deeper into the Palaeoproterozoic.

Several new taxa were recovered; one appears to be operculate (Figure 3 K-M) possessing a smooth, unornamented vesicle with a circular opening and a still-attached circular operculum. The operculate nature is noteworthy as the first clear evidence of a programmed vesicle dehiscence rather than a simple medial split suggested in some other taxa. Not only does this speak to the complexity of the cellular machinery and a sophisticated cytoskeleton, but also a complex life cycle involving formation of cysts or reproductive bodies that must be released from the parent vesicle.

Conclusions and future work

The Palaeoproterozoic and Mesoproterozoic McArthur and Birrindudu basins are richly fossiliferous, preserving named and new taxa, indicating reasonably high diversity by this time in eukaryotic evolution and boding well for future study. We find a greater stratigraphic range for several taxa, pushing back the age of the oldest evidence of eukaryotes. Additionally, discovery of a new operculate taxon indicates that early eukaryotes possessed a sophisticated cytoskeleton and complex life cycle by the end of the Palaeoproterozoic.

By pairing our palaeontological and redox data we see that eukaryotic fossils predominantly occur in samples interpreted to record oxic, shallow marine deposition, indicating that these early eukaryotes indeed lived in and favoured oxygenated habitats, and were perhaps aerobic. Further, our paired data suggest that individual taxa such as *Satka favosa*, with its strong preference for oxic settings, may have potential as fossil redox proxies where geochemical data are unavailable.

Acknowledgements

I am deeply grateful to the Palaeontological Association for the generous Research Grant (PA-RG201902) that funded sample collection and processing. Without the support of the Palaeontological Association, none of this work would have been possible. I would also like to recognize my collaborators, Max Lechte and Maggie Whelan, for their hard work collecting the geochemical data.

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Small Grant REPORT

Taphonomy of the plumage of a Late Pleistocene Eurasian griffon vulture preserved in a pyroclastic flow from Central Italy

Valentina Rossi
School of Biology, Earth and Environmental Sciences, University College Cork, Ireland

The discovery of fossilized feathers has provided critical advancement in our understanding of the evolution of avian dinosaurs and early birds, and the evolution of flight (see Foth and Rauhut 2020 for a recent review) as well as insight into the evolution of colour and behaviour (Vinther 2020). Fossilized feathers are usually found in lacustrine and restricted marine deposits and are typically preserved as dark carbon-rich two-dimensional thin films or as impressions (*i.e.* as external moulds with no original organic material) (Davis and Briggs 1995). Rarely, fossil feathers are mineralized – *i.e.* soft tissue structures are replaced by the precipitation of authigenic minerals, such as calcium phosphate and silica (Davis and Briggs 1995; Channing *et al.* 2005). Furthermore, feathers have been found embedded in amber preserved three-dimensionally (Xing *et al.* 2018). Fossilized feathers from other terrestrial settings were so far unknown.

The discovery of a nearly complete late Pleistocene Eurasian griffon vulture (*Gyps fulvus*) with evidence of the plumage preserved in the Peperino Albano (PA) ignimbrite (Colli Albani, Rome, Italy; (Meli and Maineri 1889)) offers a unique opportunity to investigate the preservation of feathers in a volcanoclastic deposit. The specimen was reported to include a partially complete skeleton as well as a body impression, including the head, neck, hindlimbs and feathers. In the original description, the partially preserved plumage was interpreted as part of the right wing and the feathers were described to be preserved as impressions (Meli and Maineri 1889). The block bearing the head and neck was studied in detail more recently (Iurino *et al.* 2014) and it was not the focus of this project. The skeletal elements and the blocks bearing the impression of the rest of the body have been lost.

A detailed analysis of the feathers has not previously been attempted. This project aimed to investigate the mode of preservation of the feathers with the primary objective of elucidating the taphonomic history of this unique fossil. To achieve this, I analysed the physical and chemical preservation of the soft tissues employing scanning electron microscopy (SEM), coupled with energy dispersive spectroscopy (EDS) and thin sections. Here I will outline my preliminary findings.

Seven blocks (V0034.1–V0034.7) exhibit the remains of the plumage of the right wing of *G. fulvus* (Figure 1A). Fossilized feathers appear yellow to rusty orange in colour and are mostly preserved in dorsal view, parallel to the bedding plane on the surface of a grey-coloured rock matrix (Figure 1B–D). Some feathers are embedded within the rock matrix (Figure 1E). All feathers observed are incomplete, lacking the most distal and proximal portion (*i.e.* the tips and the calami) whereas

the middle portion of the rachis and vane, including barbs and barbules, are usually preserved. The rachises are preserved as moulds; the shaft walls appear as a smooth beige-orange coloured stain. Rachis medulla and ridges are not preserved, but a ridge in the middle of the rachis hollow structure is often visible (Figure 1E). The quality of preservation of the barbs and barbules varies from impressions to three-dimensionally preserved.

Figure 1. The fossilized plumage of G. fulvus. *A) Overview of the seven blocks bearing the feathers. Note that block V0034.4 is the counterpart of blocks V0034.5, V0034.6 and V34.7. B–D) Fossil feathers preserved in dorsal view. E) Cross section of a feather embedded in the rock matrix; schematic of the rachis cross section reported in grey in the bottom right corner. Scale bars are A) 100 mm; B) 20 mm; C) 5 mm; D) 20 mm; and E) 3mm.*

Analysis of thin sections (Figure 2A–B) and small samples dissected from points of interest of the specimen reveals that the 3D preserved barbs and barbules are mineralized (Figure 2C–E), with the barbules showing evidence of internal granular features (here named microgranules). EDS analysis of barb and barbule walls and microgranules (Figure 2E) shows high abundance of Si, Al, O, K and minor contributions from Ca and Fe, suggesting that the feather structures have been replaced by aluminosilicates. This mode of preservation is promoted by the presence of Al-Si enriched pore water and acidic conditions in relatively shallow sedimentary layers (Naimark *et al.* 2016). The findings of this project suggest that the vulture carcass was buried by a water- and mud-rich secondary volcanoclastic deposit (possibly a lahar, see Funiciello *et al.* 2003) during or after the last eruptive phase of the Colli Albani volcanic complex. The complete entombment of the carcass, in an Al-Si water-rich fine-grained sediment, provided conducive conditions for the mineralization of the feathers.

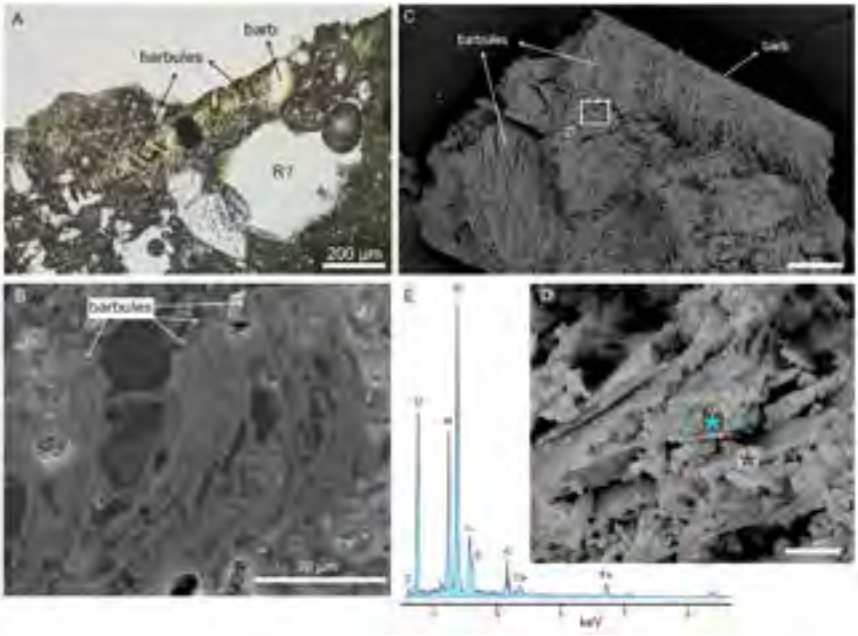

Figure 2. Microanalysis of feather structures. (A) Photograph of a selected thin section showing a barb and barbules; R? is possibly a rachis. (B) Scanning electron micrograph of barbules with microgranules in thin section. (C-E) SEM-EDS analysis of barbules and microgranules. (E) EDS spectrum of points in D.

The study of this remarkable fossil expands on the preservation of feathers in the fossil record and highlights the potential for fine grained water-rich volcanoclastic deposits for soft tissue preservation. I am currently writing these results for a scientific publication.

Acknowledgements

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Undergraduate Bursary REPORT

Exploring *Tribrachidium heraldicum* and the late Ediacaran rise of suspension feeding

Andrei Olaru
Department of Earth and Environmental Sciences, Vanderbilt University, USA.

Introduction

Tribrachidium heraldicum is an Ediacaran organism from the White Sea assemblage (~555 Ma) in South Australia, Russia and Ukraine. It is notable for its bizarre, tri-radial anatomy (Figure 1) that has historically been difficult to interpret due to a lack of recognizable similarities to modern taxa. Rahman *et al.* (2015) used a 3D *Tribrachidium* model generated using microCT to simulate water flow around the organism, finding flow patterns suggestive of suspension feeding rather than osmotrophy. However, this model lacked key anatomical features present in well-preserved fossils. Here we expand on this research using 3D models constructed with computer-aided design (CAD) software which include important morphological characters missing from earlier models. Using a new and more accurate model of *Tribrachidium*, we replicate Rahman *et al.*'s original 2015 study. In addition, we investigate the effects of specific anatomical features as possible controls on fluid flow patterns using a range of null models.

Figure 1: A Tribrachidium *with its unique triradial morphology; fossil is 18mm wide. Image © S. Darroch.*

Methods

Three-dimensional digital models of *Tribrachidium* were created using the CAD program Rhinoceros 3D v. 7. Models were constructed and scaled based on the primary literature (Hall *et al.* 2015; 2020), with additional details modelled based on photographs of well-preserved specimens. One anatomically accurate model and three different null models were constructed: a bare hemisphere; a pitted hemisphere; and a model with pits and arms but lacking bullae (bulbous growths near the 'elbows' of *Tribrachidium's* tri-radial arms). Computational fluid dynamics (CFD) simulations were performed in COMSOL Multiphysics v. 5.6 following standard protocols (Rahman *et al.* 2015). We simulated inlet velocities of 0.05, 0.1, 0.2 and 0.5 m/s (chosen to match expected conditions in *Tribrachidium's* native shallow marine settings (Hall 2015). Simulations were conducted at 0° and 90° with respect to current flow.

Results

In all the CFD simulations, fluid flow rapidly decreased in velocity as it approached the 3D model, with a low velocity wake formed downstream of the model (Figure 2). For CFD simulations with the anatomically accurate *Tribrachidium* model, low velocity flow was redirected to the apex of the organism, with small vortices forming in the three apical pits. Recirculation to the apex and creation of slow-moving vortices in the apical pits appeared for all inlet velocities (Figure 2), and recirculation was observed regardless of orientation to current (Figure 3).

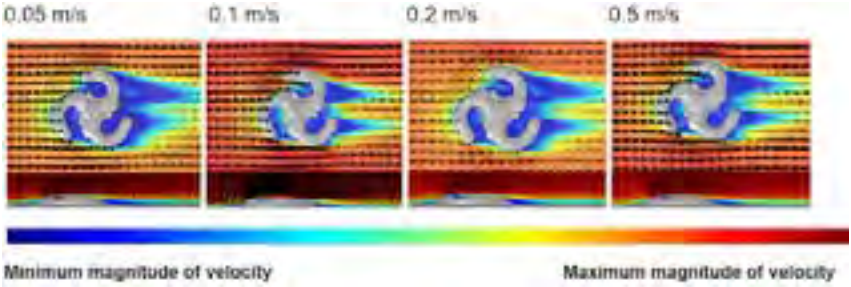

Figure 2. CFD results for anatomically accurate Tribrachidium *model. Results visualized as two-dimensional plots (horizontal and vertical cross-sections) of flow velocity magnitude with flow vectors (black arrows; size proportional to the natural logarithm of the flow velocity magnitude). Ambient flow from left to right.*

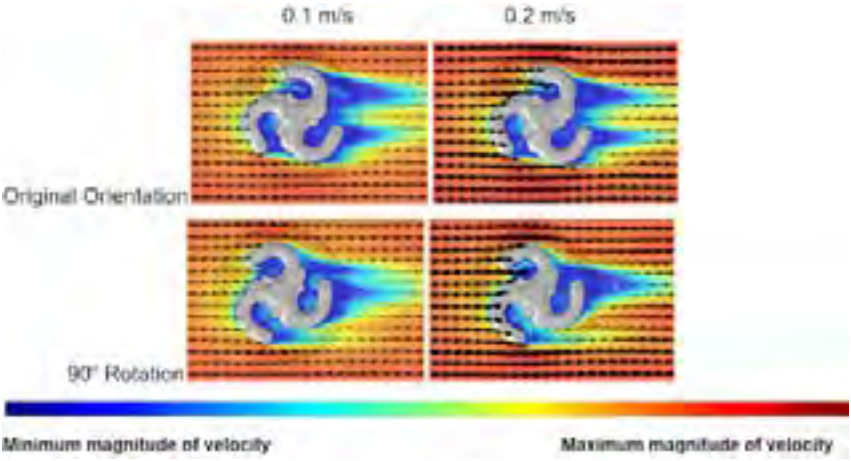

Figure 3. CFD results for anatomically accurate Tribrachidium *model at different orientations to current. Results visualized as two-dimensional plots (horizontal cross-sections) of flow velocity magnitude with flow vectors (black arrows; size proportional to the natural logarithm of the flow velocity magnitude). Ambient flow from left to right.*

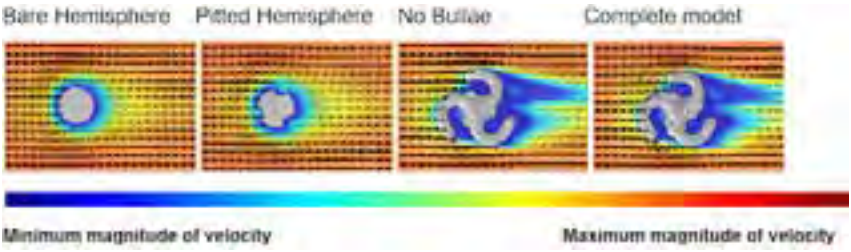

Figure 4. CFD results for null models of Tribrachidium. *Results visualized as two-dimensional plots (horizontal cross-sections) of flow velocity magnitude with flow vectors (black arrows; size proportional to the natural logarithm of the flow velocity magnitude). Inlet velocity of 0.05 m/s. Ambient flow from left to right.*

CFD simulations for the null models of *Tribrachidium* showed that the bare hemisphere distributed flow evenly over its entire surface; the addition of pits in the second model slightly disrupted this pattern, but still resulted in evenly distributed flow (Figure 4). However, the two models with arms (the third model excluding bullae and the fourth anatomically accurate model including bullae) redirected low-velocity flow to the apical pits at all simulated flow velocities (Figure 4). The presence of bullae in the model had very little visible impact on flow patterns, with the possible exception of helping shield the pit that was most exposed to direct flow.

Discussion

CFD simulations using our anatomically accurate *Tribrachidium* model showed the same overall fluid flow patterns as described by Rahman *et al.* (2015) (Figure 2). As flow passed over the model, fluid was concentrated in specific regions (*i.e.* the apical pits), which have been hypothesized to represent specialized feeding structures (Rahman *et al.* 2015). This is consistent with a passive suspension feeding lifestyle, specifically the mechanism of gravitational deposition, where particles settle out of suspension over feeding structures under the influence of gravity. The flow patterns are incompatible with osmotrophy (*i.e.* feeding through direct absorption of dissolved molecules), which would require flow to be distributed evenly over the surface of the organism (similar to our first two null models; Figure 4). The presence of consistent recirculation at multiple orientations also supports Rahman *et al.*'s (2015) hypothesis that *Tribrachidium* was adapted to live in environments characterized by multi-directional currents (Figure 3).

Our series of stepped null models reveal that the most significant body features aiding *Tribrachidium's* suspension feeding lifestyle are its tri-radial arms (Figure 4). As stated above, the presence of bullae had very little visible impact on flow patterns, with the possible exception of helping shield the pit that was most exposed to direct flow. However, it is difficult to discern if this is an adaptive function of the bullae or an incidental artifact of their placement and shape; therefore, the role of the bullae in *Tribrachidium's* lifestyle remains unresolved.

The use of null models adds nuance to our understanding of the functional morphology of *Tribrachidium*. After establishing that the organism was likely a suspension feeder, adding or removing different anatomical components allowed us to gauge their effect on flow patterns, illustrating how suspension feeding was achieved and helping establish the functions of key body parts. This serves to demonstrate the important role of null models for understanding the palaeobiology of extinct organisms, especially those without extant analogues, as is the case for most Ediacaran organisms.

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Reviews

Adrift: The Curious Tale of the Lego Lost at Sea

Tracey Williams, 2022, Publisher: Unicorn, ISBN: 1913491196

In early 1997, a storm that had been brewing in the Atlantic rolled in toward the English Channel. A large container ship called the *Tokyo Express*, travelling from Rotterdam and bound for New York, was caught in the squall only 20 miles off Land's End. While battling through the howling wind and rain, a giant 28-foot wave struck the 58,000-tonne ship with such force that she tilted 60 degrees onto her side, before over righting by 40 degrees. The battering, which the captain of the *Tokyo Express* described as a 'once in a 100-year freak wave', forced the ship to abandon her journey across the Atlantic and head to the UK for repair. However, the mega wave did more than just damage the vessel – 62 large shipping containers tumbled overboard, plunging into the icy waves. While the majority of the containers sank down to Davy Jones' locker without a trace, some were found in the following days bobbing in the ocean off the coast of Cornwall and Devon. It had been reported that these containers might be full of cigarette lighters, super glue and other hazardous chemicals, and this caused great alarm to the local authorities. The coastguard acted swiftly, towing away as many containers as they could to prevent them being struck by passing ships, but eventually some hazardous chemicals did start washing up on local beaches, triggering a clean-up operation from the coastguard and the fire service. Surprisingly, lost containers are not an unheard-of occurrence in the west country, and normally the story would have faded over a few short weeks, but the *Tokyo Express* had lost a cargo container that would etch its name into local legend.

I was ten years old when the *Tokyo Express* shed its containers into the Channel. Growing up on the south coast of Devon, I distinctly remember the storm. As news filtered into the community and the press about the spill, I recall my father excitedly talking about the prospect of treasure being washed up on the beaches. Our family were very keen beachcombers, and we would spend most weekends walking our dog, Rosie, along the local beaches looking for the bounty of the tides. Buoys, lobster pots, mermaids' purses, driftwood, shells, sea glass, fossils, lobster claws, anchors, shark jaws, bird skulls – even lumps of ambergris, filled large glass containers that littered our house (and filled the bathroom for some reason). The family excitedly talked about the storm and ruminated about the treasures that might wash up on the beach. I seem to remember rumours of motorbikes and even whole Range Rovers being washed up, but as with most things that pertain to the sea, this was probably inebriated gossip from the small community of fishermen who resided most evenings in our local pub. My father announced that he was going on an expedition to 'see what he could see' and the next day, at the crack of dawn to catch the tide, he scooted off in search of loot along the coast.

I have no idea what I was doing that day, but I do remember my father arriving home. He entered the kitchen triumphantly, smelling of salt, his cheeks rosy from the wind, with a very wet and sandy Rosie dog in tow. He beamed a big smile as he came over to the table and began emptying his pockets. There were a few shells and bits of sea urchin, but then he started to reveal his unbelievable (to a ten-year-old) haul. A selection of multicolored flippers. Miniscule yellow spear guns covered in tar. Artificial seaweed. Perfectly sculpted scuba tanks and life jackets. Tiny plastic flowers. A selection of plastic octopuses. But then, he slowly pulled out the pièce de résistance. It was missing the tip of its tail and the top of its head, but it was clear what it was, because I already owned many examples like this. A small, sculpted dragon made from black plastic. I knew exactly what it was – it was Lego. I have no idea if this is factually correct, but I like to think my dad was one of the first people to have found washed up pieces of the 'Great Lego Spill' of 1997. Over the next few weeks, we spent every day we could at the beach, hoovering up Lego pieces with glee. It transpires that one of the containers lost off the *Tokyo Express* contained 4.8 million Lego pieces. Ironically, most of these pieces were nautical themed and were en route to be made into kits and distributed throughout North America.

Hunting for Lego on the beaches of Devon and Cornwall with my family and Rosie dog are one of my most cherished childhood memories. Like most memories, they sink to the back of your mind, but these memories were dredged back to me when I came across a Twitter account called @LegoLostAtSea. Run by Tracey Williams, the account documents her amazing and sometimes bizarre beachcombing finds along the long sandy coast of the west country. I got in contact with Tracey through Twitter in 2018 to share my memories and was met with a barrage of interesting and deeply thought-out questions. Tracey had seen my Twitter bio and wanted to know whether the Lego would be incorporated into the geological record – a thin Lego layer in the rock that would potentially mark the great storm event of 1997, and could this layer be found by geologists of the future? A lego-y marker of the age of plastics. I was enthralled with the idea of this Anthropocene marker bed and made some sort of flippant comment about how you could write a book about it, to which Tracey calmly told me she already was.

A few months later a copy turned up at my front door. The book is beautiful, wonderfully laid out, with beautiful illustrations and photos. It is written in lovely simple prose that feels like you are chatting to Tracey over a cup of tea after a beach walk. Through her writing you can feel the sense of adventure with each new beachcombing discovery. The book starts by explaining the events of the *Tokyo Express* and the lost Lego container, and charts the scope of the spill. One aspect of the book that was very well done is gently reminding the reader that although the Lego aspect of the spill is quite fun, we must remember that Lego is plastic, and this is an environmental disaster. We aren't sure how Lego breaks down, how long it will persist in its current form or if it becomes dreaded microplastics (almost certainly). Nobody really knows what the impact it will have on sea life has been either, and a heartbreaking picture of a dead cat shark trapped inside one of the larger lego door frames really brought that home to me. We must also remember that this isn't an event that happened in the past. Unbelievably, Tracey is still finding Lego spilled from the *Tokyo Express*. It is not uncommon for fishermen many many miles off the Cornish coast to still haul up Lego in their nets, showing that the *Tokyo Express* spill is still impacting our coast today.

Tracey weaves some really fascinating science into the book effortlessly, conducting interviews with oceanographers and splicing the science of ocean currents and the buoyancy of plastics into

the text in a very disarming manner. I was also super impressed that Tracey got Lego to make a statement about the event in the book, about their role in adding to plastic pollution. Depressingly, the latter half of the book is dedicated to the other types of plastics that Tracey commonly finds washed in with the tides. Mountains of plastic soldiers, smarties lids, hair curlers, fake flowers, flip flops, toothbrushes … you name it, if it's plastic it inevitably ends up in the sea. One of the most alarming plastic substances commonly found are 'pyroplastic' pebbles – dark gray and black plastic pseudo-rocks. No one really knows how they form. Chemical analyses suggest they are the burned remains of plastic bags and food containers that have been melted in landfills. Maybe they have been eroded from these sites or, more likely, dumped indiscriminately into our oceans. When these pseudo-rocks roll on the seafloor they mix with sand, rocks, and other detritus forming a 'plastiglomerate' – another shocking product of the Anthropocene.

As you can probably tell, this book is very close to my heart. While not strictly about palaeontology, the book touches on the subject that palaeo-people think about – how have humans fundamentally altered the rock record and what are the markers of the start of the Anthropocene? While the advent of farming might be one suggestion, or the detonation of nuclear weapons another, the proliferation and worldwide use of plastic must be a clear contender. Maybe in a few million years' time, when the ice caps re-form, a group of undergraduates will walk along cliffs that have distinct Lego layers in them and the lecturers will describe the environmental conditions at the beginning of the Legocene.

Thomas Clements

Thomas is a 'doctor of decay' and the Palaeontological Association's Reviews Editor. Like Smaug the Dragon, he can be found sitting atop a mountain of plastic bricks but now feels guilty about loving Lego. He can be found on Twitter: `@Thomas_Clements`.

Fossilization: Understanding the Material Nature of Ancient Plants and Animals

Edited by Carole T. Gee, Victoria E. McCoy and P. Martin Sander, 2021, 274 pp., Johns Hopkins University Press, Baltimore, ISBN: 9781421440217.

Fossilization, the process which allows plants and animals to be preserved in the rock record, plays a key role in palaeontological research and thus has been a research topic for centuries. During the past decades, much knowledge has been gained about exceptionally preserved biota due to the study of various Fossil-Lagerstätten throughout the Phanerozoic and around the globe, but compiled overviews about that burning subject remain scarce. Carole T. Gee and her co-editors try to fill that gap with *Fossilization*.

The book is the outcome of a research project about "The Limits of the Fossil Record: Analytical and Experimental Approaches to Fossilization", sponsored by the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG). It contains ten chapters written by 16 international contributors, mostly from

the Institute of Geosciences at the University of Bonn, Germany. The printed hardcover version of this book is appealing, with a dust cover containing representative images. It is well printed and illustrated with black-and-white figures and plates in the text, the plates also collected on high-glossy paper in the middle of the book. Individual chapters contain an abstract and conclusions that bring their essence to the reader, in addition to a very useful section on future perspectives.

In the introductory chapter, Sander and Gee set the scene and explain the importance of the study of fossilization to answer questions of evolutionary biology and its benefit from a tightly integrated approach by applying state-of-the-art analytical tools. Preservation of soft tissues and proteins in tetrapod bones is discussed by Wiersma *et al.* in chapter 2, with an extension of the probably oldest record of osteocyte-like structures to the early Permian. In chapter 3, Yang and Canoville present reproduction-related hard and soft tissues and structures in non-avian dinosaurs and birds, which contributes to a better understanding of their evolution of reproduction. Raman spectroscopy is key to several studies presented in this volume, and Geisler and Menneken dedicate chapter 4 to it, with emphasis on a Devonian acanthodian fish spine. In chapter 5, the value of amber for soft tissue preservation and as source for biomolecules of arthropods and their different taphonomic pathways is reviewed by Barthel *et al.*.

In chapter 6, Gee and Liesegang present experimental silicification of wood in the lab and the field, an important process in the preservation of internal tissues in fossil wood. Chapter 7 continues with the structure and chemistry of silica in mineralized wood, where Liesegang *et al.* elucidate the complex mineralization process that leads to the preservation of delicate cellular details, based on various characterization methods. Plant-insect interactions are recorded by four major expansions of arthropod herbivory, and in chapter 8, McCoy *et al.* examine the fossil record of plant defences against insect herbivory during these expansions, showing increased abundance and diversity through time. In chapter 9, Gee and McCoy review colour in living and fossil plants and summarize what is known about biological pigments in the palaeobotanical record. In chapter 10, McCoy concludes about the future of fossilization, stressing the long history of its study, with key aspects of taphonomic research on living (or recently dead) organisms, controlled laboratory experiments, as well as modern analytical methods.

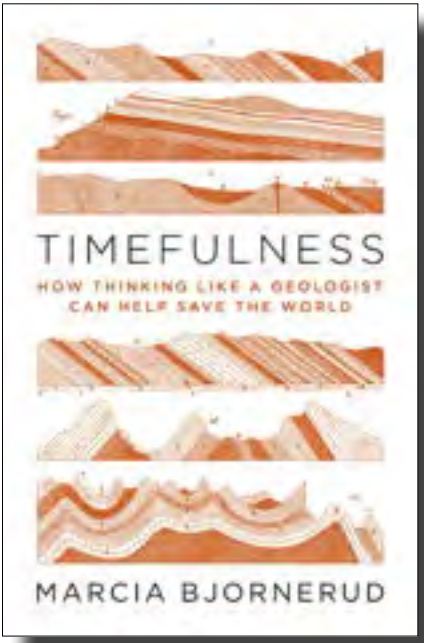
In summary, this book provides an excellent overview of the state of the art of fossilization from a modern perspective and from the viewpoint of a large international and interdisciplinary research group. The selection of presented fossilized plants and animals is somewhat biased towards plants (four chapters) and vertebrates (three chapters), whereas the wide field of invertebrate fossilization (and references thereof) largely remains neglected, apart from arthropod inclusions in amber (one chapter). This fact is also reflected in the cited references of the rather general chapters 1 and 10. Cutting-edge research based on innovative analytical methods is the central theme of this well-edited book, which will make it a standard reference for future work in experimental palaeontology and the understanding of fossilization processes.

Dirk Knaust

Dirk is an ichnologist, palaeontologist and sedimentologist based in Stavanger, Norway. He is author of the "Atlas of Trace Fossils in Well Core" (Springer, 2017) and co-editor of "Trace Fossils as Indicators of Sedimentary Environments" (Elsevier, 2012).

Timefulness: How thinking like a geologist can help save the world

Marcia Bjornerud, 2018, 224 pp, Princeton University Press,
ISBN: 9780691181202



Professor Marcia Bjornerud's *Timefulness* provides a whistle-stop tour of time through the eyes of a geologist. This book attempts to put the vast span of Earth into context relative to our brief, but highly consequential time on this planet – and I believe it succeeds in doing so. While one might want to practise mindfulness in their everyday life, Bjornerud argues that only through 'timefulness' can we truly contextualise humanity's impact on Earth, providing the much-needed temporal perspective to achieve a more sustainable future.

Timefulness consists of six chapters covering a range of themes, discoveries and practices in geology, from the extinction of the non-avian dinosaurs to the use of oxygen isotopes to reconstruct past climates. While the book introduces the reader to advanced themes and concepts, Bjornerud has a real talent for making even the most complicated subject matters digestible for the lay reader. Throughout the book, hand-drawn illustrations (by the talented Haley Hagerman) litter the pages, bringing various concepts and processes to life. Each chapter is filled with personal anecdotes that deliver a very human quality to the book. You can almost imagine being down the local pub with your friends recounting old stories. Bjornerud also manages to interweave various relevant reflections on human history and current affairs, addressing issues such as Young-Earth creationism, as well as the influence of democratic election cycles on the short-sightedness of governments. A good case is also made for the introduction of a Nobel Prize for the field of geology, which does leave the reader asking … why not?

While much of the book is dedicated to briefly introducing various relevant discoveries, Bjornerud hits home in the final chapters of *Timefulness* with discussions on the Anthropocene, and the current state of the Earth relative to its geological history. Current rates of erosion, extinction, sea-level rise, and atmospheric carbon dioxide levels are all examined, painting the awfully grim impact humanity has had (and is having) on this planet we like to call home. Although I would have loved to have heard more from the palaeontological perspective, this does not take away from Bjornerud providing some convincing arguments for why "thinking like a geologist can help save the world". In particular, Bjornerud highlights how problematic the apparent technological solutions to anthropogenic global warming (carbon capture and storage and geo-engineering) are.

Overall, I found *Timefulness* to be a relatively easy read and believe it would be accessible to a wide audience. Researchers usually struggle to find the time to read popular science books (amongst

the hundreds of scientific papers we all have saved on our desktop/stacked on our desks waiting to be read), so I found the brevity of *Timefulness* a welcome change from some other popular science books I have read in recent years.

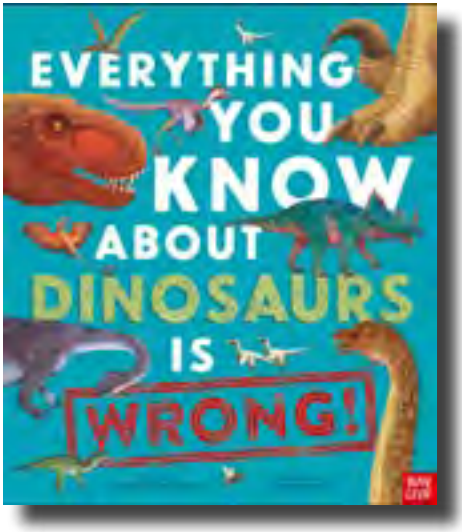
So… to get to the point, would I recommend it? Yes, absolutely.

Lewis A. Jones

Lewis Jones is a palaeobiologist at the Universidade de Vigo, Spain. He enjoys listening to Slipknot and Vanessa Carlton, which makes for an interesting transition on his Spotify playlists. He can be found on Twitter: `@LewisAlanJones`.

Everything You Know About Dinosaurs is Wrong!

Nick Crumpton, Gavin Scott, 2021, 64pp., Nosy Crow, ISBN 978178800810.



There are already enough kids' books about dinosaurs… WRONG!

As a palaeontologist, it will come as no surprise that the bookshelves of my children are already well stocked with books about prehistoric creatures, some in various dubious poses that reflect the vintage of the illustrations. The thought of adding another may fill you with dread, but when it comes to *Everything You Know About Dinosaurs is Wrong!* there's definitely room for one more.

The *Everything You Know About…* series of myth-busting books from Nosy Crow are as fun to read aloud as they are engaging to the reader (who doesn't love the opportunity to shout 'WRONG!' in their parent's face?), and I wager that even the most experienced dino-buffs will find something new or surprising in this book. The range of topics covered goes from the more well-worn dinosaur tropes right up to cutting edge research on phylogenetics, biomechanics and macroevolution to name a few. There are even several pages dedicated to the science of how we go about studying fossils, what techniques are in the modern palaeontologist's quiver, and best of all who is doing the research. 'Dinosaurs are just for boys…WRONG!' should perhaps be on every undergraduate reading list.

Nick Crumpton's prose is refreshingly honest, and perfectly strikes the balance between readability and scientific accuracy that is so often the Achilles heel of books for children. The clarity and warmth of his voice are evident on every page. Gavin Scott's illustrations bring the host of characters vividly to life, and not just all-too-familiar critters like *T. rex* and *Diplodocus* but the full gamut of recently described and exotic taxa from around the globe. I suspect there's also quite a few dinosaur workers who have borrowed their portrait from the fantastic gallery towards the back

of the book, full of personality and charm.

But, you don't want to know what *I* think about it – two much more discerning critics are my kids:

Simeon, aged 7, "I really liked that is showed dinosaurs are not just for boys, girls can love dinosaurs too. I liked it when it talked about the mistakes palaeontologists make, and especially when it said there might be mistakes in this book!" Top fact – Dinosaurs couldn't really roar.

Helena, aged 9, "I really liked the pictures, they helped me understand it and I learnt a lot." Top fact – *T. rex* couldn't actually outrun you.

In summary, whether you know a palaeontologist of the future who loves dinosaurs, or you are already behind them on the latest research, you should buy this book.

Duncan Murdock, aged 36 and a half
Duncan is a Collections Manager at Oxford University Museum of Natural History, and father of two much more well-informed children. He can be found on twitter `@djemurdock`.

Books available to review

The following books are available to review, and others are in the pipeline. Please contact the Reviews Editor Thomas Clements (e-mail <**bookreview@palass.org**>) if you are interested in reviewing any of these or any other book, video or game of palaeontological interest that you would like to see reviewed.

- *Functional Inference in Paleoanthropology: Theory and Practice*, by David J. Daegling.
- *The cosmic oasis*, by Mark Williams and Jan Zalasiewicz.

Dr Thomas Clements
PalAss Reviews Editor,
c/o Department of Geology
School of Geography, Earth and Environmental Sciences
University of Birmingham
Edgbaston
Birmingham B15 2TT
UK

Careers Q & A

Professional palaeontologists in the wider world

Graham Worton completed his degree in Geological Sciences in 1984 andshortly afterwards became a Fellow of the Geological Society and later a Chartered Geologist. He has worked as a professional geologist in the UK and overseas for the last 38 years, starting in applied environmental geology, before becoming Keeper of Geology at Dudley Museum & Art Gallery in 2000 and leading the successful designation of the Black Country as a UNESCO Global Geopark in 2020. The Black Country's palaeontological assets, geoconservation and geoheritage are of particular interest, as well as engaging local communities and amateur enthusiasts with this.

Photo courtesy of Graham Worton.

1. When you were a child, what did you want to become when you grew up?

I was always fascinated with the natural world and animals in particular. I loved science lessons at school and animals in general. TV brought exciting programmes with people like Sir David Attenborough and Jaques Cousteau so I thought I would like to become a marine biologist or natural scientist of some sort.

2. How did you first get interested in geology, and specifically palaeontology?

I think I was also very interested in geology as a young child. I remember being curious about the pretty stones that you saw everywhere in gravel footpaths and walls where I lived. My first encounter with fossils I think was seeing them in the building stones of our local Dudley Castle which is made of blocks of highly fossiliferous Silurian limestone. These clearly included fossil seashells. That made me very curious, and I remember going to Wrens Nest with a primary school friend to find fossils when I was still very young. From that point on I think I was a geologist at heart and the history of life had a particular meaning for me.

3. Having worked in industry, how did you make the transition to working in a museum?

I think that, coming from a place like the Black Country where the geology and its resources had such an influence on every aspect of the place and its people, I probably always had a foot in both the applied and more academic ends of the subject, so it's always been a bit of a spectrum for me rather than different disciplines.

I trained as a geologist because I was simply fascinated by the subject. That training also included things like the importance of the subject to understanding how the world changes and how the natural systems provide the resources for life. The museum end of things simply preserved the evidence, so they are inextricably linked in my mind.

In the normal course of my duties as an applied geologist I collected specimens and recorded details that were useful for the professional side of my work and that would have enduring scientific value. The question for me then was – what is the best thing to do to preserve and share this when it is scheduled for disposal on the professional side of things?

The answer to that came through working as a volunteer at Dudley Museum. That taught me the holistic importance of preserving both the fossil evidence and its field context, and showed me a process by which those specimens and data could be cared for and shared with others who might be interested or inspired by these amazing things too.

As the years passed, I became more involved with the museum work as a volunteer, doing things such as object interpretation for the public, co-designing and installing exhibitions, helping with rock and fossil events and promotional/educational activities, before I was appointed Keeper of Geology. It's fair to say though, despite being formally outside the museums profession up to that point, it had already been a fascinating16-year journey in which I had always been involved in both the academic and practical sides of the subject.

4. You were the Lead Officer for the bid to designate the Black Country as a UNESCO Global Geopark – what were the highlights and challenges of the process?

That has been another amazing journey in my career. Becoming a Geopark was all about recognizing the palaeontological, geological and geoheritage assets of the area, encouraging greater interaction with them and preserving them for the future.

From the start of that journey it was about trying to understand all the connections that make this place special then to sensitively use it to build knowledge, respect and pride. Doing that creates a deeper sense of belonging for the community and changes perspectives to create a much more positive, welcoming profile for a place. Geoparks are, by definition, large areas with special geology that influences and shapes everything – the Black Country is certainly that.

It began quietly and slowly with fact finding; just a small team of us looking at what we could do to make a difference. It was clear that ignorance about the place and its extensive amazing geoheritage and greenspaces was fuelling dissatisfaction – we immediately knew how the geology and related cultural and natural heritage could make a massive impact in perception for the whole area. We were formally accepted into the Global Network at the very height of the COVID-19 pandemic lockdown (10th July 2020) and couldn't host any events or celebrations at that time, so it's fair to say it was an eventful journey!

From my perspective, once we understood the process and had self-audited our heritage and processes, the challenges were mainly about the politics and details of formalising a partnership across diverse organizations such as local authorities, national heritage bodies, community groups and charitable trusts. It required refocusing to partnership working on something much bigger and more significant than ever before. That involved a lot of discussions and thinking about workloads, resources and priorities. It takes time and empathy.

The highlights have been plentiful. I have loved seeing the seed of palaeontology and geology become the foundation of a sustainable tourism destination that will grow to provide many more jobs throughout its heritage assets, its infrastructure and supply chains, as well as development of new educational resources.

5. As Keeper of Geology, what does your job involve on a daily basis?

The Keeper of Geology role is, and was from the outset, a slightly wider role than a traditional curator. It focuses on the geological collection, its care (storage, environmental control, cataloguing *etc.*), its display and use in education, training and research. It has strategic strands such as the collections and their future development direction, resourcing and evolving management techniques. The Keeper role also is a subject specialism / expert role and therefore is an important aspect of front-of-house engagement in terms of education and events, and therefore also in wider museum management decisions too. It provides expertise and advice in geological site conservation issues and geotourism initiatives too, so it is never boring!

6. What is the biggest highlight of your work as a palaeontologist/geologist so far?
That's difficult; I have been extraordinarily blessed with amazing moments, surrounded by many wonderful people. Choosing just one highlight is impossible… Of those that spring to mind, the thing I always hold with me and that drives my day-to-day work is witnessing change in people through what we do here. The simple act of placing objects and amazing stories into the public realm (and sometimes directly into the hands of people) and seeing the impact of that inspirational material on the faces of those experiencing it for the first time … that daily highlight always makes me happy.

On a slightly grander scale on that theme, I also love seeing the successes of the young people in the museum's Geoteam, witnessing them grow in confidence and skill is so satisfying. It's like seeing the future of our science evolving before your eyes and growing in good hands – could anything be better!

For museum and palaeontological highlights, there have been some very humbling moments in my career as a Keeper. Being asked to speak in the UK Houses of Parliament about the importance of geology to people (at the launch event for the National Geodiversity Charter). Being asked to contribute (with a colleague from Natural England) a chapter to an international book on geotourism and to contribute a paper in the special edition of the international journal *Geoconservation Research* about the special geology and palaeontology of the Black Country. Being the representative of the Black Country at the Global Geoparks coordinating committees … mind-boggling stuff for a simple Black Country lad.

Also on the museums front, in the early days just being part of the team designing and installing what was to become the award-winning gallery 'The Time Trail' at Dudley was amazing for me. Then in later years being part of the team behind the re-design and interpretation ideas of the Lapworth Museum of Geology – both true celebrations of Earth Science that it has simply been a joy to be part of.

In more specific terms of palaeontology, during my volunteer days finding, recording the stratigraphy of, and accessioning extremely rare fossils like *Trimerus* and *Deiphon* trilobites for the Dudley collection were amazing moments.

People have been ridiculously kind to me over the years and have given me more than my fair share of appreciation and accolade. Because of them I have been given local, regional and national awards for customer care in tourism and even the Halstead Medal of the GA and the Brighton Medal of the GCG – all of which are treasured highlights – and all of which I take as recognition not just of my own efforts and passion for what I do but as recognition of all the people who were involved in making all of these projects possible and so special.

7. What gives you most satisfaction in your work, and what do you not enjoy so much?
This one's a bit easier, sharing 'the wonder of it all' with people gives me the greatest joy and dealing with the bureaucracy and politics that sometimes comes into play I don't enjoy at all!

8. How do you find the process of bridging palaeontology/geology education with the tourism aspect of the Geopark and museum?
I see this as an absolute essential of our work. If people don't see the point in what we do they will not support what we do with resources and opportunity. I see education in natural science as a bit out of balance so 'informal learning' through tourism and leisure is a gift that we can give to redress that balance a bit. Our learning with the collections can be directly related to the local people and where they live too, so hopefully we can embed a deeper connection and better knowledge retention through this.

Within the context of wider geotourism, the geological story of a landscape is largely undiscovered and seen as a challenge to tourism operators. Through the work of the geopark, however, we can break down any fears about complex stories and vocabulary and if we do that well, many future opportunities will emerge with economic models that both promote knowledge of Earth Science but also generate resources for research and training too.

9. Do you have any tips for anyone wishing to transition into museum work or geo-tourism?
It will be no surprise that jobs in museums aren't easy to find and the geotourism sector is only just getting its act together so the future is an undiscovered country to some degree. In either case however, advantages can be gained by learning the ropes as a volunteer like I and so many others have done over the years. So, it's worth doing a bit of volunteering if only to get a sense of the work and see if it's for you.

I would also say that this is a public service sector on the whole, so the thought process is often about what is best for the other person/group/audience, and the desire to help and share is really important. Rewards are not as great in terms of finance as the private sector but it is a soulful sector with different rewards, so think about who you are and what motivates you personally, as this will be important over the lifespan of a career.

In my personal experience then, key attributes for success in this sector are not learned behaviours and procedures so much as what's within and driving the individual. If you love your subject, love to learn new things and have an attention to detail or have been blessed with the confidence to stand in front of people to share what you know, then there are roles across the museums/geotourism spectrum that will provide you with a happy, varied and fulfilled working life – whether that be based out of the public eye on the collections care side or 'in yer face' promoting the collections and heritage – or both like mine has turned out to be.

10. If you could take a workplace habit from one field to the other, what would it be?
Caring about what you do. Also care about the people you serve and what their needs are.

11. Is there a skill you wish you had been taught at University that would be useful in industry? What turned out not to be useful?
I wasn't ready at all for the world of work. I knew how to write essays and show sources of my learning but I couldn't write a succinct report for a client, as most of us will have to do whether for a private client or a council committee.

I had never drafted a specification for a piece of work, compiled a tender document or supervised a drilling team. I had no concept of the rigours of professional curatorial work. I had no knowledge of managing a budget and my styles of communication at that point were quite limited! So a few lectures about generic 'what a client might want and how that all works' would I think be very helpful.

I learned most of these skills painfully on the job, feeling the weight of my mistakes and of the disappointment of those I was working for, in my early career. I would happily spare anyone that kind of learning experience!

12. What are your future ambitions?
I want to see the Black Country UNESCO Global Geopark grow and flourish, our little team grow, be ever more creative and innovative, and the collections be more widely seen as the treasures they are. In particular, I want to expand the petrology of the Black Country collection as a training tool for applied geologists and the microfossils collections to close the gap on our lack of knowledge and coverage of this important aspect of our palaeontology. I also want to witness more young people learning with us and growing in confidence as young Earth and environmental scientists to take forward all of this with skill and enthusiasm.

Dudley Museum & Art Gallery closed in 2016, with some of its collections going to 'Dudley Museum at the Archives':

<**https://www.dudley.gov.uk/things-to-do/museums/dudley-museum-at-the-archives/**>

You can find out about the Black Country Global Geopark at

<**https://blackcountrygeopark.dudley.gov.uk/bcg/**>

Palaeontology

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Regional Correspondents

Hiu Wai Lee

Region: **Hong Kong**; Affiliation: University of Hong Kong
Position: PhD student
Research/job focus: Interested in how the skull evolves and develops in archosaurs, particularly in pseudosuchians.

Miguel Díaz de León

Region: **Mexico**; Affiliation: The National Technological Institute of Mexico
Position: Substitute teacher. Pronoun: He/Him
Research/job focus: Vertebrate paleontology, virtual paleontology

Christina Ozeki

Region: **Japan**; Affiliation: Kyoto University
Position: PhD candidate
Research/job focus: Focuses on the stages of decomposition of large, marine vertebrates through geological time.

Lukáš Laibl

Region: **Czech Republic;** Affiliation: Czech Academy of Sciences, Inst. of Geology
Position: Researcher. Pronouns: he/him
Research/job focus: Focuses on the morphology, evolution, and development of various Paleozoic arthropods.

Devapriya Chattopadhyay

Region: **India**; Affiliation: Indian Institute of Science Education & Research Pune
Position: Associate Professor. Pronouns: she/her
Research/job focus: Understanding how marine mollusks respond to their physical and biological environment in ecological and evolutionary timescales.
(Photo courtesy: Science Media Centre, IISER Pune)

Miky Lova Tantely Ravelson

Region: **Indian Ocean**; Affiliation: ASJA University Antsirabe
Position: Researcher. Pronouns: Mr
Research/job focus: Interest on Sauropod Dinosaur

Jean Vannier

Region: **France**; Affiliation: Université Claude Bernard Lyon 1
Position: Senior Researcher
Research/job focus: Early life, late Precambrian and lower Palaeozoic faunas and marine ecosystems (based of Fossil-Lagerstätten).

Rudy Lerosey Aubril

Region: **USA**; Affiliation: Harvard University
Position: Research Associate
Research/job focus: Cambrian exceptionally preserved biotas

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.

Newsletter copy

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

Deadline for copy for Issue No. 111 is 1st October 2022.

Palaeontological Association on the Internet

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

Advertising in the Newsletter

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

£80 for half a page £150 for a full page

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

Rates for distribution of separate fliers with the Newsletter:

1,200 copies for worldwide distribution	£250
1,000 copies for worldwide distribution exclusive of North America	£200
650 copies for UK circulation only	£150

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

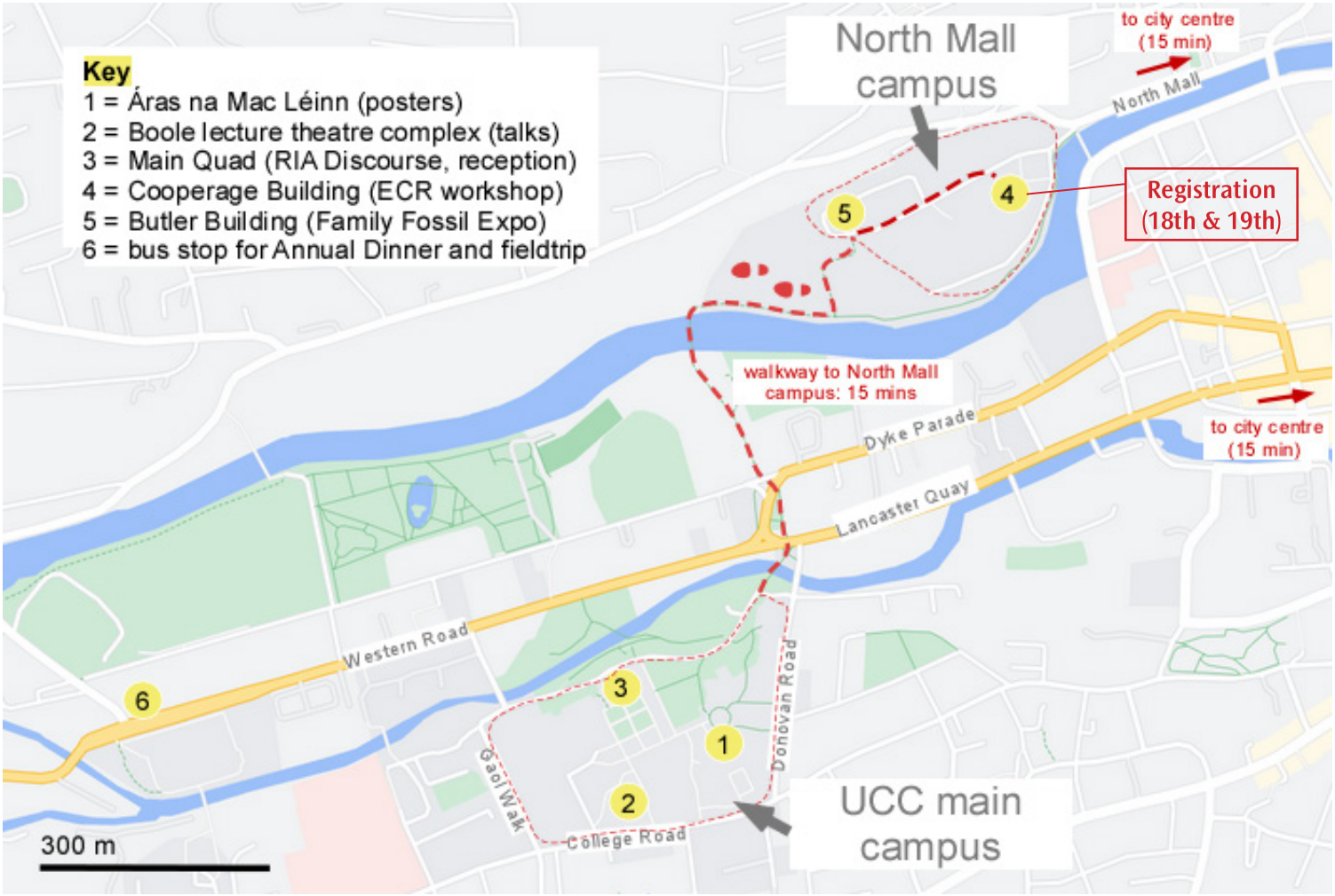
The Palaeontological Association

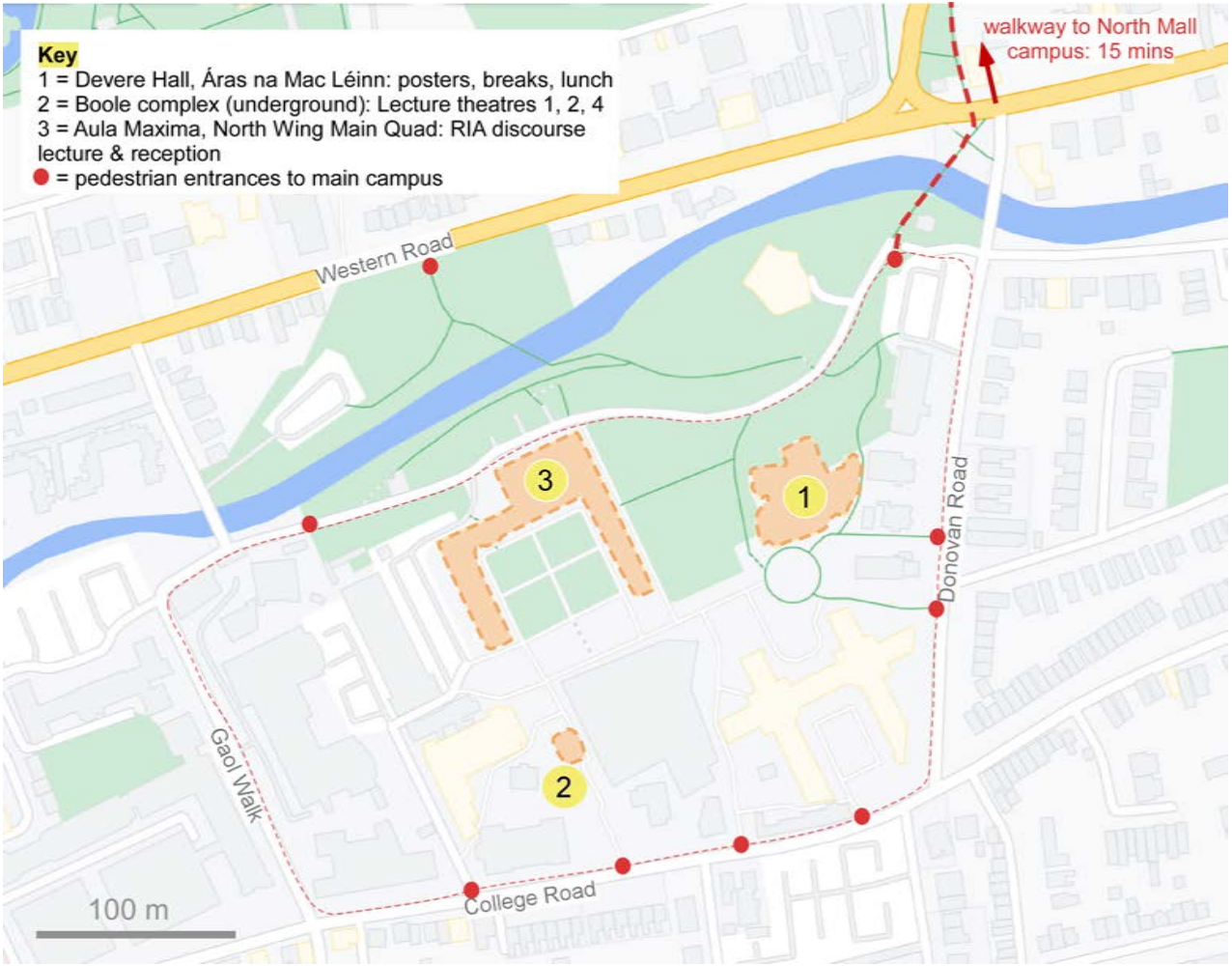
66th Annual Meeting

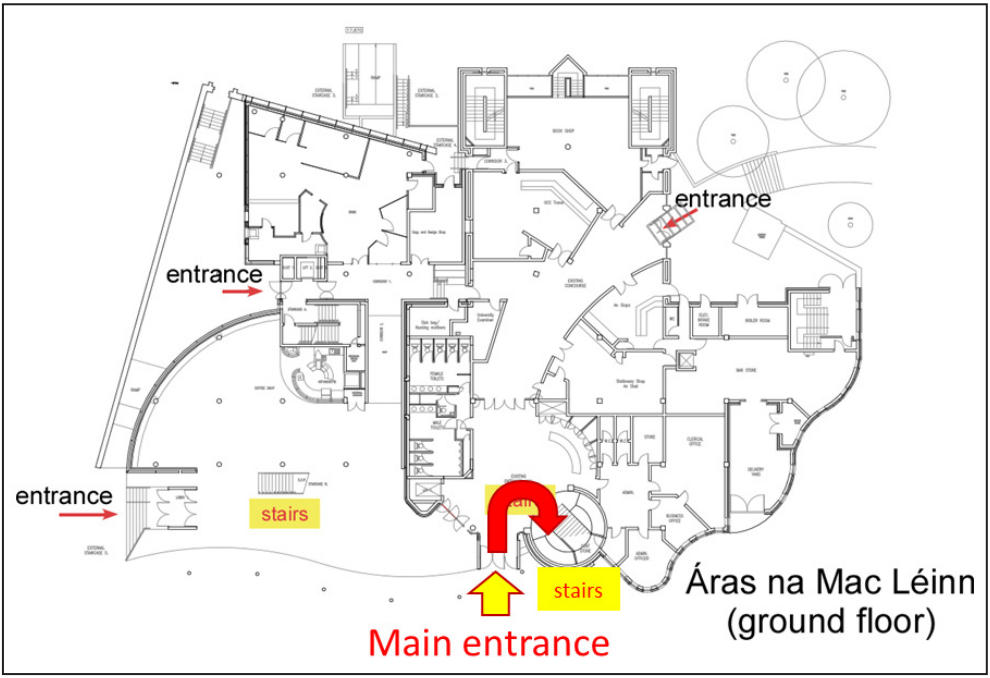
18th–24th July 2022

University College Cork
Ireland

PROGRAMME

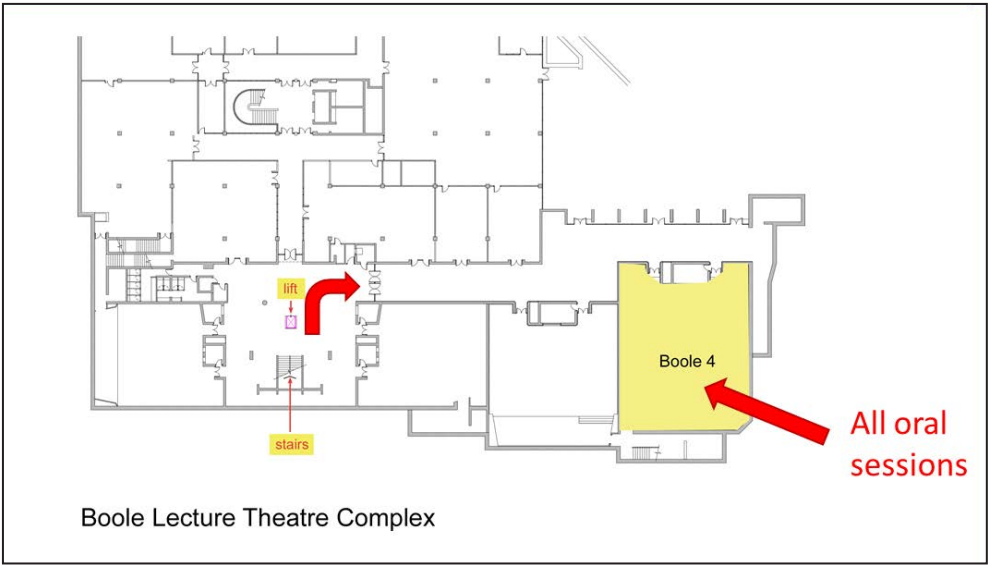

Key
1 = Áras na Mac Léinn (posters)
2 = Boole lecture theatre complex (talks)
3 = Main Quad (RIA Discourse, reception)
4 = Cooperage Building (ECR workshop)
5 = Butler Building (Family Fossil Expo)
6 = bus stop for Annual Dinner and fieldtrip
North Mall campus
to city centre (15 min)
North Mall
Registration (18th & 19th)
walkway to North Mall campus: 15 mins
Dyke Parade
Lancaster Quay
to city centre (15 min)
Western Road
Donovan Road
Gaol Walk
College Road
UCC main campus
300 m


Key
1 = Devere Hall, Áras na Mac Léinn: posters, breaks, lunch
2 = Boole complex (underground): Lecture theatres 1, 2, 4
3 = Aula Maxima, North Wing Main Quad: RIA discourse lecture & reception
= pedestrian entrances to main campus
walkway to North Mall campus: 15 mins
Western Road
Donovan Road
Gaol Walk
College Road
100 m
1
2
3



First floor:
- Registration (20th – 22nd)
- Tea/coffee breaks
- Cafe and bar (lunch collection)

Second floor:
- Workshops
- Private meetings



The Palaeontological Association

66th Annual Meeting
18th–24th July 2022

University College Cork

The programme for the 66th Annual Meeting of the Palaeontological Association is provided after the following summary of the Meeting. An abstract booklet will be distributed at the Meeting.

Venue

The Annual Meeting will take place at various locations at University College Cork. All scientific sessions, workshops, the Symposium and Royal Irish Academy Discourse Lecture will take place on the University's main campus. Of these events, the Royal Irish Academy Discourse Lecture will take place in the Aula Maxima in the Main Quad; all other talks will take place in Boole Lecture Theatre 4, part of the underground Boole theatre complex beneath the Boole Library. The early-career researcher event and Family Fossil Expo will take place on the University's Distillery Fields campus, which is a 15 minute walk along the River Lee walkway from main campus. The early-career researcher event will take place in laboratories G12 and G13 in the Cooperage Building and the Family Fossil Expo will take place in Butler Building room BB1. There are bus stops on Western Road beside main campus that connect with the bus station in the city centre in less than ten minutes. Alternatively, main campus is a 25 minute walk from the bus station and a 35 minute walk from Cork Kent train station. The Distillery Fields campus is a five minute walk from the city centre.

Registration

Registration will be possible on Monday 18th July (14.00 – 19.00) and Tuesday 19th July (08.00 – 17.00) in the 4th year Hub in the Cooperage Building on the Distillery Fields campus. On Wednesday 20th, Thursday 21st, and Friday 22nd July there will be a registration desk in Devere Hall in Áras na Mac Léinn on main campus from 08.00 – 18.00.

Oral presentations

The Symposium speakers have each been allocated 40 minutes (30 minutes plus 10 minutes questions). All other speakers have been allocated either a regular talk slot or a lightning talk slot. The regular talk slots are 15 minutes. It is therefore expected that you prepare to speak for no more than 12 minutes to allow time for questions and switching between presenters. The lightning talk slots are five minutes; you should prepare to speak for no more than four minutes to allow time for a question and switching between presenters. The Meeting does not feature parallel sessions. The Boole 4 lecture theatre has an AV projector linked to a large screen. All presentations should be in PowerPoint or PDF format.

Presentations may be submitted in advance of the meeting to Maria McNamara (e-mail <**annualmeeting2022@palass.org**>). Any presentations not submitted prior to the Meeting must be uploaded to the local system and checked. You can do this at the dedicated presenter station outside the Boole 4 theatre from 08.00 – 18.00 on Wednesday 20th and Thursday 21st July and from 08.00 – 14.00 on Friday 22nd July. This should be done as early as possible, ideally the day before

the allotted presentation slot. The Meeting organizers cannot guarantee an opportunity to check the presentation file if uploaded on the same day as the scheduled talk slot.

Poster presentations

Posters will be displayed in Devere Hall on the first floor of Áras na Mac Léinn. Poster boards will accommodate an A0-sized poster presented in portrait format only. Materials to affix your poster to the boards (e.g. pins, Velcro) will be available in the Hall. Posters should be mounted between 08.00 and 18.00 on Wednesday 20th July or first thing on the morning of Thursday 21st July (between 08.00 and 08.45).

Travel grants to student members

Students who have been awarded a PalAss travel grant should see the Executive Officer, Dr Jo Hellawell, at the Association's stand to receive their reimbursement.

Childcare

There are baby changing facilities on campus, and a nursing room can be made available as required.

Accessibility

All buildings in the University are accessible via ramps and/or lifts. For assistance during the meeting please speak to volunteers on the registration desk.

Meals

Delegates who have pre-booked lunch on the 20th, 21st and/or 22nd may collect it from the College Bar on the first floor of Áras na Mac Léinn. For delegates who have not pre-booked lunch, options on main campus will be limited as the Meeting will take place outside term time. Options on main campus include the café in the Glucksman Gallery and Starbucks on the ground floor of Áras na Mac Léinn. Options located outside the University include the Natural Foods Bakery in Fitzgerald's Park (a five minute walk), the Green Frog café opposite the eastern gates to main campus, and various options along Western Road and Washington Street (a five to ten minute walk).

Cork

Cork is Ireland's second city and is situated on Ireland's south coast, on the shores of the Atlantic Ocean. The city has been rated as one of the top three "Friendliest Cities in the World" (*Conde Nast Traveller*). The city centre is located on an island in the River Lee, with extensive quays and docks that lead towards Cork Harbour, one of the largest natural harbours in the world. The city was originally a monastic settlement and was expanded by the Vikings from *c.* 915 AD. The city is known as the "Rebel city" (and County Cork as the "Rebel County") because it supported the Yorkist cause in the English Wars of the Roses. Cork is traditionally strongly nationalist, which led to the burning of the city during the War of Independence by the British forces. According to *Lonely Planet*, "everything good about Ireland can be found in Cork": over 1,200 km of coastline, a rich culinary tradition, and a hub for live music, cultural events, history and outdoor activities. We hope that you enjoy your stay.

The organizers of the Annual Meeting gratefully acknowledge the support of the sponsors:

College of Science, Engineering and Food Science, UCC

Cork Convention Bureau

Environmental Research Institute, UCC

Failte Ireland

Geological Society of London

Geological Survey of Ireland

Geological Survey of Northern Ireland

Irish Centre for Research in Applied Geosciences

Irish Geological Association

Institute of Geologists of Ireland

Ireland's Fossil Heritage

JEOL

Lampert

Mason Technology

Niton UK

National Museum of Ireland

Perkin Elmer

Renishaw

Royal Irish Academy

School of Biological, Earth and Environmental Sciences, UCC

The Paleontological Institute

The Royal Society

Wiley

The Palaeontological Association thanks the Organizing Committee:

Chair: Professor Maria E. McNamara

Administrative support lead: Naomi O'Reilly

Committee Hannah Binner, Daniel Falk, Beatriz Carazo del Hoyo, Dan Cirtina, Dr Chris Mays, Aaron Quigley, Dr Chris Rogers, Dr Valentina Rossi, Anna Schoneberger, Tiffany Slater, Dr Zixiao Yang

Summary of Schedule

Monday 18th July:
Family Fossil Expo and Royal Irish Academy Discourse Lecture

Registration will be available from 14.00 – 19.00 in the 4th year Hub in the Cooperage building on Distillery Fields campus.

The Meeting will begin with an interactive public fossil exhibition at the School of Biological, Earth and Environmental Sciences, UCC from 16.00 – 19.00 on 18th July. The exhibition will feature fossil-themed activities and games delivered by staff and students of the School of Biological, Earth and Environmental Sciences at UCC, with contributions from other delegates of the Annual Meeting and representatives of the Palaeontological Association and the Irish Centre for Research in Applied Geosciences.

The exhibition will be followed at 20.00 by a public lecture delivered by Prof. Larisa deSantis of Vanderbilt University, entitled "Decoding the past to conserve our future". This lecture forms part of the Royal Irish Academy Discourse Lecture series (<**https://www.ria.ie/public-engagement/royal-irish-academy-discourse-series**>) and represents the first time that the Discourses are associated with a major scientific meeting.

The Discourses are the oldest and most renowned series of talks in Ireland, with the first Discourse presented in 1786. The RIA Discourses were traditionally the occasions reserved for the most distinguished academics to first present and discuss new work in public, and today aim to bring thought leaders to the Academy to discuss important contemporary issues. Historical Discourses of note include those by Robert Mallet on his pioneering work on earthquakes, and by Sir William Rowan Hamilton on quaternion algebra. Recent speakers include various Nobel Laureates, former president of Ireland Mary McAleese and former Secretary General of the European Commission Catherine Day.

Tuesday 19th July:
Early-career researcher event

Registration will be available from 08.00 – 17.00 in the 4th year Hub in the Cooperage Building on Distillery Fields campus.

The "Career Links workshop" is a dedicated early-career researcher (ECR) event that will run from 09.00 – 17.00 and will focus on networking. The event will provide an opportunity for ECR participants to get to know their peers and senior researchers in their field, and to learn more about career progression options and strategies. The event will also allow senior researchers to make connections with up-and-coming researchers in their field who may become future collaborators and/or members of their research group.

Wednesday 20th July: Workshops, Lab tours, Symposium and Reception

Registration will be available in Devere Hall in Áras na Mac Léinn on main campus from 08.00 – 18.00.

The morning of 20th July features several concurrent workshops on topics that include statistics, public engagement and finding funding. The workshops are led by specialists from different groups, including Transmitting Science, the Irish Centre for Research into Applied Geosciences, Irish Fossil Heritage and the Environmental Research Institute. See below for more details.

Concurrent with the workshops, there will be tours of the palaeobiology/taphonomy and microbeam laboratory facilities at the School of Biological, Earth and Environmental Sciences.

Delegates who have pre-booked lunch may collect it from the College Bar from 12.00 – 13.00, where there is ample seating. You will need to show your lunch ticket.

The scientific part of the Annual Meeting will begin with the Annual Symposium, which will run from 13.00 – 17.45 with the theme "Chemical fossils". Please see below for details of the full schedule, with the list of speakers and talk titles.

Following the Symposium there will be an icebreaker reception from 17.45 to 20.00 in the Aula Maxima, Main Quad on UCC's main campus. You will need to show your reception ticket for entry.

Thursday 21st July: Scientific sessions, Annual Address and Annual Dinner

Registration will be available in Devere Hall in Áras na Mac Léinn on main campus from 08.00 – 18.00.

The scientific sessions will start at 08.45 in Boole Lecture Theatre 4 in the underground Boole lecture theatre complex. Posters will be set up in Devere Hall in Áras na Mac Léinn where lunch and coffee breaks will also be held.

Delegates who have pre-booked lunch may collect it from the College Bar from 13.00 – 14.00, where there is ample seating. You will need to show your lunch ticket.

There will be an extended coffee break in the morning (10.45 – 11.30) and another in the afternoon (15.45 – 16.30); these double up as poster sessions.

The Annual Address will be delivered by Prof. Dani Schmidt from the University of Bristol. The Address will start at 16.30 in Boole Theatre 4 and is titled "What – if anything – can palaeontology contribute to understanding our climate crisis?".

The Annual Dinner will be held at Páirc Uí Chaoimh, Cork's premier stadium for the Irish national sports Gaelic football and hurling. Buses to the venue will leave Western Road beside main campus at 18.30. You will need to show your dinner ticket for entry. The dinner will be preceded by a reception beginning at 19.00 accompanied by live instrumental traditional Irish music and with a live hurling match on the pitch, visible from the venue. The dinner begins at 20.00 and will feature a four-course meal accompanied by drinks (delegates can opt to receive two free alcoholic drinks or up to four non-alcoholic drinks); there will be two open cash bars. The dinner will be followed by a céilí (an energetic dance party with traditional group dances and live band). Buses will bring delegates back to the city centre and Western Road, leaving Páirc Uí Chaoimh at *c*. 23.00, 24.00 and 01.30.

Friday 22nd July: Scientific sessions and prizes

Registration will be available in Devere Hall in Áras na Mac Léinn on main campus from 08.00 – 18.00.

The scientific sessions will start at 09.00 in Boole Lecture Theatre 4 in the underground Boole lecture theatre complex. Posters will be set up in Devere Hall in Áras na Mac Léinn where lunch and coffee breaks will also be held.

Delegates who have pre-booked lunch may collect it from the College Bar from 13.00 – 14.00, where there is ample seating. You will need to show your lunch ticket.

There will be an extended coffee break in the morning (10.45 – 11.30) and another in the afternoon (15.15 – 16.00), which double up as poster sessions.

Talks will end at 17.45, after which time the conference will close with presentations by the organizing committees of upcoming meetings, the award of the President's Prize and the Council Poster Prize, and concluding remarks.

Saturday 23rd July – Sunday 24th July: Conference field-trip

A two-day post-conference field-trip will visit the Carboniferous rocks of North Clare on Ireland's Atlantic seaboard. Delegates will visit several Lower Carboniferous (Viséan) sites in the remarkable Burren region and Upper Carboniferous (Namurian) sites along the coast, including the Cliffs of Moher. The Burren is the largest glaciokarst in Europe and is celebrated for its spectacular scenery but also its unique flora and archaeological heritage. The visually stunning Cliffs of Moher, which rise to over 200 m above sea level, are the longest sea cliffs in Europe and host internationally important seabird colonies. The field-trip will visit various sites of palaeontological and geomorphological interest and will include hikes of up to several hours on uneven terrain.

The trip will depart from Cork at 08.00 on the 23rd, returning *c.* 19.00 on the 24th. The pickup and collection points are the same, on Western Road.

Field-trip leaders: Maria McNamara and Chris Mays.

The Palaeontological Association

Registered Charity Number: 1168330

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 (ProgPal) 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 commonsense 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, in either 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.

Reporting unacceptable behaviour: If you are the subject of unacceptable behaviour or have witnessed any such behaviour, you can report it to us (anonymously if you choose to) via our online reporting form at <**https://www.palass.org/meetings-events/report-meeting-code-conduct-violation**>.

Anyone experiencing or witnessing behaviour that constitutes an immediate or serious threat to public safety, or a criminal act, is expected to contact the appropriate law enforcement agency. Those witnessing a potential criminal act should also take actions necessary to maintain their own personal safety.

Schedule of events and timetable of presentations

Monday 18th July

Registration for the conference available in the 4th year Hub, Cooperage Building, North Mall campus.

Public engagement day

16.00 – 19.00 **Family Fossil Expo** hosted by the Cork palaeobiology group, the Palaeontological Association, iCRAG and others. Delegates are free to visit the expo; pre-registration not necessary.
Room BB1, Butler Building, Distillery Fields campus

20.00 – 21.30 **Royal Irish Academy Discourse Lecture**
Decoding the past to conserve our future
Prof. Larisa DeSantis
Aula Maxima, Main Quad, UCC main campus
Delegates must pre-register as spaces are limited.

Tuesday 19th July

Registration for the conference available in the 4th year Hub, Cooperage Building, North Mall campus.

Early-career researcher (ECR) event: Career Links Workshop

Rooms G12 and G13, Cooperage building, Distillery Fields campus

Delegates must pre-register for the ECR workshop as spaces are limited.

09.00 – 09.30 Registration (participants may register for the full meeting)

09.30 – 10.00 Tea/coffee, scones

10.00 – 10.15 Welcome

10.15 – 10.45 Introductions

10.45 – 12.00 Peer meetup in research zones

12.00 – 12.45 Lunch

12.45 – 13.30 5-min lightning talks by senior researchers on their labs and research

13.30 – 14.30 Meetup with senior researchers in research zones

14.30 – 15.00 Tea/coffee break

15.00 – 16.15 10 min talks on career paths (2 x tenured academics and 2 x PhD graduates now working in non-academic careers)

16.15 – 17.30 Panel discussion on career pathways with all senior researchers present

18.00 – 20.00 Dinner at the nearby Fran Well microbrewery

Wednesday 20th July

Workshops, lab tours, Symposium and Reception

Registration will be available in Devere Hall on the first floor of Áras na Mac Léinn on main campus from 08.00 – 18.00 each day from Wednesday 20th to Friday 22nd July. On Wednesday 20th July, poster setup will be available from 08.00 – 18.00.

Pre-meeting workshops

The workshops will take place in the meeting rooms on the second floor of Áras na Mac Léinn on main campus. Participants must be pre-registered as spaces are limited.

09.00 – 12.00 **Introduction to Statistical Analysis**
Instructor: Soledad De Esteban-Trivigno (Transmitting Science)
Béarra Meeting Room

09.00 – 12.00 **Getting Funded**
Instructor: Sonia Monteiro (Environmental Research Institute, UCC)
Dúthalla Meeting Room

09.00 – 12.00 **Public engagement**
Instructors: Dr Jess Franklin (Ireland's Fossil Heritage, UCC) and Elspeth Sinclair (iCRAG)
Muscraí Meeting Room

09.00 – 12.00 **Bias, discrimination and decolonising palaeontology**
Instructor: Cassius Morrison (UCL & NHM)
Airdmore Meeting Room

Tours of the Cork Palaeobiology laboratories

The laboratory tours each last approximately 1 hr 10 min and will begin at 09.00, 09.25, 09.50, 10.15 and 10.40. Participants must be pre-registered as spaces are limited; participants have been pre-assigned to a specific tour. The meeting point for each tour is underneath the walkway between the Butler Building and Enterprise Centre, Distillery Fields campus.

12.00 – 13.00 Lunch. Pre-booked lunches may be collected from the College Bar on the first floor of Áras na Mac Léinn.

Symposium: "Chemical fossils"

Boole Lecture Theatre 4, Boole Theatre Complex, main campus.

12.50 – 13.00 Welcome address

13.00 – 13.40 **Ocean deoxygenation and acidification at the end-Triassic extinction the one-two punch of elevated CO_2**
Jessica H. Whiteside

13.40 – 14.20 **Braving the elements: taphonomic and diagenetic pathways to protein preservation**
Paul V. Ullmann

14.20 – 15.00 **Illuminating the 3D ultrastructure and chemical composition of the earliest plants and fungi**
Christine Strullu-Derrien

15.00 – 15.45 Tea/coffee break (Devere Hall, Áras na Mac Léinn)

15.45 – 16.25 **Biomolecular and structural analyses of fossil plants – tools for tracing survival strategies during mass extinctions**
Vivi Vajda

16.25– 17.05 **Authenticating ancient proteins: exploring the phylogenetic potential of proteins and measures of their endogeneity**
Michael Buckley

17.05 – 17.45 **Chemical investigations resolve enigmatic features within Burgess Shale-type fossils**
Farid Saleh

Reception

17.45 – 20.00 Aula Maxima, Main Quad

Thursday 21st July

Scientific sessions, Annual Address and Annual Dinner

Underlined author denotes designated speaker.
* Candidates for the President's Prize are marked with an asterisk.
† Lightning talks are marked with a dagger.

08.00 – 08.45 Poster set-up in Devere Hall on the first floor of Áras na Mac Léinn

All talks will take place in Boole Lecture Theatre 4, Boole Theatre Complex, main campus.

Session 1
Chair: Orla Bath-Enright

09.00 – 09.15 **Pterosaur take-off: estimating launch capabilities in one of the largest flying animals**
*Benjamin Griffin, Elizabeth G. Martin-Silverstone, Rodrigo V. Pêgas, Oliver E. Demuth, Erik Meilak, Colin Palmer and Emily J. Rayfield

09.15 – 09.30 **How to become a crab: phenotypic constraints on a recurring body plan**
Joanna M. Wolfe, Joy C. Julius, Lauren Ballou, Javier Luque, Victoria M. Watson-Zink, Jonas Keiler *et al.*

09.30 – 09.35 **The oldest hurdiid radiodont in China known from complete specimens †**
Dongjing Fu, Allison C. Daley, Melanie J. Hopkins, Xiaoya Ma, Orla G. Bath Enright, Harriet B. Drage *et al.*

09.35 – 09.40 **A novel interpretation of the Ediacaran rangeomorph *Culmofrons plumosa* as a reclining organism †**
*Giovanni Pasinetti and Duncan McIlroy

09.40 – 09.45 **Why the eyes of phacopid trilobites look the way they do †**
Brigitte Schoenemann and Euan N. K. Clarkson

09.45 – 10.00 **Convergent evolution of raptorality in Telluraves**
*Brigit Tronrud

10.00 – 10.15 **Multiple increases in atmospheric oxygen and marine productivity through the Neoproterozoic and Palaeozoic**
*Richard G. Stockey, Devon B. Cole, Una C. Farrell, SGP Trace Metal Working Group, Noah J. Planavsky and Erik A. Sperling

10.15 – 10.30 **The origin of panarthropod legs**
*Alavya Dhungana and Martin R. Smith

10.30 – 10.35 **A brief history of the "Age of Barnacles" †**
Andrew Gale

10.35 – 10.40 **Stratigraphic completeness in phyletic evolution: insights from astronomically paced carbonate platform successions †**
Emilia Jarochowska, Niklas Hohmann, David De Vleeschouwer, Rachel C. M. Warnock, Joël Koelewijn and Peter Burgess

10.40 – 10.45 **Current issues with conodont tissues: using multi-analytical methods to unravel the conodont conundrum †**
*Bryan Shirley and Emilia Jarochowska

10.45 – 11.30 **Tea/coffee break and posters**
Devere Hall, Áras na Mac Léinn

Session 2
Chair: Pierre Gueriau

11.30 – 11.45 **Climatic drivers of pterosaur origins**
Emma M. Dunne, Alexander Farnsworth, Richard J. Butler, Sterling Nesbitt, Nicholas C. Fraser, Stephen L. Brusatte *et al.*

11.45 – 12.00 **Cambrian bivalved arthropods revisited: evolution and ecology of a disparate group**
*Alejandro Izquierdo Lopez and Jean-Bernard Caron

12.00 – 12.05 **Documenting diagenetic alteration of an aragonitic Miocene giant clam (*Tridacna* sp.) with implications for strontium isotope stratigraphy (SIS) †**
*Max Fursman, Viola Warter, Linda Marko, David Evans, Willem Renema, Dominik C. Hezel and Wolfgang Müller

12.05 – 12.10 **How to build a Lagerstätte: new taphonomic and sedimentological insights into the preservation of exceptional Ediacaran fossils at Spaniard's Bay, Newfoundland †**
*Christopher McKean, Rod S. Taylor and Duncan McIlroy

12.10 – 12.15 **Uncovering the true diversity of the Wealden iguanodontians †**
*Joseph A. Bonsor, Susannah C. R. Maidment and Paul M. Barrett

12.15 – 12.30 **Examining the morphological response of marine calcifying taxa to extreme environmental change during the Cretaceous-Paleogene mass extinction in Southern Ocean shelf, open-ocean, and deep-sea ecosystems**
James D. Witts, Heather Birch, Amy Flower, Calum MacFie and Daniela N. Schmidt

12.30 – 12.45 **Were there multiple bursts in the early evolution of Ichthyosauromorpha?**
Benjamin C. Moon

12.45 – 12.50 **Anatomy and phylogeny of the first macraucheniid (Mammalia: Litopterna) from the Neogene Bahía Inglesa Formation (late Miocene), Atacama Region, Northern Chile †**
*Hans P. Püschel, Jhonatan Alarcón-Muñoz, Sergio Soto-Acuña, Raúl Ugalde, Sarah L. Shelley and Stephen L. Brusatte

12.50 – 12.55 **Cabinet of curiosity: a fungal community in Late Devonian *Callixylon newberryi* wood from the University College Dublin historical slide collection †**
Carla Harper, Anne-Laure Decombeix, Thibault Durieux and Michael Krings

12.55 – 13.00 **Description of *Helmetia expansa* and phylogenetic analyses of concilitergans †**
*Sarah R. Losso, Jean-Bernard Caron and Javier Ortega-Hernández

13.00 – 14.00 **Lunch**
Devere Hall, Áras na Mac Léinn

Session 3
Chair: Ross Anderson

14.00 – 14.15 **DeepDive: deep learning estimation of palaeodiversity from fossil data**
*Rebecca Cooper and Daniele Silvestro

14.15 – 14.30 **Reviving vetulicolians: a "lost chapter" in chordate history?**
*Giovanni Mussini, Frances S. Dunn and M. Paul Smith

14.30 – 14.35 **The Las Hoyas (Serrania de Cuenca, Spain) fossil biases reveal a constantly changing ecosystem during the Barremian †**
Hugo Martin-Abad, Candela Blanco-Moreno, Paloma Alcorlo, Zain Belaústegui, Miguel Ángel Rodríguez-Pascua, José Francisco Mediato Arribas and Ángela D. Buscalioni

14.35 – 14.40 **A 300 million year record of ecosystem change – what conodonts can tell us †**
*Christopher Stockey, Philip C. J. Donoghue, Duncan J. E. Murdock and Mark A. Purnell

14.40 – 14.45 **Terrestrial vertebrates from Triassic caves of south-west Britain: older than we thought †**
Michael J. Simms and Kerstin Drost

14.45 – 15.00 **Palaeontological heritage as a powerful resource to promote the understanding of ecology and evolution concepts at schools in a project based learning initiative**
Lara de la Cita García and Ángela D. Buscalioni

15.00 – 15.15 **Increasing the equitability of data citation in palaeontology: a view to the future**
Jansen Smith, Nussaïbah B. Raja, Danijela Dimitrijević, Emma M. Dunne, Laura P. A. Mulvey, Paulina Nätscher *et al.*

15.15 – 15.30 **Disentangling phylogenetic and ecomorphological signal in 2D skull shape in the radiation of archosaurs**
Roland Sookias, Nicole Grunstra, Anne Le Maître and Christian Foth

15.30 – 15.35 **Insect decline in the last 100 million years investigated with quantitative morphology: the example of lacewing larvae †**
Carolin Haug and Joachim T. Haug

15.35 – 15.40 **Gondwanan araucariaceous genus related to *Wollemia* was restricted to the southern high latitudes †**
*Miriam A. Slodownik and Robert S. Hill

15.40 – 16.30 **Tea/coffee break and posters**
Devere Hall, Áras na Mac Léinn

Annual Address

Boole Lecture Theatre 4

16.30 – 17.30 **What – if anything – can palaeontology contribute to understanding our climate crisis?**
Daniela N. Schmidt

Reception & Annual Dinner

Páirc Uí Chaoimh stadium

18.30 Transport from Western Road, beside UCC main campus

19.00 – 20.00 **Reception**

20.00 – 01.30 **Annual Dinner followed by céilí**

Friday 22nd July

Scientific sessions

All talks will take place in Boole Lecture Theatre 4, Boole Theatre Complex, main campus.

Session 4
Chair: Emily Mitchell

09.00 – 09.15 **Fossilized soft tissues from the Colli Albani: a new mode of preservation for feathers**
Valentina Rossi, Dawid Iurino, Edoardo Terranova and Raffaele Sardella

09.15 – 09.30 **A Cambrian tommotiid preserving soft tissues reveals the metameric ancestry of lophophorates**
Jin Guo, Luke A. Parry, Jakob Vinther, Gregory D. Edgecombe, Fan Wei, Jun Zhao *et al.*

09.30 – 09.45 **Revising taxonomy using a collaborative tool (Xper3) with an example from Early Triassic conodonts**
Lilian Lacome, Samuel Ginot and Pauline Guenser

09.45 – 10.00 **A biogeographic theory of thermal habitat loss during global temperature change**
Adam Tibor Kocsis, Erin E. Saupe and Carl J. Reddin

10.00 – 10.15 **Estimating bite force in extinct dinosaurs using phylogenetically predicted physiological cross-sectional areas**
Manabu Sakamoto

10.15 – 10.30 **Rangeomorph orientations with independent current indicators demonstrate the reclining rheotropic mode of life of the Ediacaran rangeomorph taxa *Fractofusus misrai*, *Bradgatia* sp. and *Pectinifrons abyssalis***
*Daniel Pérez Pinedo, Jenna M. Neville, Giovanni Pasinetti, Christopher McKean, Rod S. Taylor and Duncan McIlroy

10.30 – 10.35 **Floral diversity, disparity and turnover at the Siluro–Devonian boundary: palynological evidence from the Anglo-Welsh Basin, UK †**
Alexander C. Ball, Charles H. Wellman, John B. Richardson, Stephen Stukins and Paul Kenrick

10.35 – 10.40 **Variscan deformation: the driving force in bone alteration of the Jarrow tetrapods †**
Aodhán Ó Gogáin, Gary O'Sullivan, Thomas Clements, Brendan Hoare, John Murray and Patrick N. Wyse Jackson

10.40 – 10.45 **An exceptional Jurassic fern with biotic interactions from southern Sweden †**
Stephen McLoughlin

10.45 – 11.30 **Tea/coffee break and posters**
Devere Hall, Áras na Mac Léinn

Session 5
Chair: Thomas Harvey

11.30 – 11.45 **Assessing skull function in tyrannosauroids using 3D finite element analysis**
*Andre Rowe, Emily J. Rayfield, Michael J. Benton and Thomas E. Williamson

11.45 – 12.00 **Evolutionary innovation and competitive replacement drove the rise of modern coral reefs**
*Joseph Flannery Sutherland, Alexander Farnsworth and Michael J. Benton

12.00 – 12.05 **Study of decay in the branchiopod crustacean *Triops* in sediment using micro computed tomography †**
*Madeleine Waskom, Sarah R. Losso and Javier Ortega-Hernández

12.05 – 12.10 **Palaeobiology's next top model: combining evidence from morphology and stratigraphy †**
*Laura Mulvey, Imran A. Rahman and Rachel C.M. Warnock

12.10 – 12.15 **Untangling the web of arachnid systematics: using confocal microscopy to image Devonian trigonotarbids †**
*Emma Jayne Long, Gregory D. Edgecombe, Xiaoya Ma and Brett Clark

12.15 – 12.30 **True colours: a new model for the taphonomy of melanin chemistry and the identification of phaeomelanin in Miocene and Cretaceous fossils**
***Tiffany Slater,** Shosuke Ito, Kazumasa Wakamatsu, Fucheng Zhang, Peter Sjövall, Martin Jarenmark, Johan Lindgren and Maria E. McNamara

12.30 – 12.45 **Biogeographic observer bias: Devonian Gondwana**
Elizabeth Dowding

12.45 – 12.50 **Comparative taphonomy of anurans from lacustrine-hosted Cenozoic Lagerstätten †**
*Daniel Falk, Oliver Wings and Maria E. McNamara

12.50 – 12.55 **Anatomy and phylogeny of a close relative of the chondrichthyan *Cladoselache* from the Devonian of Morocco †**
Christian Klug, Linda Frey, Michael Coates, Merle Greif, Melina Jobbins, Alexander Pohle, Abdelouahed Lagnaoui, Wahiba Bel Haouz and Michal Ginter

12.55 – 13.00 **Frontal appendages from the Fezouata Biota (Morocco) reveal high diversity and ecological adaptations in radiodonts during the Early Ordovician †**
*Gaëtan Potin, Pénélope Claisse, Pierre Gueriau and Allison C. Daley

13.00 – 14.00 **Lunch**
Devere Hall, Áras na Mac Léinn

Session 6
Chair: Frances Dunn

14.00 – 14.15 **The continental end-Permian extinction event of eastern Gondwana – a song of slime and fire**
Chris Mays, Vivi Vajda, Tracy D. Frank, Christopher R. Fielding, Sam M. Slater and Stephen McLoughlin

14.15 – 14.30 **Taxonomic variation in teleostean fishes from Las Hoyas (Lower Cretaceous) using shape analysis**
Carla San Roman, Hugo Martín-Abad and Jesús Marugán Lobón

14.30 – 14.45 **Does your data collection method matter? Investigating the differences in palaeoecological reconstructions from published and citizen science data**
*Rebecca Walley, Richard J. Twitchett, Jessica H. Whiteside and Stephen Stukins

14.45 – 15.00 **Dental form and function in the early feeding diversification of dinosaurs †**
*Antonio Ballell Mayoral, Michael J. Benton and Emily J. Rayfield

15.00 – 15.05 **Diversity of shield morphologies in crabs of the group Carcinidae – a quantitative approach †**
Florian Braig and Joachim T. Haug

15.05 – 15.10 **Appendicular and axial modular change reveals different routes taken by secondarily aquatic mammals and reptiles †**
*Kiersten Formoso, Graeme T. Lloyd and David J. Bottjer

15.10 – 15.15 **Bryophytes in the fossil record: two examples from non-amber preservational contexts †**
Candela Blanco Moreno, David Horcajada, Hugo Martín-Abad, Ruth A. Stockey, Gar W. Rothwell, Ángela D. Buscalioni and Alexandru M.F. Tomescu

15.15 – 16.00 **Tea/coffee break**
Devere Hall, Áras na Mac Léinn

Session 7
Chair: John Cunningham

16.00 – 16.15 **The role of fossil tips in inferring the tree of life**
Nicolas Mongiardino Koch, Luke A. Parry and Russell J. Garwood

16.15 – 16.30 **Putting your best foot forward: the ecology of early theropod flyers refined by their feet**
Michael Pittman, Phil R. Bell, Case Vincent Miller, Nathan J. Enriquez, Xiaoli Wang, Xiaoting Zheng, Leah R. Tsang, Yuen Ting Tse, Michael Landes and Thomas G. Kaye

16.30 – 16.45 **Thermal structure of Late Pliensbachian assemblages determines their response to Early Toarcian warming pulses**
Carl J. Reddin, Jan Landwehrs, Georg Feulner, Erin E. Saupe, Clemens Ullmann and Martin Aberhan

16.45 – 17.00 **The first Cambrian tunicate from Laurentia reveals the origins of the ascidian body plan**
Karma Nanglu, Rudy Lerosey-Aubril and Javier Ortega-Hernández

17.00 – 17.15 **Associations between trilobite moulting variability and morphometry**
Harriet B. Drage, James D. Holmes, Diego C. García-Bellido and John R. Paterson

17.15 – 17.30 **The Las Hoyas (Serranía de Cuenca, Spain) fossil biases reveal a constantly changing ecosystem during the Barremian**
Carlos Martinez Perez, Gisella Della Costa, Humberto Ferrón, Duncan J. E. Murdock, M. Paul Smith, Guillermo Albanesi and Philip C. J. Donoghue

17.30 – 17.45 **Post-extinction recovery of the Phanerozoic oceans and the rise of biodiversity hotspots**
Michael J. Benton, Pedro Cermeño, Carmen García-Comas, Alexandre Pohl, Simon Williams, Chhaya Chaudhary *et al.*

Closing business

Boole Lecture Theatre 4

17.45 – 18.00 Presentation from the organizing committees of PalAss 2023 (Cambridge).

18.00 Presentation of the President's Prize and the Council Poster Prize followed by closing remarks.

Saturday 23rd July

Post-conference field-trip

Departure time is 08.00 from the bus stop on Western Road, beside UCC's main campus. We expect to arrive back in Cork *ca.* 19.00 on Sunday 24th July.

Field-trip leaders: Maria McNamara and Chris Mays

Abstract of Annual Address

The Annual Address will be given on Thursday 21st July at 16.30.

What – if anything – can palaeontology contribute to understanding our climate crisis

Prof. Daniela N. Schmidt
University of Bristol, UK

The Intergovernmental Panel for Climate Change in the 6th Assessment stated that historical and palaeontological records show that climatic variability has high potential to affect biodiversity and human society and that "… global biodiversity crises [are] often triggered by rapid warming". Often these records of change occur over millennia and are only studied regionally or at limited taxonomic levels in incomplete records. This is raising the question what the contribution of the geological record can be to answering questions on impacts and risks of climate change on natural systems. We draw on the fantastic records in our archives and museums around the world, but these have gaps that are both geographic and temporal. Most recently, the climate crisis is not seen in isolation any more but strongly coupled to the biodiversity crisis. In this presentation I will draw on examples of links between environmental change and biotic response in the fossil record, and highlight the power of our methodologies working with challenging records and our experience in combining climate and biological records. I will argue that, while we cannot say much about the risks of climate change in the coming decades, the fossil record has fundamental contributions to make via the analysis of ecosystem resilience and responses.