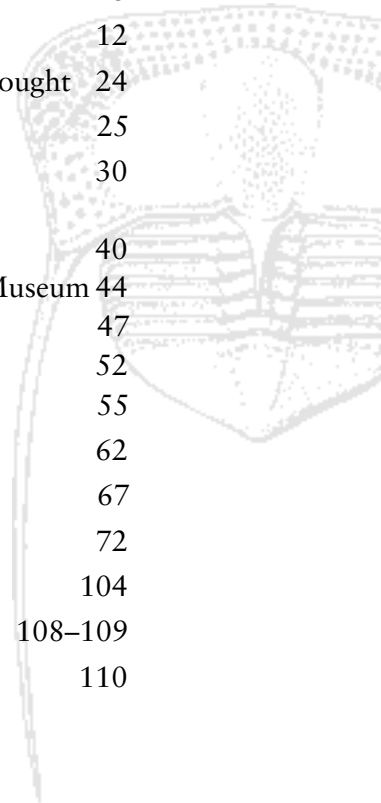


100

The Palaeontology Newsletter

Contents

Editorial	2
Association Business	3
Annual Meeting 2019	3
Awards and Prizes AGM 2018	12
PalAss YouTube Ambassador sought	24
Association Meetings	25
News	30
From our correspondents	
A Palaeontologist Abroad	40
Behind the Scenes: Yorkshire Museum	44
She married a dinosaur	47
Spotlight on Diversity	52
Future meetings of other bodies	55
Meeting Reports	62
Obituary: Ralph E. Chapman	67
Grant Reports	72
Book Reviews	104
<i>Palaeontology</i> vol. 62 parts 1 & 2	108–109
<i>Papers in Palaeontology</i> vol. 5 part 1	110



Reminder: The deadline for copy for Issue no. 101 is 3rd June 2019.

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Editorial

This 100th issue continues to put the “new” in Newsletter. **Jo Hellawell** writes about our new President Charles Wellman, and new Publicity Officer **Susannah Lydon** gives us her first news column. New award winners are announced, including the first ever PalAss Exceptional Lecturer (Stephan Lautenschlager). (Get your bids for Stephan’s services in now; check out pages 34 and 107.) There are also adverts – courtesy of **Lucy McCobb** – looking for the face of the Association’s new YouTube channel as well as a call for postgraduate volunteers to join the Association’s outreach efforts.

But of course palaeontology would not be the same without the old. Behind the Scenes at the Museum returns with **Sarah King’s** piece on The Yorkshire Museum (York, UK). **Norman MacLeod** provides a comprehensive obituary of Ralph Chapman, and this issue’s palaeontologists abroad (**Rebecca Bennion**, **Nicolás Campione** and **Paige dePolo**) give their accounts of life in Belgium, Australia and the UK, respectively.

However, I would most like to direct your attention to the Association’s ongoing diversity efforts. **Jan Zalasiewicz’s** piece highlights some of the issues that women in particular have faced historically, with the stories of Lilian ‘Pixie’ Brown and Jeanne Baret, and, in a new column (Spotlight on Diversity), **Paul Barrett** writes frankly about his own issues with mental health. This latter work was commissioned by our new Diversity Officer, **Rachel Warnock**, and you can expect more in future issues as the Association continues to respond to the Diversity Survey.

Graeme Lloyd

Newsletter Editor

<newsletter@palass.org>

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Association Business

Annual Meeting 2019

Notification of the 2019 Annual Meeting, AGM and Annual Address

The 2019 Annual Meeting of the Palaeontological Association will be held at the University of Valencia, Spain, on 18th to 21st December, organized by Dr Carlos Martínez-Pérez and colleagues.

Nominations for Council

AGM 2019

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

- Vice President
- Editor-in-Chief
- Outreach Officer
- Internet Officer
- Ordinary Members (3 vacancies)

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

All potential Council Members are asked to consider the following:

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

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

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

The nature of these roles is described in the 'job descriptions' over the page.



Council vacancies: 'job descriptions'

Vice-President (two-year term)

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

Editor-in-Chief (five-year term)

Primary roles

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

Secondary roles

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

Approximate time spent: 5-6 hours a week.

Outreach Officer (three-year term)

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



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

Internet Officer (three-year term)

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

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

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

Awards and Prizes

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

Lapworth Medal

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



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

Nominations must be compiled into a PDF file of less than 10 MB and uploaded to the PalAss website. The award will be considered by Council at its May meeting and awardees will be invited to



a ceremony at the Annual Meeting in December. Awards will also be announced in the *Newsletter*, on the Association website and through social media. Council reserves the right to not make an award in any year.

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

President's Medal



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

The candidate must be nominated by at least two members of the Association. Nominations must include a single page that summarizes the candidate's career, further supported by a brief statement from the two nominating members. A list of ten principal publications must accompany the nomination. Letters of support by others may also be submitted. If a candidate has taken time out from their professional career for family and other purposes, this should be highlighted.

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

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

Hodson Award

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

The candidate must be nominated by at least two members of the Association and the application must be supported by an appropriate academic case, namely a single page of details on the candidate's career, a list of principal publications, and a brief statement from each of the two nominees. If a candidate has taken time out from their professional career for family or other purposes, this should be highlighted.

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

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



Mary Anning Award

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

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

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

Gertrude Elles Award

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

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

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

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

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

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



Honorary Life Membership

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

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

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

Annual Meeting President's Prize and Council Poster Prize

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

Best Paper Award

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

Palaeontological Association Undergraduate Prize Scheme

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

Departments may use any criterion for selection, though most prefer to use the scheme as an acknowledgement of best performance in a relevant exam or project. Only one nomination will be accepted from any one institution in each calendar year. The nominee must be an undergraduate



student, not a postgraduate, when they are selected. Normally the award is made to a student in their penultimate year of study, but a final-year candidate may be chosen if this is deemed more appropriate for the department in question.

Contact <executive@palass.org> 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

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

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

Format of the scheme:

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

Eligibility and selection process of the PalAss Exceptional Lecturer:

- Eligible candidates will have a PhD in palaeontology or a related field and will normally be in the early to mid-stage of their career.
- Applicants can reside in any country, but must be members of the Association.



- Candidates must self-nominate.
- To self-nominate, a two-page CV, statement of motivation, and a title and illustrated 200-word abstract of a proposed seminar must be submitted via the Association's webpage as a single PDF file (maximum size 10 MB).
- The PalAss Exceptional Lecturer will be chosen based on the career track record, including research impact (relative to their career stage) and oratorical skills.

Selection of host institutions:

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

Expectations for host institutions:

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

Deadlines each year:

- 1st September: Deadline for nominations for the PalAss Exceptional Lecturer.
- December: The PalAss Exceptional Lecturer announced at the Annual Meeting.
- March: Call for host institutions to participate in the Innovations in Palaeontology Lecture Series 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 (<www.palass.org>). Those with deadlines in the next six months are detailed below.

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

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

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

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

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

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



Engagement Grants

Awards are made to encourage educational outreach, public engagement and related initiatives in palaeontological themes. Normally, the budget for an individual grant would be less than £5,000. However, under exceptional circumstances, a budget of up to £10,000 for an individual application will be considered. Grants can support either stand-alone complete projects, or they can be 'proof of concept' case studies that have their own outcomes but that form the groundwork for a larger bid elsewhere. Proposals must fit with the charitable aims of the Association. Full details of the application terms and conditions are available on the Association website.

The principal applicant must be a member of the Association. Preference will normally be given to candidates who have not previously won an award. Preference is also given to applications for a single purpose (rather than top-ups of grants for existing projects). We particularly encourage applications with an innovative aspect, such as engaging with new media, and especially cases that will disseminate good practice.

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

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

AGM 2018: Awards and Prizes

Lapworth Medal: Professor Derek J. Siveter

Mark Williams and Thijs Vandenbroucke write: Over four decades (since 1977) Derek Siveter has contributed over 100 high-quality research papers, including many published in *Science*, *Nature*, *PNAS*, and the Royal Society journals. His research extends from substantial contributions analysing Cambrian and Silurian ecosystems through the investigation of the Chengjiang and Herefordshire Lagerstätten, to the detailed and systematic documentation of Palaeozoic arthropods, especially trilobites, a group he first began working on in the 1960s. Along his scientific journey, Derek has collaborated with some of the best palaeontologists of his generation, marking him out as a scientist who produces the highest quality work.

An innovative thinker, Derek was amongst the first to investigate the carbon isotope signature of early Palaeozoic rocks, both from the perspective of understanding oceanographic change, and for its practical application to Silurian stratigraphy. He has pressed his mind to elucidating the morphology of some of the most intractable and enigmatic early animals, from Cambrian vetulicolians to Silurian sea spiders. His work has generated considerable new morphological evidence that underpins many of the most recent phylogenetic



Photo: Lucy Evans



analyses of arthropods. And he has been a great publicist of palaeontology through various media, including two well-received books on Chengjiang fossils (for which he was responsible for the magnificent illustrations), and through media as diverse as BBC's *Tomorrow's World*, *The Times* newspaper, and numerous radio interviews. Derek Siveter was also instrumental in seeking and successfully obtaining UNESCO World Heritage status for the Chengjiang biota, and through NERC- and Leverhulme-funded projects has been instrumental in developing the palaeontological significance of the Herefordshire Lagerstätte.

Derek has contributed greatly to the heartbeat of his science over many years. He has served as a Council member and Editor for the Palaeontological Association, and as an Editor for the Geological Society of London. Perhaps most notably, he was a member and subsequently chairman of the British Geological Survey Collections Advisory Committee, where his input was – quite frankly – critical for supporting the full and proper long-term maintenance of that significant palaeontological collection. He has contributed greatly to the development of young people's careers, especially of his PhD and post-doctoral researchers, whose studies now span three decades, on subjects ranging from early (Silurian) foraminifera to the trilobite palaeobiogeography of East Asia. These researchers include those in notable positions, such as palaeontologist Mark Sutton of Imperial College London, and Talia Karim, Collections Manager at the Museum of Natural History, University of Colorado. Even in retirement Derek continues to nurture the careers of young people, serving as a member (and sometime chairman) of the China Oxford Scholarship Fund, and as an Executive Council Member of the Universities' China Committee in London.



Photo: Duncan Murdoch.

Derek was unable to collect his Lapworth Medal in person at the annual meeting in Bristol due to a road accident the week before in China (although Derek Briggs very kindly responded on his behalf). An alternative ceremony was arranged for Derek at Oxford University Museum of Natural History, where he worked for over 25 years and is now an Honorary Associate, and the medal was presented by the Museum's Director, Paul Smith, in his last act as Association President. The event was attended by over 40 colleagues and friends together with three generations of his family members. A significant contingent of Association members went along to the very pleasant event, including Richard Fortey (also a Lapworth medallist), David Siveter and Mark Sutton. After the Museum reception, Derek was guest of honour at a formal dinner in St Cross College, Oxford.



President's Medal: Professor Emily J. Rayfield

Paul Barrett and Zerina Johanson write: We nominated Emily Rayfield for the President's Medal



Photo: Phil Donoghue.

in recognition of her extensive and notable achievements in palaeobiology and her ongoing potential to make major new contributions to the field. Emily is, without question, one of the world's leading biomechanists/palaeobiologists and has made an extraordinarily impressive series of groundbreaking, novel contributions to the subject, many of which are acknowledged as benchmarks. Her expertise ranges widely, encompassing work on extinct and extant organisms, dealing with taxa as diverse as coralline algae, conodonts and dinosaurs, and she has been at the cutting edge of developing and applying new analytical approaches to palaeobiological problems, all with great success. She pioneered the use of finite element models in the subject, a technique that is now applied in many other labs worldwide as a direct result.

Emily established a strong international reputation early in her career and is in great demand as a collaborator and consultant. Her extended research group has grown and prospered, with many of her students and postdocs moving on to influential positions of their own. Indeed, it would be no exaggeration to state that she has established an eponymous school that is intimately associated with her guidance and influence. In addition to her outstanding academic work, Emily is a passionate and exemplary member of the broader palaeontological community in the UK and overseas, helping to mould and shape the future of the subject and to direct its goals. This has been reflected in her appointment to major scientific citizenship roles including the Vice-Presidency of the Palaeontological Association and the Presidency of the Society of Vertebrate Paleontology.

Hodson Award: Dr Xiaoya Ma

David Siveter and Mark Williams write: Xiaoya Ma is an early-career scientist who has made fundamental contributions to the palaeobiology and evolution of Cambrian animals, and has been at the forefront of the new research field of neuropalaeontology. Xiaoya was a zoology undergraduate in the Key Laboratory for Palaeobiology, Yunnan University, and was one of the best zoology students of her year, graduating with a score of 85%. She studied for her MSc in the Yunnan University laboratory of Prof. Hou Xiangang, the discoverer of the Chengjiang Lagerstätte. She took her MSc a year early, gained an impressive mark (91%), and was awarded a 'Best Masters Thesis' and a 'Best Student' award of Yunnan Province. Xiaoya undertook her PhD at the University of Leicester on vermiform animals from the Chengjiang biota, supervised by Professors Dick Aldridge, David Siveter and Derek Siveter (Oxford). She adjusted remarkably well to a new culture. During her PhD she was awarded the Council Poster Prize at the Annual Meeting of the Palaeontological Association.



Following her PhD Xiaoya had a period as an Honorary Researcher at Leicester, when she continued to publish papers based on her PhD studies. In 2011 she secured a named postdoctoral position on a Leverhulme Grant to work at the Natural History Museum, London. This postdoctoral award aimed to elucidate understanding of the central nervous, cardiovascular and associated systems of exceptionally-preserved Cambrian arthropods and to interpret their phylogenetic significance. The PI collaborators on the project were Professors Greg Edgecombe (Natural History Museum, London) and Nick Strausfeld FRS (Department of Neuroscience, University of Arizona). This is pioneering research in a novel field of study – neuropalaeontology. Xiaoya fully seized its potential with the publication of groundbreaking palaeobiological results. Moreover, she ensured that she continued with this type of innovative research: in the face of stiff competition she subsequently secured a prestigious NERC five-year Independent Research Fellowship. Her interdisciplinary research interfaces palaeobiological data and taphonomic studies with fundamental impact on evolutionary models. Xiaoya is an author of many papers in international journals, with most in high-profile outlets including *Nature*, *Current Biology* and *Philosophical Transactions of the Royal Society*. She has made well-received (in many cases invited) presentations at a range of international conferences in the USA, South America, Asia and Europe. Xiaoya is a dedicated researcher with an international profile. She has already, in a relatively short period of time, proffered key insight into our understanding of the relationships and evolution of animals as captured in the ‘Cambrian Explosion’.



Photo: Phil Donoghue.

Mary Anning Award: Nick Chase

Martin Munt writes: Nick Chase started collecting fossils in Swanage and on the Isle of Wight in the 1970s, at a time when collectors were starting a renaissance of interest in British dinosaurs and starting to look to those historically significant locations. Nick's early successes included finds of crocodiles, turtles and pterosaur remains from the Purbeck Limestone. It was, however, his discovery of a near complete *Mantellisaurus atherfieldensis* from Brook on the Isle of Wight that got his skills as a fossil collector noticed. Donated to the Natural History Museum, London, his generosity with his finds has gone unchanged since. Moving to Freshwater on the Isle of Wight, Nick concentrated his collecting efforts on the Compton Bay section of the Lower Cretaceous Wessex Formation (Wealden Group). The source of a number of historical finds, the outcrop of Wealden rocks is, however, quite short in Compton Bay compared to the nearly continuous outcrop along the Island's world-famous south-west coast, and has just three bone-bearing, plant-debris beds. With easy access to the shore, Compton Bay is also the most visited of the dinosaur localities, making it a very challenging location for good finds; additionally so as it is fully exposed to the prevailing south-westerlies that sweep along the English Channel in the winter months.



Nick has had a history of quite remarkable discoveries, many of these featuring in the PalAss field guide *Dinosaurs of the Isle of Wight* and Dean Lomax's book *Dinosaurs of the British Isles*. One of the most striking specimens is the three-dimensional skull, lower jaws, partial skeleton and scutes of a large crocodile *Goniopholis*. Another exceptional find was the near-complete skeleton of a juvenile *Hypsilophodon*, missing just the end of its tail. Nick also found the oldest spider preserved in amber, *Cretamygale chasei*, later described by Paul Seldon in *Palaentology*. In more recent years Nick has made three outstanding discoveries: first, the most complete specimen of the ornithopod dinosaur *Valdosaurus*, described by Paul Barrett; second, the remains of two, or possibly more, inter-mixed sauropods; and third, the most complete specimen of *Mantellisaurus atherfieldensis*.

The Isle of Wight is justly world famous for its dinosaur discoveries; however, both historically and more recently, many important fossil finds soon leave the island, often being sold to major museums. Most of Nick's finds have been generously donated to Dinosaur Isle museum and therefore have remained on the island. Nick's legacy has been his commitment to ensuring that his discoveries have gone into public ownership, enabling our science to progress, as well as securing the Museum's future as a repository of specimens at the richest dinosaur locality in Europe.



Photo: Jeremy Lockwood.



Photo: Martin Munt.

Unfortunately, Nick was unable to attend the Annual Meeting in Bristol, but instead was presented with the award at a small ceremony on the Isle of Wight at Dinosaur Isle. Richard Twitchett, Vice-President of the Association, attended and made the award in front of Nick's family, friends and other invited guests. It was an excellent occasion with refreshments generously provided by the Friends of Dinosaur Isle and the Museum, as well as a small display of photos and press cuttings that showcased Nick's career as a fossil hunter.



Gertrude Elles Award: Emma Dunne and Dr Ross Barnett



Photo: Thomas Clements.

The inaugural Gertrude Elles Award was presented to Emma Dunne and Ross Barnett in recognition of their high-quality public engagement with The Brilliant Club's Scholars Programme (see <<https://thebrilliantclub.org/>>). The Brilliant Club is an award-winning university access charity that works with schools and universities in the UK and exists to increase the number of pupils from under-represented backgrounds progressing to highly selective universities. This is achieved via the Scholars Programme, by mobilizing the PhD and postdoc community to share its academic expertise with state schools. Early-career researchers are encouraged to go into local state schools to deliver academically-rigorous programmes to small groups of pupils who have shown potential.

For the past three years Emma Dunne, a PhD student in vertebrate palaeontology, and Ross Barnett, an evolutionary biologist who focuses on ancient DNA, have worked as tutors with the Scholars Programme. Tutors each independently design a course based on their primary research topic, which is then presented in university-style small group tutorials. Emma has designed a Key Stage 3-4 course 'Is Palaeontology Extinct?' and Ross a course entitled 'Pleistocene Park: How to Clone a Mammoth'. There has been increased awareness in recent years of the lack of diversity across the palaeontological community. Through their work with The Brilliant Club, Emma and Ross have been working directly with students from under-represented groups, primarily to raise their aspirations regarding tertiary education, but also to promote the field of palaeontology and present it as a vibrant and exciting field of research open to everyone. Together, Emma and Ross have worked directly with over 250 pupils in 17 primary and secondary schools across the West Midlands, North Yorkshire and County Durham during the past three years. Both are continuing their work as tutors and this term will work with a further 24 pupils.

Best Paper Awards

The Palaeontological Association awards annual prizes to the best papers published in *Palaeontology* and *Papers in Palaeontology*, to recognize and reward excellence in our field of science. Each year the science editors (who have the task of steering papers through the review process) are asked to nominate papers that they feel stand out as being particularly noteworthy and that have scientific breadth and impact. For *Palaeontology* the papers should have a wide impact and shape future research directions, and for *Papers in Palaeontology* novelty, breadth, quality of the description and a clear and robust discussion of why the fauna or flora has wider significance are sought. The nominated papers are then voted on by the Editorial Board. The awards are open to all authors irrespective of age or nationality, and membership of the Association is not required. Frontiers reviews, rapid communications and regular research articles are all eligible. With the journals attracting so many high-quality papers this year competition for the 2018 prize was fierce, making



the choice very difficult for the Editorial Board. The two papers that emerged as winners were as follows:

BENSON, R.B.J., HUNT, G., CARRANO, M.T. and CAMPIONE, N. 2018. Cope's rule and the adaptive landscape of dinosaur body size evolution. *Palaeontology*, **61**(1), 13–48.
<<https://doi.org/10.1111/pala.12329>>

This study focused on patterns of evolutionary rates, directionality and constraint to investigate the evolutionary diversification of dinosaur body mass. Using a large composite phylogenetic tree of dinosaurs and their relatives and applying a non-uniform macroevolutionary model, Benson *et al.* were able to show that the best explanation for the observed pattern was constrained evolution around macroevolutionary 'optima'. This work has great significance for anyone interested in how evolution proceeds, as indicated by the high citation count it has already garnered.

Jl, C. and BUCHER, H. 2018. Anisian (Middle Triassic) ammonoids from British Columbia (Canada): biochronological and palaeobiogeographical implications. *Papers in Palaeontology*, **4**(4), 623–642.
<<https://doi.org/10.1002/spp2.1222>>

This paper describes a new fauna of Triassic ammonoids which leads to a significant refinement in the correlation for North America and the documentation that evolutionary turnover rates of ammonoids did not decrease toward higher latitude. As a result, the authors were able to question the common view that geographically differentiated evolutionary rates originate from the latitudinal gradient of taxonomic richness.

PalAss Exceptional Lecturer

Dr Stephan Lautenschlager was selected as the inaugural PalAss Exceptional Lecturer. He will be presenting the PalAss 'Innovations in Palaeontology' lecture series at institutions that apply to host him over the coming months. As a lecturer in Earth sciences/palaeobiology at the University of Birmingham, Stephan's research focuses on developing new approaches to computational palaeobiology. Stephan is keen to bridge the gap between traditional palaeontological research and modern, state-of-the-art technology, putting him at the forefront of the emerging discipline of 'virtual palaeontology'.

His proposed lecture is entitled 'Palaeontology 2.0 – reconstructing lost worlds using digital visualization and computational analyses'. Stephan will introduce audiences to different methods and approaches in virtual palaeontology and outline specific applications based on case studies, including: i) the use of digital tools to virtually prepare, repair and restore fossils; ii) digital reconstruction of soft-tissue structures (musculature, brain, inner ear) in fossil vertebrates to obtain and infer palaeobiology and palaeo-behaviour; and iii) biomechanical analyses using digital models to investigate functional properties of fossil organisms and address macroevolutionary questions. While these examples largely focus on vertebrate fossils, the potential for wider application to various fossil organisms and related disciplines, including geology and biology, exists and could lead to interdisciplinary and complementary approaches.

Stephan will be available to present this lecture at institutions from September 2019 until May 2020, and institutions wishing to host him should see the Association website for more details.

(See also pages 9 and 107 for further information.)



AGM 2018: Small Grant Awards

The Small Grants awarded by the Association for funding in 2018 include the Sylvester-Bradley, Callomon, Whittington and Stan Wood awards. Council agreed that the following applicants should receive Sylvester-Bradley awards: Alavya Dhungana (£700), Emma J. Long (£1,050), Nicolás Mongiardino Koch (£1,100), Dr Leandro Pérez (£1,490) and Jack Prowting (£1,451.09). The Callomon Award was made to Andres Elgorriaga (£1,300); the Whittington Award to Thomas J. Raven (£1,500); and Stan Wood awards to Ellen J. Coombs (£1,499) and Dr Penélope Cruzado-Caballero (£1,450). Details of the proposed research are given below.

Ecology of Silurian deep-water coral communities

Alavya Dhungana

University of Cambridge

The Kilbride peninsula that straddles the Galway–Mayo border contains exceptionally-preserved deep-water Silurian coral assemblages. Smothered by volcanoclastic debris, this mass mortality event provides an ideal situation to investigate the spatial distribution of the tabulate-dominated diverse coral assemblage. This project will be the first example of spatial point process statistics applied to the corals in the geological record. We will laser-scan the fossiliferous surfaces to ascertain accurate morphological and spatial data for the corals. These data will be quantified and compared to known ecological models, to investigate the distribution, species interaction and growth of the corals. The results of this study will give a detailed statistical insight into palaeo-coral assemblages, and ultimately allow comparison to the ecology of extant counterparts.

Reconstructing the early development of segmented animals in 3D

Emma Long

Durham University

Using micro-CT technology, this project will reconstruct the internal anatomy of annelids and panarthropods in 3D at various stages of their development. These scans will be the first of their kind to document a developmental time series for these animals, showcasing their changing morphologies through time. The first application of this valuable new resource will be to place an extraordinary early Cambrian microfossil in its developmental context. No larger than a grain of rice, this animal was exceptionally preserved in its developmental stages in the phosphatic limestones of China's Chengjiang Formation. The fossil has paired eyes and antenniform appendages, a ventral oral cavity, and numerous stubby 'legs' arranged ventrolaterally along the body. Though at first glance these features may give the organism the appearance of a modern-day velvet worm or caterpillar (the panarthropods), a closer inspection of its internal anatomy has revealed similarities to a different group altogether, the annelids (such as bristle worms). To determine which of these very different and ancient groups the organism belongs to, its morphology and segmental



composition will be compared to that of its proposed descendants using the developmental time series data. This unique fossil will therefore provide a framework for segmental homology, illuminating the mysterious origins of that most remarkable evolutionary innovation, the head.

Merging genomics and phenomics to understand macroevolution: a case study using echinoid body size

Nicolás Mongiardino Koch

Yale University

The field of macroevolution had its origins among palaeontologists concerned with the tempo and mode of phenotypic evolution across geological timescales. Nonetheless, formalization of these concepts into testable hypotheses was largely achieved by neontologists working on phylogenetic comparative methods. Although these two fields developed in isolation initially, the unique precision obtainable through the combination of molecular phylogenies with data from the fossil record rapidly became evident. Echinoids possess several unique features that lend themselves to detailed macroevolutionary studies of phenotypic diversification. They have an impressive fossil record, as well as a relatively complex morphology that allows extinct and extant taxa to be incorporated into well-resolved phylogenetic hypotheses. I will perform phylogenetic inference on the clade using a combination of morphological and transcriptomic data in order to build a new time-calibrated topology. I will then focus on the evolutionary dynamics of body size, a trait of paramount biological significance, using a massive dataset obtained through mining of the taxonomic literature. By employing novel methodologies and building comprehensive datasets this project aims to shed light on the mechanisms behind morphological evolution in an important clade of marine invertebrates.

Oligocene/Miocene Bryozoans from southern South America: a taxonomic and biogeographic perspective

Leandro Pérez

Museo de La Plata

The general aim of this project is to increase the systematic knowledge of the Cenozoic marine bryozoan faunas in the southern tip of South America, contributing to a corrected taxonomic identification of the taxa occurring in the area. The project will be based on the revision of specimens studied by Canu (1904; 1908) from the Oligocene and Miocene, currently housed in the Muséum national d'Histoire naturelle, Paris. Its main aim is focused on establishing the systematic relations of Canu's taxa (~ 60) and thus clarifying the taxonomic status of additional material collected recently in Patagonia. Finally, comparisons will be made with the bryozoan record of the Australasian region in order to establish biogeographic patterns present at that time in the Southern Hemisphere, which will ultimately explain current bryozoan distribution.



Palaeoclimatic variation in the Adriatic Sea during the Late Pleistocene Heinrich Event 1 (18 – 14 Kys BP)

Jack Prowting

University of Portsmouth

This research aims to provide a high-resolution reconstruction of the conditions in core ND14Q from the southern Adriatic Sea, assessing the impacts of Heinrich Event 1 on the geochemistry of the tests of foraminifera during the Late Pleistocene. The methods utilized – $\delta^{14}\text{C}$ dating, $\delta^{18}\text{O}$ and U/Mn ratios – will provide an interpretation of the marine conditions, including temperature and redox conditions, and the effect the input of fresh water from the melting of North Atlantic icebergs had on the thermohaline circulation (THC) of the Adriatic Sea. In order to complete these analyses, it is necessary to visit the Facultad de Ciencias de la Tierra at the University of Barcelona. In addition, benthic foraminifera, one epifaunal and one infaunal species, will be used in geochemical analyses to show the variations in conditions above and below the sediment-water interface. This study therefore provides an insight into the conditions of three different environments. Research such as this could be used in further studies as a model for the freshwater budget of marine systems; with accelerated global climate change and the subsequent melting of the polar ice caps, it will be possible to compare the conditions during Heinrich Event 1 and the present day.

New window on Jurassic Patagonian gymnosperm diversity: the exquisitely preserved “Pomelo” taphoflora of Chubut, Argentina

Andres Elgorriaga

Universidad de Buenos Aires

The Middle Jurassic Cañadón Asfalto Formation, Patagonia, is widely known for its rich diversity of fossil tetrapods. By contrast, little is known about its taphoflora, and any information is primarily based on fragmentary fossil impressions. To overcome this situation, I plan to carry out intensive field-work to document the rich gymnosperm taphoflora of a new locality of the unit named “Pomelo”, which stands out among others of the area because of its preservational quality. Fossil compressions from the Pomelo locality usually show extensive macro-morphological features, with cutinized leaves measuring up to 25 cm, while also preserving sub-micrometric cuticular details. Preliminary studies of this new locality revealed the presence of vegetative and reproductive remains of horsetails, ferns, cycadophytes, seed ferns, ginkgoaleans and at least three lineages of conifers; palynological samples suggest an even greater diversity. Intensive field-work at Pomelo will be followed with thorough systematic studies in order to reconstruct whole plants. Subsequently, these reconstructions will be studied in a phylogenetic context to better understand the evolution and the relationships of gymnosperm lineages in the western part of the Southern Hemisphere, allowing for a better characterization of the Jurassic palaeoenvironments in which the rich tetrapod fauna thrived.



The evolutionary history of North American nodosaurid ankylosaurian dinosaurs

Thomas J. Raven

Natural History Museum, London and University of Brighton

Thyreophora, the armoured dinosaurs, are an iconic group of ornithischian dinosaurs consisting of ankylosaurs and stegosaurs, as well as a paraphyletic assemblage of basal taxa, and are characterized by the famous *Ankylosaurus* and *Stegosaurus*. They are known from all continents from rocks from the earliest Jurassic to the latest Cretaceous and were ubiquitous in terrestrial ecosystems. Despite this, they are surprisingly poorly understood, with most work focusing on the bizarre ornamentation that covers the bodies of these animals and the taxonomy of the clades Stegosauria and Ankylosauridae. The other subclade of ankylosaurs, the Nodosauridae, have been relatively ignored despite an excellent fossil record, and there is much unknown about the taxonomy and phylogeny of this group. This has hindered understanding about the mode and tempo of evolution of the thyreophoran dinosaurs in general, as well as the biogeographic relationships of the ankylosaurs. This project aims to study the collections of natural history institutions in Washington DC, New York, Yale, Chicago, Toronto and Ottawa to unravel the taxonomy and phylogenetic inter-relationships of the nodosaurid ankylosaurian dinosaurs, which can then be used for macroevolutionary studies of the thyreophoran dinosaurs.

Investigating cranial morphology in two geographically distinct groups of Oligocene cetaceans

Ellen J. Coombs

University College London

The cetacean (whale, dolphin, and porpoise) skull has evolved from being adapted to a predominantly terrestrial lifestyle to one that is specialized to a wholly aquatic lifestyle. This is one of the greatest changes open to study in the fossil record. Whales underwent several substantial evolutionary changes during the Oligocene, including the divergence of toothed whales and baleen whales, and the evolution of specializations such as echolocation. During this period, the skull was evolving at a rapid rate. This award will allow me to study the unique whales from the Oligocene of New Zealand and Australia. I will surface-scan skulls to produce a 3D dataset which I will then use to look at shape change and morphology of the skull in this geographic region at this time. I will compare these data with data I have already collected from Oligocene fossils from the USA. This will allow me to look at skull shape to see how, and if, it varies between these two geographically separated groups that inhabited different oceans. The project is particularly important as many of the specimens in Australia and New Zealand have not been digitized before. Further, quantification of the skull in Oligocene whales has not been compared between distinct groups before. This project will be crucial to better understanding whale evolution in different parts of the world. Outcomes will inform studies on cetacean evolution, as well as providing free-access 3D digital scans of specimens for research and public outreach.



Patagonian ornithopod dinosaurs and the conquest of Western Gondwana

Penélope Cruzado-Caballero

Universidad Nacional de Río Negro

The ornithopod dinosaurs from Gondwana remain largely unknown. In recent decades, the Argentinian ornithopod record has been increased with new and diverse bone remains found throughout the Upper Cretaceous. Many of them found in localities around the town of Rincón de los Sauces, Neuquén are postcranial remains, both articulated and disarticulated. Described from these remains is a new taxon, which exhibits affinities with the clade Elasmaria. However, it is necessary to discover cranial remains and more postcranial remains to obtain a robust phylogenetic framework and test the hypothesis of the existence of an endemic clade of South American ornithopods and the possible role of Argentina as a reservoir of basal species. A field campaign is proposed to prospect the area near to Rincón de los Sauces. This project will shed light on the evolutionary and migratory history of this clade on the South American landmass during the Upper Cretaceous.



Become the face of PalAss on YouTube!

In response to feedback, we are extending the deadline for contributions to our new PalAss YouTube channel and clarifying the process of video production.

As part of our response to the results of the 2018 PalAss diversity study, PalAss is developing a YouTube channel in order to reach out to a broader and more diverse audience.

We are launching an open call for contributions to the following series:

- (1) *Flagship topical series.* The first, flagship, series will focus on the evolution of key adaptations, including (but not limited to) eyes, brains, limbs and colour. Each series will feature six 60 second episodes; all episodes in a single series will be presented by the same researcher, designated a **PalAss YouTube Ambassador**. Video filming, editing and production will be done by a professional filming company. The PalAss Public Engagement Group and the video production company will work with the Ambassador on developing the narrative, script and design of the videos. Most of the video footage should be filmed in a single location (*e.g.* a laboratory), but the award includes £500 which the Ambassador can use to cover travel costs *e.g.* to field locations or museum collections. Applications to become the 2019 PalAss YouTube Ambassador should include a brief description of the major elements of your proposal, including a brief overview of the narrative and potential fossils or settings to be featured; a 30 second video; and confirmation that the applicant will be available for 2-3 days during summer or early autumn 2019 for video development and filming. The series will be launched in late 2019.
- (2) *My fossil and me.* A series of short videos (60-90 seconds), each featuring a single presenter with a fossil prop; one video per presenter. Three videos will be released per annum. Applicants will be required to submit a CV and a 20 second video. Successful applicants will be responsible for shooting the footage using *e.g.* a smartphone or digital camera in line with style guidelines provided by the Association. No funding is available for contributors. All submitted videos will be reviewed by PalAss Council.
- (3) *Life as a palaeontologist.* A series of one-off short videos (60-90 seconds) each featuring a single presenter discussing aspects of their job. Three videos will be released per annum. Applicants are required to submit a CV and a 20 second video. Successful applicants will be responsible for shooting the footage using *e.g.* a smartphone or digital camera in line with style guidelines provided by the Association. No funding is available for contributors. All submitted videos will be reviewed by PalAss Council.

Applications for the PalAss YouTube Ambassador scheme and for one-off contributions to the other two series should be submitted on the PalAss website by 23:59BST on 26th April 2019. Applicants will be notified of the outcome of the selection process in mid-May 2019. There will be further calls for contributions, once the channel is up and running.



ASSOCIATION MEETINGS

Code of Conduct for Palaeontological Association Meetings

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

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

Behavioural expectations

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

Digital images and social media

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



63rd Annual Meeting of the Palaeontological Association

University of Valencia, Spain 15 – 21 December 2019

The Annual Meeting of the Palaeontological Association will be held at the University of Valencia, one of the oldest universities in Spain, founded in 1499. The organizing committee is chaired by Dr Carlos Martínez-Pérez, with help from members of the Botany and Geology department at the University of Valencia, as well as collaborators from the University of Alicante and the Spanish Geological Survey.

Outline conference programme

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

Workshops and symposium

The meeting will begin with several workshops during the morning of Wednesday 18th December at the Faculty of Philology. Several workshops supported by specialists from Transmitting Science are planned; these will be on the application of analytical techniques for the study of fossils, the meeting will continue in the afternoon with a symposium focusing on 'Virtual Palaeontology', consisting of six invited talks by recognized international researchers on topics including 3D acquisition techniques, tomography, photogrammetry, morphometrics, computational fluid dynamics, finite element analysis and multi body dynamic techniques.

Conference and Annual Address

The main conference will begin on Thursday 19th December with a full day of talks and posters, followed by the Annual General Meeting and the Annual Address given by Dr Maria McNamara (University College Cork) during the afternoon. At the end of the working day, the Annual Dinner will be held in a village on the outskirts of Valencia, at the nature reserve of La Albufera, with a live 'paella cooking show' and a disco party. Friday 20th December will be a full day of posters and talks in parallel sessions. Talks for both days will be allocated 15 minutes including time for questions.

Field-trips

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

The post-conference field-trip will entail a one-day visit (21st December) to the Miocene of the Province of Alicante, visiting the ichnological record of the Cabo de las Huertas close to Alicante,



the Messinian coral reef of Santa Pola and the unique Palaeontological Museum of the province in Elche. The field-trip will be limited to 45 participants (coach capacity), departing from Valencia and returning there during the late afternoon. The price will include a meal.

Getting to Valencia

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

Valencia is well connected with the rest of Spain and Europe, with its International Airport (VLC), being the destination for several Ryanair and Easyjet flights. From this airport you can easily reach the city centre by taxi or Metro (Lines 3-5). Valencia is also connected by high speed train (AVE) to Madrid, Barcelona and Alicante, and these can easily be reached from most cities in Europe, as well as non-European destinations. AVE trains arrive into Joaquín Sorolla Station, situated a 10-minute walk from the city centre.

Registration and booking

Registration, booking and abstract submission will commence in June 2019. Abstract submission will close in September (date to be confirmed) and abstracts submitted after the closing date will not be considered. Registration after that date will incur an additional administration charge, with the final deadline for registration in November 2019, unless capacity is reached earlier. Registration and bookings will be taken on a strictly first-come, first-served basis. No refunds will be available after the final deadline. Registration, abstract submission, booking and payment (by credit card) will be available online via the Palaeontological Association website (<www.palass.org>) from June 2019.

Accommodation

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

Travel grants to student members

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



The city of Valencia

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



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

We look forward to welcoming you to Valencia in December!



6th – 8th
June

Free registration

Talks, posters,
and social
events

Blender and
Paleobiology
Database workshops

Early career
discussion/advice
session

Abstract submission open now!



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news



The new President of PalAss

Photo courtesy of Charles Wellman.



Our new President is Charles Wellman, Professor of Palaeobiology in the Department of Animal and Plant Sciences at the University of Sheffield. Charles undertook a PhD on early land plant remains from the Lower Old Red Sandstone of Scotland, supervised by Prof. Dianne Edwards FRS (Cardiff University) and Dr John Richardson (Natural History Museum, London). Following postdocs at both institutions and a period of time working for an environmental consultancy, he took a position in Sheffield where he has remained ever since.

Charles has carried out extensive research on the origin and early diversification of land plants, including studies of fossils (dispersed spores and plant megafossils) as well as living material (evo-devo studies of spore wall development and analysis of the effects of UV-B radiation on plant reproductive

structures). More recently his research has extended back in time, to consider what lived on the land prior to plants, and forward in time, to Carboniferous-Jurassic palaeobotany/palynology.

Charles is a past President of the International Federation of Palynological Societies (IFPS), and we warmly welcome him to his new position as President of the Palaeontological Association.

The PalAss Council welcomes new members Thijs Vandenbroucke (Vice-President), Mark Purnell (Editor Trustee) and Susannah Lydon (Publicity Officer). Rachel Warnock, previously an Ordinary Member of Council, steps into the new role of Diversity Officer.

We are very grateful for the time and efforts of departing Council members Paul Smith, Richard Twitchett, Andrew Smith, Liam Herringshaw and Fiona Gill.

Jo Hellawell

Executive Officer

Palaeontology and Papers in Palaeontology in 2018

2018 was a busy year for the PalAss journals, with *Palaeontology* rising for the first time to be leader in its subject area (1st out of 56 in 'Palaeontology': ISI Journal Citation Reports © Ranking 2017) and *Papers in Palaeontology* is now ranked 10th. This resulted in a marked increase in the rate of submissions to both journals and, conjointly, an increase in rejection rates. In 2018, 179 papers were submitted to *Palaeontology* for consideration and only 79 went to review (a rejection rate of over 50 % without review). With such a competitive field of papers to choose from, and so as not to overload the system, the Editorial Board is having to make some tough decisions to ensure only papers of the highest quality and impact get sent for review.



Our papers are also generating a lot more interest, with social media mentions very much above average for journals in our field. While the number of times a paper is cited is a commonly available metric, our publishers also provide us with information on frequency of downloads. The top ten downloaded papers for 2017–2018 are listed below and give a crude idea of what has proved to be a hot topic recently.

First author	Title	DOI	2-year download
PALAEONTOLOGY			
SALLAN, L.	The 'Tully Monster' is not a vertebrate: characters, convergence and taphonomy in Palaeozoic problematic animals	< https://doi.org/10.1111/pala.12282 >	6,604
BENSON, R.B.J.	Cope's rule and the adaptive landscape of dinosaur body size evolution	< https://doi.org/10.1111/pala.12329 >	3,885
HERRERA-FLORES, J.A.	Macroevolutionary patterns in Rhynchocephalia: is the tuatara (<i>Sphenodon punctatus</i>) a living fossil?	< https://doi.org/10.1111/pala.12284 >	3,382
HARPER, D.A.T.	Brachiopods: origin and early history	< https://doi.org/10.1111/pala.12307 >	3,212
HOYAL CUTHILL, J.F.	Cambrian petalonamid <i>Stromatoveris</i> phylogenetically links Ediacaran biota to later animals	< https://doi.org/10.1111/pala.12393 >	2,965
DUNHILL, A.M.	Impact of the Late Triassic mass extinction on functional diversity and composition of marine ecosystems	< https://doi.org/10.1111/pala.12332 >	2,415
O'REILLY, J.E.	Probabilistic methods surpass parsimony when assessing clade support in phylogenetic analyses of discrete morphological data	< https://doi.org/10.1111/pala.12330 >	2,270
SMITHWICK, F.M.	On the purported presence of fossilized collagen fibres in an ichthyosaur and a theropod dinosaur	< https://doi.org/10.1111/pala.12292 >	2,176



PUTTICK, M.N.	Body length of bony fishes was not a selective factor during the biggest mass extinction of all time	< https://doi.org/10.1111/pala.12309 >	1,924
SOUL, L.C.	Bias in phylogenetic measurements of extinction and a case study of end Permian tetrapods	< https://doi.org/10.1111/pala.12274 >	1,782

PAPERS IN PALAEOLOGY

CONG, P.-Y.	New radiodonts with gnathobase like structures from the Cambrian Chengjiang biota and implications for the systematics of Radiodonta	< https://doi.org/10.1002/spp2.1219 >	2,621
SMITHSON, T.R.	A new Mississippian tetrapod from Fife, Scotland, and its environmental context	< https://doi.org/10.1002/spp2.1086 >	1,248
LEUZINGER, L.	A new chondrichthyan fauna from the Late Jurassic of the Swiss Jura (Kimmeridgian) dominated by hybodonts, chimaeroids and guitarfishes	< https://doi.org/10.1002/spp2.1085 >	1,097
FORD, D.P.	A redescription of <i>Orovenator mayorum</i> (Sauropsida, Diapsida) using high resolution μ CT, and the consequences for early amniote phylogeny	< https://doi.org/10.1002/spp2.1236 >	1,051
BUTLER, E.	Postcranial morphology of the Early Triassic epicynodont <i>Galesaurus planiceps</i> (Owen) from the Karoo Basin, South Africa	< https://doi.org/10.1002/spp2.1220 >	873
ZAHER, M.	The Middle Triassic procolophonid <i>Kapes bentoni</i> : computed tomography of the skull and skeleton	< https://doi.org/10.1002/spp2.1232 >	733
DUNN, F.S.	Anatomy of the Ediacaran rangeomorph <i>Charnia masoni</i>	< https://doi.org/10.1002/spp2.1234 >	518



HOLMER, L.E.	Ecology, biofacies, biogeography and systematics of micromorphic lingulate brachiopods from the Ordovician (Darriwilian– Sandbian) of south central China	< https://doi.org/10.1002/spp2.1077 >	481
PEEL, J.S.	The Buen Formation (Cambrian Series 2) biota of North Greenland	< https://doi.org/10.1002/spp2.1112 >	455
DAY, M.O.	A new species of burnetiid (Therapsida, Burnetiamorpha) from the early Wuchiapingian of South Africa and implications for the evolutionary ecology of the family Burnetiidae	< https://doi.org/10.1002/spp2.1114 >	436

Obviously, downloads are to some extent influenced by how long a paper has been around, but the paper by Sallan *et al.* on the nature of the Tully Monster was clearly our most talked about contribution!

Andrew Smith

Editor-in-Chief

Nigel Trewin legacy

The Palaeontological Association has gratefully received a legacy from the estate of the late Professor Nigel Trewin. Nigel was a long-term supporter of the Association who regularly attended Annual Meetings, published numerous papers in our journals and served on Council. An obituary detailing Nigel's remarkable palaeontological career appeared in *Palaeontology Newsletter* number 97 (pages 69–70). It was Nigel's wish that the funds be used to "contribute towards research and publication costs". To this end Nigel's generous donation will be used to supplement our research grants fund. We extend both our sympathies and our thanks to Nigel's family, in particular his wife Margie.

Charles Wellman

President



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Diversity update

In 2017 PalAss commissioned a Diversity Study to gather information about diversity across PalAss membership and palaeontology more broadly. Although we each have perceptions about diversity and opportunities within our field, these perceptions vary because we each experience the workplace and community in different ways, depending on many factors that make us who we are, including gender, race, sexual orientation and socioeconomic background. The study, carried out by Parigen Ltd, aimed at identifying under-represented groups, identifying issues that present barriers to individuals from these groups, and gathering evidence that the PalAss can use in prioritizing and developing initiatives going forward.

Immediate actions from the Diversity Study include the creation of a Diversity Officer role and the formation of a Diversity Group from Council members. These Council members will be responsible for realizing the recommended actions from the Diversity Study. The results of the study are relevant to everyone in palaeontology and the complete report is available online, at <https://www.palass.org/association/diversity-study>. We encourage members to review the study's key findings, and to consider how they might apply in their institutes or classrooms and to other scientific activities. An enormous amount of progress has been made in diversifying STEM subjects over the past 50 years, but educational and career opportunities remain extremely unequal. Maintaining and making further progress requires continually examining available evidence, updating policies, implementing and reviewing the outcomes of different strategies. We look forward to working with our membership and other scientific organizations in creating a diverse and inclusive community for palaeontologists.

Rachel Warnock
Diversity Officer

Innovations in Palaeontology Lecture Series

We are pleased to announce that Dr Stephan Lautenschlager from the University of Birmingham has been appointed as the PalAss Exceptional Lecturer for 2019/20 and we now invite interested institutions to apply to host him via the Association's website. Please provide a timeframe (between September 2019 and May 2020) during which you would like Stephan to give a lecture at your institution. The list of interested institutions will be forwarded to him on 1st May, although any applications from institutions submitted after this date will still be considered depending on the remaining time and budget. The Association will pay for any reasonable travel costs incurred by the Exceptional Lecturer in visiting each of the host institutions (up to a maximum of £500 per lecture). The host institutions are expected to cover costs of accommodation (where necessary) and hospitality.

Please see the website for more details: <https://www.palass.org/awards-grants/awards/innovations-palaeontology-lecture-series-and-palass-exceptional-lecturer>.

Uwe Balthasar
Meetings Coordinator



Outreach volunteer opportunity for postgraduate students

In recent years the Palaeontological Association has had an outreach presence at the Lyme Regis Fossil Festival and the Yorkshire Fossil Festival, where we have delivered activities to primary schools and the general public. We plan to take part again in 2019 and are looking for several new postgraduate volunteers to help. If you would like to take part, please write to us (no more than one A4 page) explaining why you are interested and describe details of your previous outreach experience. Please also state if you have a preference for helping at Lyme Regis (3–5 May 2019) or Yorkshire (13–15 September 2019). We also need a letter of support from your supervisor.

Please send these documents to the Executive Officer (e-mail <executive@palass.org>) by 5th April 2019. Whilst undertaking these outreach activities all travel and living expenses will be covered by the Association.

Lucy McCobb
Outreach Officer

MBE for Bob Davidson

Bob Davidson was awarded an MBE in the 2019 New Year Honours List, in his capacity as Chairman of The Friends of Hugh Miller, and for services to palaeontology in Scotland. Born in Aberdeen, Bob has worked in the oil industry since he was 21 years old. The industry has taken him all over the world to some 19 countries, but an assignment to the Libyan Sahara Desert from 1979 to 1982 changed his life. One of his off-duty pastimes there was to drive out to the wind-blown gravel beds and collect fossil shark teeth, and he soon discovered that there were far more fossils than just shark teeth. He became an avid fossil hunter and his Libyan collection contains fossil crocodile, whale, horse and fish bones, specimens that no one else had realized were there. On his return to the UK, Bob collected all the books he could find on palaeontology and taught himself the basics in the period to 1989. After meeting the late Professor Nigel



Photo courtesy of Martin Gostwick.

Trewin he started to receive recognition in the fossil field. Together they produced three scientific papers and excavated half a dozen or so localities, shedding new light and bringing them up to date in print. They founded a field-trip group dubbed the 'Fossil Fish Filleters', who made field-trips annually to localities across the northeast of Scotland. Over the years Bob has amassed a fossil fish collection of some 900 specimens and has co-written a further ten scientific papers. He joined the Friends of Hugh Miller in 2008, not least because the charity is based in Cromarty, just round the bay from Miller's Devonian fish deposits, a favourite locality for many excursions. As for the future, he



says slowing down is out of the question due to his tripartite passion for palaeontology, motorsport and the oil industry.

Martin Gostwick

Secretary, The Friends of Hugh Miller

Hinde Medal of the Pander Society

The Hinde Medal was inaugurated for young conodont workers who have made a particularly significant contribution in the early part of their career, and in late 2018 this medal was conferred on Carlos Martínez-Pérez of the University of Valencia. Within seven years of his PhD on Emsian conodont faunas from the Spanish Central Pyrenees, Carlos has bridged the traditional divide between conodont alpha taxonomy and their functional biology, bringing about a revival of an organism-oriented approach. Carlos has worked with Phil Donoghue at the University of Bristol, seeking to learn new methods and broaden his research programme, having been awarded two competitive postdoctoral scholarships. Carlos continues to push the boundaries of conodont palaeobiology, recently undertaking the application of nanotomography and computational fluid dynamics to his research. Carlos has done great service to international conodont research. He has reconciled traditional, laborious conodont taxonomy within a broad context of early vertebrate functional morphology and macroevolution. The outcomes have been published as crisp, provocative articles in high-profile journals, with readerships across palaeobiology and evolutionary biology. He is a truly worthy recipient of the Hinde Medal.



Photo: Phil Donoghue.

Paul Smith

Oxford University Museum of Natural History

Palaeontology at the EGU: the Lamarck and other medals

EGU hosts a series of awards and medals, at both division and Union levels. The Stratigraphy, Sedimentology and Palaeontology (SSP) Division's annual Jean Baptiste Lamarck Medal rotates around a sedimentologist, a stratigrapher and a palaeontologist. Next year, the medal will be earmarked for a palaeontologist. The medal is normally awarded to an active, mid-career researcher for exceptional contributions to the field. We invite the membership to nominate a fellow palaeontologist for the 2020 Lamarck Medal, to be awarded at the 2020 General Assembly in Vienna (3–8 May 2020). The closing date for nominations is 15th June 2019 via the website <<https://www.egu.eu/awards-medals/nominations/>>. While on the site, have a look at the early-career awards, both at division and Union level!

Thijs Vandenbroucke

EGU – SPP Palaeontology Officer



Bristol Summer Diversity Internship

Our Summer Diversity Internship at the University of Bristol is a step towards improving diversity in palaeontology and we are now inviting applications for summer 2019. The scheme is open to second-year undergraduate students studying a relevant degree in biological or Earth sciences, and offers a stipend of £250 per week to carry out a summer project supervised by a member of staff in the Palaeobiology Research Group. The internship is a great way to gain knowledge and experience in palaeobiology and will help with future applications for PhD positions and other research jobs. We are particularly keen to hear from applicants from BAME backgrounds, as BAME under-representation is a recognized issue throughout science in the UK. For students whose home address is outside the Bristol area, there may be some support available towards accommodation costs. See the website for more information: <<http://bristol.ac.uk/earthsciences/research/palaeobiology/study/internships/summer-diversity-internship/>>.

Please spread the word to any undergraduate students who may be interested.

Vanessa Luk

University of Bristol

Fossils in the news

It's a great pleasure to write my first newsletter article as Publicity Officer. My primary concern in this task is living up to the high standards set by Liam Herringshaw during his stint.

One of the things I learnt from writing for the *Guardian's* now extinct Science Blog Network was that getting palaeontological news (other than the seemingly ever-popular dinosaur coverage) read by a wider audience often required a creative, even quirky, approach. Some recent unusual fossil finds have successfully gained attention across the spectrum, from tabloids to tech forums, and even medical websites.

The first study concerned the earliest recognized occurrence of bone cancer in an amniote. Lead author Yara Haridy (based at the Museum für Naturkunde, Berlin) and colleagues described evidence for osteosarcoma in the femur of a shell-less stem-turtle *Pappochelys rosinae* from the Middle Triassic of Germany. The study was published in *JAMA Oncology*, a journal not known for its palaeontological content.

The *Daily Mail*, celebrated by many for its ongoing quest to divide the world into substances which either cause or cure cancer, did not disappoint, and covered the story in a surprising level of detail (if not complete accuracy). The *Daily Star* even ran the story, in its 'weird news' section, with the gloriously inaccurate headline 'Dinosaurs had CANCER'. The *New York Times* ran a more measured piece, and with a rather more pleasing headline: 'The Patient Had Bone Cancer. The Diagnosis Arrived 240 Million Years Too Late'. Coverage of this story will have raised the profile of palaeopathology with new audiences across the globe.

Another recent study to grab the media imagination concerned a fossil spider with preserved reflective eye tissue. A spider fauna from the Lower Cretaceous of Korea described in the *Journal of Systematic Palaeontology* by Tae-Yoon S. Park (Korea Polar Research Institute), Kye-Soo Nam (Daejeon Science High School for the Gifted!) and Paul A. Selden (University of Kansas) included a specimen preserving the first spider eye tapetum in the fossil record, found in the first member of the Lagonomegopidae to be preserved in rock rather than in amber. Tech website *Gizmodo* described the spider's glowing eyes, and even Fox News got in on the act with their article 'Ancient, fossilized



spiders still have weird and glowing eyes'. A striking image of the spider's reflective eyes 'caught in the headlights' featured in many of the articles.

Finally, dinosaurs inevitably got in on the 'weird and wonderful' fossil news trend, with wide coverage for a study published in *Scientific Reports* on a new species of dicraeosaurid sauropod, *Bajadasaurus pronuspinax*, from the Lower Cretaceous of Patagonia, by lead author Pablo Gallina (Consejo Nacional de Investigaciones Científicas y Técnicas, Buenos Aires) and colleagues. Sporting paired long, forward-pointing neural spines along its neck and back, and beautifully reconstructed by Jorge A. González in the image accompanying many of the articles, *Bajadasaurus* was variously described in headlines as 'badass', 'sexy' (presumably to another dicraeosaurid, at the very least) and as having a 'mohawk of spikes'. In his blog post for *Scientific American*, Brian Switek (aka @Laelaps) wrote a measured discussion of possible interpretations for these structures, but even Switek concluded that *Bajadasaurus* is 'a supremely cool new dinosaur'.

The most interesting coverage of *Bajadasaurus* came from tech site *Gizmodo's* Australia website, where Steve Brusatte was quoted: 'I can't help but think that the spines functioned in the same way as Johnny Rotten's hair: to get attention' (I feel compelled at this point to note that my ex-Sex Pistols namesake John Lydon is no relation!). The same article also pointed out that *Bajadasaurus* most resembles creatures from *No Man's Sky*, a video game with a cult following, involving exploration of a near-infinite universe of alien planets with unique ecosystems.

There's a fine line to be drawn between over-sensationalizing fossil finds and failing to draw the popular media coverage that so many important new discoveries really do deserve. Nevertheless, finding popular culture hooks, commissioning high quality reconstructions, and even just finding a quirky hook for a story, do help to ensure that the wider world gets to hear about exciting palaeontological research.

Susannah Lydon

University of Nottingham





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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 Rebecca Bennion, Nicolás Campione and Paige dePolo.

Rebecca Bennion is a Briton in Belgium, doing a PhD at the University of Liège and funded by the Fonds de la Recherche Scientifique.

Q1: How did you end up in Belgium?

I took a gap year after my Masters and took the time to investigate different PhD opportunities in marine vertebrate evolution and palaeoecology. I sent out e-mails to some potential supervisors whose research I found interesting, including Valentin Fischer at Liège whose work on ichthyosaurs I had come across during my Master's thesis. He suggested a project on evolutionary convergence between marine reptiles and cetaceans co-supervised by marine mammal expert Olivier Lambert at the Royal Belgian Institute of Natural Sciences. After visiting Belgium to meet them and discuss the project I decided this was an excellent opportunity and moved to Liège in August 2017.



Q2: How is your position funded?

I'm funded by the frs-FNRS, the research agency for the French-speaking universities of Belgium, on a FRIA PhD studentship. The system is a little different to the UK's – my supervisors and I wrote the application together and I then had to defend the proposal at interview to an FNRS jury of senior researchers. This was a very nerve-racking experience but I was obviously successful!

Q3: What is your project about?

Secondarily aquatic tetrapods, most notably ichthyosaurs and cetaceans, are textbook examples of convergent evolution. These are highly successful groups which have repeatedly colonised a number of ecological niches during their evolutionary histories, ranging from small piscivores to gigantic macropredators. Surprisingly, the macroevolutionary pathways behind these ecological convergences are poorly understood and have rarely been analysed quantitatively.

My project looks at skull ecomorphological convergence between different groups of raptorial, tail-propelled aquatic tetrapods (ichthyosaurs, mosasaurs, archaeocete and odontocete cetaceans). I am using 3D morphometrics to investigate parallel trajectories of skull evolution in these groups to reveal how their adaptive landscape changes through time and biotic crises.



Q4: What surprised you most about living in Belgium?

I'd never been to Belgium before so pretty much everything was surprising to me! Belgians have a very relaxed attitude to life, excellent sense of humour, and they really love food. They have so many curious local traditions and I've really enjoyed the experience of living in a different culture.

I was also surprised by how rich the palaeontological heritage is for such a small country: Palaeozoic reefs, Cretaceous dinosaurs and mosasaurs, Neogene marine mammals, Quaternary cave faunas. We have excellent collections in Liège of Belgian specimens as well as historic acquisitions from as far away as Australia.

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

This is a difficult question as I do go back to the UK fairly often on the Eurostar. I think I would have to go for the UK seaside with its stunning scenery and great fossil hunting locations! I grew up on the Jurassic Coast of Yorkshire and have also lived within easy travelling distance of the beaches in Dorset and Sussex. Of course Belgium does have a coastline but it is over two hours away from Liège by train and it's not quite the same.

I also miss being able to easily do science outreach to the public. There are opportunities over here but it can be difficult for me to participate with the language barrier.

Rebecca tweets at @CalymeneBlue.

Nicolás Campione is a Canadian in Australia, employed as a Lecturer in Earth Sciences at the University of New England.

Q1: How did you end up in Australia?

Oddly enough, via Sweden. Upon completing my PhD in Toronto, Canada, I moved to Sweden as a postdoctoral researcher to work with Benjamin Kear, Henning Blom and Per Ahlberg. Initially the research was intended to focus on reconstructing diversity patterns of fossil sharks, an ongoing project, but I was then sucked into the teaching and supervisory requirements of the department, which was nonetheless a very enjoyable and rewarding experience. Upon completing my position, I was successful in getting a lectureship position at the University of New England in Armidale, NSW, and lucky to join the Palaeoscience Research Centre (one of the largest groups of its kind in the southern hemisphere) and where I have started my own research group exploring morphological evolution in a variety of organisms.



Q2: How is your position funded?

I am currently paid as standard faculty at UNE. However, I was recently awarded a highly competitive Discovery Early Career Research Award (DECRA) by the Australian Research Council, which will allow me to dedicate my time to a new project interpreting dinosaurian ecology by quantifying their dental complexity and shape. This will be a welcome change of pace from the previous five years, where my research has been largely self-funded.



Q3: What is your project about?

My research programme seeks to reconstruct long-term patterns of morphological evolution in the fossil record in order to begin interpreting the processes driving diversification and extinction throughout the history of life. As a result, I work on a variety of research projects with various colleagues, such as the deep-time evolution of sharks, body size evolution and palaeoecology of dinosaurs and the Boreal Alberta Dinosaur Project (a long-term field-based project in Northwestern Alberta).

Q4: What surprised you most about living in Australia?

The wildlife. Canadian and Swedish wildlife were interesting, but they never captivated me the way that Australia's has. From the spiders to the roos, but most of all the parrots – so many parrots!

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

Three things: 1) A proper winter, heaps of snow, -40°C, wind chill, freezing rain and the lot; 2) hockey (Ottawa Senators), which I've unfortunately lost touch with since leaving Canada; and 3) insulation. As much as I love the cold, it's nice to have a warm place; Australians don't do insulation.

You can follow Nic on Twitter (@paleonic) or check out his website at <nicolascampione.weebly.com>.



Paige dePolo is an American in the United Kingdom, studying for a PhD at the University of Edinburgh and funded through a European Research Council grant.

Q1: How did you end up in the UK?

I ended up in Scotland through a fair bit of serendipity. During my last year of undergrad, I was looking for an academic sponsor for some international scholarships and made email contact with my current supervisor, Steve Brusatte. He helped me develop a project to complement on-going research at Edinburgh describing dinosaur footprints on the Isle of Skye. At the end of my Masters, Steve offered me the opportunity to pursue a PhD studying something completely different, Paleocene mammals. Continuing to work with the Edinburgh crew was a singular



chance to grow as a researcher, so, after spending a few months back stateside to reapply for a visa, I'm back in Scotland for the next couple of years.

Q2: How is your position funded?

My PhD is funded through a European Research Council Starting Grant (PaM) awarded to my supervisor.

Q3: What is your project about?

My project focuses on pantodonts, one of the first groups of mammals to grow to large body sizes after the K–Pg extinction event. Through completing anatomical descriptions of new *Pantolambda* specimens from the San Juan Basin of New Mexico and visiting museum collections in the US, China and Russia, I'm aiming to pull together an in-group phylogeny for Pantodontia. The phylogeny will then serve as the basis for testing macroevolutionary hypotheses about how the group changed through time. This work will determine which pantodonts would be best suited as exemplar taxa and what their character scoring will be for the larger mammalian phylogeny our research group is constructing to investigate the timing and tempo of the mammal radiation relative to the K–Pg extinction.

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

The casual way that the age of historical and archaeological things is regarded on this side of the Atlantic floors me. In the western part of the US, we regard buildings from the 1800s with a sort of reverential awe and here buildings of that age are nothing special and, in fact, practically new. The time dimension of the historical places on this side of the Atlantic always results in my feeling a little bit discombobulated. I know that human timescales pale in comparison to the million-year timescales I deal in when it comes to research but it still boggles my mind that the University I study at is an older institution than my country.

Q5: Apart from friends and family, what do you miss most about the US?

I miss the high desert climate of my state (Nevada) – the wide open, sunny skies, crunch of dry sand and gravel underfoot, the smell of sagebrush after one of the infrequent cloudbursts. There's a wildness in the mountains and deserts back home that is honestly unparalleled in the more densely populated spaces here in the UK. The aspect of Scottish climate that wears on me the most is the extremely short days and lack of sunlight during the winter. Luckily, that sort of weather gives me ample motivation to stay focused on research.

Paige tweets at @Paige_dePolo.



Behind the Scenes at the Museum

The Yorkshire Museum, York, UK



Artist's impression of the new Yorkshire Museum, 1828. Image courtesy of York Museums Trust <<http://yorkmuseumstrust.org.uk/>>, CC BY-SA 4.0.

The collections at the Yorkshire Museum were founded in 1822 by the Yorkshire Philosophical Society (YPS), who are still in existence today. The formation of the YPS happened at a time of great growth for philosophical societies in the north of England; similar societies were founded in Leeds, Whitby, Newcastle and Sheffield, to name but a few. These societies performed something of an academic function at a time when few people attended universities. In practice, they were made up of gentlemen with enough time and money to discuss important new discoveries in nature and antiquity, and indeed often with the means to travel widely and collect or exchange such material. (Women of course were not permitted until well into the 20th century, unless they were able to come up with some cash, usually for the ever-needy buildings fund, and even then they were 'Lady Subscribers' rather than full members.) The YPS was very successful and well respected, leading to a high-quality collection and accompanying library, mostly focused on Yorkshire but covering material from all over the country and the wider world. For example, in 1864 they acquired an almost complete South Island giant moa skeleton from New Zealand, collected to order, and partly examined and described by Richard Owen.

The collections of the YPS grew quickly, requiring construction of the Yorkshire Museum to house them. The Museum was built over the ruins of St Mary's Abbey, once the most powerful abbey in the north of England, and is the third oldest purpose-built museum in the UK. It was completed in time to host the 1831 inaugural meeting of the British Association for the Advancement of Science, now known as the British Science Association. One of the founders of the YPS, William Vernon Harcourt, was instrumental in founding the BAAS. The very first meeting of the Museums Association was also held in York, in 1889, due to Henry Platnauer, then Keeper of the Museum, being a cofounder of the organisation.



The impetus for founding the YPS and its collections was the discovery of the Kirkdale Cave fossil fauna, in Kirkbymoorside, about 30 miles north of York. In 1821 quarrymen discovered unusual-looking bones and teeth within the rocks, which were clearly not from local animals. These were brought to the attention of William Buckland, who was studying many similar cave sites across Europe. He identified Kirkdale Cave as a hyena den and that the other animals found in the area, such as hippo and elephant, had been dragged into the cave as food. He concluded that all the animals had been living in the local area rather than being washed in by the Great Flood. Indeed, the Kirkdale material formed a major part of his book *Reliquiae Diluvianae*, published in 1823. The YPS received a substantial collection of the Kirkdale material, and the collections have flourished ever since.



Cave hyena jawbone from Kirkdale Cave, around 14 cm long. Image courtesy of York Museums Trust <<http://yorkmuseumstrust.org.uk/>>, CC BY-SA 4.0.

John Phillips, William Smith's nephew, was taken on as the first Keeper of the collections in 1826. The YPS had purchased a copy of Smith's geological map of Britain in 1824 while the pair were lecturing across the north of England. The map is now on permanent display.



A section of the Yorkshire Museum's copy of William Smith's geological map, dating from around 1824, showing the Vale of York and the North York Moors. Image courtesy of York Museums Trust <<http://yorkmuseumstrust.org.uk/>>, CC BY-SA 4.0.

Today, the Yorkshire Museum is part of York Museums Trust, which was formed in 2002 and includes York Castle Museum, York Art Gallery and York Museum Gardens, which contain the ruins of St Mary's Abbey. The collections are wide ranging, covering social history, fine and decorative arts, archaeology and numismatics, and biology and geology, and all are designated by Arts Council England as being of national and international importance. The palaeontology collections number around 120,000 specimens, including around 300 type specimens. The collections are comprehensive in their coverage, but are strong in Jurassic fossils (numbering around 10,000), and Quaternary material, especially from the North Sea and the limestone caves of the Yorkshire Dales. There are also exhaustive personal collections, such as a large collection of Speeton Clay fossils from the Lower Cretaceous, and a reference collection of Pliensbachian-Toarcian belemnites.



The collections are actively used in our schools programme, in volunteer-led handling sessions, in talks and events, and displays and exhibitions, and we regularly host scientific researchers. Our Lower Jurassic collections are popular, especially our ichthyosaur material. Our eight-metre-long type specimen of *Temnodontosaurus crassimanus* is on permanent display alongside the type specimens of *Microcleidus homalospondylus* and *Rhomaleosaurus zetlandicus*. All are accessible to researchers who are sure-footed in cramped spaces!

Our most high-profile activity in recent years was the opening of the 'Yorkshire's Jurassic World' gallery spaces. This exhibition showcases our material from the Lower, Middle and Upper Jurassic, and we were privileged to have Sir David Attenborough at the grand opening in March 2018. The exhibition is planned to be in place for five years, and we have a varied programme of events lined up to suit everyone from young children through to academics. We are also looking forward to the bicentenary of the founding of our collections in 2022, when we will be celebrating historic specimens as well as those donated to us in recent years.



*Curator of Natural Sciences, Dr Sarah King, and researcher Dean Lomax working on the tail section of the *Temnodontosaurus crassimanus* type specimen, which is on permanent display at the Yorkshire Museum. Neck of *Microcleidus homalospondylus* type specimen in foreground. Image courtesy of York Museums Trust <<http://yorkmuseumstrust.org.uk/>>, CC BY-SA 4.0.*

The Yorkshire Museum is open to the public every day, and we welcome research enquiries. For more information, see the website at <www.yorkshiremuseum.org.uk>. The Natural Science collections can also be found on Twitter, @YMT_Science.

Sarah King
York Museums Trust



She married a dinosaur

Being guest of honour at the Maharaja's ball is not something that one normally associates with palaeontological fieldwork, but the invitation was indeed followed by the black Rolls-Royce turning up at the doorstep. And, while the Maharaja himself was soberly dressed, he was flanked by his official body double and jewel-wearer (bizarrely, a Scot of philosophical temperament), weighed down by the famous Patiala pearls draping his turban and profusions of gems draped across his shoulders, around a central diamond as large as a robin's egg. But then, for the most famous fossil collector of his day, the extraordinary heights of local culture may become commonplace – or, in this case, a distraction from the job at hand, which was to search for skeletons.

It's just one sidelight from the adventures of Barnum Brown, the American Museum of Natural History's roving and legendarily prolific collector, as recounted by his second wife Lilian 'Pixie' Brown in her palaeontological travelogue *I married a Dinosaur*. Barnum Brown had already established a working style that might have been designed for a Hollywood epic. As a young rookie at the NMNH in 1898, he had turned up one day to be sent to Patagonia at a few hours' notice. There he survived a shipwreck to spend one and a half productive years, eventually sending back four and a half tons of spectacular bones. On his return, out he went to the Montana badlands, to become the discoverer of *Tyrannosaurus rex*. Then, he spent several years journeying down Canada's Red Deer River trying to nab the best fossil specimens before rival collector Charles Sternberg did¹.

So when, in the early 1920s, he had more fossil assignments to fulfil and a young bride sighing for a honeymoon, the narrative was bound to develop along the most traditional of storybook lines. Pixie Brown, telling the story thirty years later, may have taken her revenge with the greatest tact and delicacy; nevertheless, beneath the beguiling storytelling, some kind of score was clearly being settled. Pixie had a way with words and could recognize a good McGuffin when one was put in front of her, and the traditional honeymoon that, of course, never happened, forms a kind of running subtext around which everything else falls into place. From the wedding in Calcutta, it was straight off to the Siwalik hills, for Barnum to explore those 'foremost ghoulings grounds' for the bones of 'sabre-tooth tigers, hyaena-bears and strange dogs big as lions' – bones which gave the region locally a reputation for being cursed by Shiva, Hindu god of destruction. As Barnum strode into the hills in search of Shiva's victims, Pixie was left to look after base camp, which she clearly did with aplomb, and a keen eye for the local terrain and its human and animal life. And when that mission was accomplished and that long-promised honeymoon finally came within reach – why, it was straight off to Burma, where more bones were there, somewhere, for the taking for our intrepid explorer, and Pixie held the fort in the field camp once more.

The book, therefore, reads like one of the longer and more engaging essays from the heyday of the *National Geographic*, a pot pourri of the local people and customs and legends, of close escapes from leopards, of monkeys stealing the laundry, of the adopting of (and eventual heartfelt parting from) Bimbo the baby elephant, of encounters with village elders, itinerant tradespeople, merchants, retired English colonels, holy men – and the Maharaja, of course.

¹ The rivalry was generally friendly, so has not subsequently hogged the limelight quite so much as the entirely more rancorous 19th century competition over bones between Edward Drinker Cope and Charles Othniel Marsh.



Barnum makes an appearance now and again, and there are even examples of his quarry – of some tusk-bearing skull, playing hard-to-get in a river bank, of the regrettable absence of the rest of the body, of packing of bones for the journey back – but mostly there is a Barnum-shaped empty space in the book, as he is generally out there somewhere, elsewhere, on the hunt.

In the book's foreword, Roy Chapman Andrews, contemporary and equally charismatic fossil-hunter of the NMNH's stable, explorer of the Gobi Desert, talked of Barnum Brown as the unpredictable lone wolf at that museum. He would disappear for months somewhere – often no-one knew quite where – to some far-flung corner of the world, following his intuition to wherever he thought there might be fossils of sufficient scale and grandeur. Barnum almost invariably found them – and then returned to his desk as suddenly and unpredictably as he had gone. Amid such a mystery-charged context, this – he said – was most definitely Pixie's book, and one that charmed him so much that he would keep a copy by his bedside table, to take its 'rare medicine' when he was low in spirits.

There may well have been deeper currents in those medicinal pages. Barnum's roving spirit was not always focused on the disinterring of skeletons of extinct beasts. He provided information for the burgeoning oil companies, acted on occasion as government spy to help war plans, advised Walt Disney on dinosaurs for the classic *Rite of Spring* sequence of *Fantasia*² and, it is rumoured, left a trail of jilted lovers in the wake of his travels. The vivacious Pixie, who was no-one's victim, may have wandered a little herself, if pleasing company was to be found, and if the book is revenge it is not served cold, but with affectionate irony – and the passage where she describes nursing Barnum out of a near-fatal encounter with malaria in Burma is genuinely moving. The shade of Madame de Pompadour, who navigated the passions and politics of Versailles with similar poise and heart, might have been applauding.

Now, this subtle and baroque allusiveness is all a world away from my own fieldwork memories, of sundry bed and breakfast establishments and smoke-stained pubs where, after prising a handful of tattered graptolites from the grip of the Welsh slates, the main adventure is in racing down the hill in time for the last meal in the hostelry, and perhaps, when the spirit of adventure is pulsing through the veins, in taking on the local Minnesota Fats at the pool table. But then, there are few published reminiscences in the popular realm of the searches for graptolites, or orthocone nautiloids, or conchostrocans, or rugose corals³. The saurians (and mammals of similarly scary demeanour) still rule the roost to fill these kinds of pages. On land, at least. Somehow, the biological small fry can take on more allure when being chased at sea – even with a narrative delivered in all seriousness, with the Maharaja's pearls (if any were chanced upon) being kept strictly under wraps.

So, when John Murray stood up in front of the audience at Hulme Town Hall on 11th December, 1877⁴, his scientific travelogue for Lancashire's populace was of quite another tone. The previous year he had returned from a journey of some four years and nearly seventy thousand nautical miles aboard HMS *Challenger*, exploring the world's oceans and, in as much as any single endeavour did, establishing the science of oceanography. Murray's account has none of the sly

² The dinosaurs look fantastic, even today, and Barnum Brown's notion (fieldwork-derived) that the dinosaur's demise was caused by lethal drought was memorably impressed into the ending of this *Rite*. Pity that Stravinsky hated the liberties taken with his music.

³ Richard Fortey's *Trilobite!* does, thankfully, fly the flag for the invertebrates in this respect.

⁴ <<https://trove.nla.gov.au/work/16373363?q&versionId=19212942>>.



humour of the indomitable Mrs Brown, and there is not the slightest hint of playing to the gallery. He clearly credited his Lancashire audience with the same seriousness of purpose and work ethic that he himself abundantly possessed, as he was beginning the enormous task of editing the 50 volumes of the *Challenger* findings. He allowed himself a little touch of awe at the beginning, talking of the 'dark unfathomed cave' of the ocean deep, where the sea serpent might lurk, perhaps guarding some 'gem of purest ray'. And then it was straight down to the brassiest of tacks.

What is a 'field day', as Murray called it, like on board such a ship? It depended clearly on systematic, backbreaking use of a methodology that combined vaulting ambition – to systematically sample that utterly mysterious sea floor that lay far beneath – with technology that was both primitive and ingenious. Murray clearly had the soul of an engineer as well as an oceanographer, and dwelt lovingly on the mechanics of the process. There were the 'accumulators' as he called them, for example – stout bands of India rubber a yard long between thick wooden disks – that absorbed sudden increases in tension as the miles-long rope was let out, and the 'sinkers' of iron that carried the rope with its sample tubes and dredges downwards, and also the ingenious device that released these sinkers as the whole contraption touched the sea floor: a tribute of a three or four hundredweight of iron that was paid 'to old Neptune' with each sounding, as Murray put it, with one of his rare flashes of humour. There were other kinds of price to pay. The crude technology reached snapping point more than once, so old Neptune was also gifted a total of fifty-seven miles of rope, left on various parts of the sea floor. They had come prepared for such mishaps, though, originally loading 181 miles of the stuff (while Murray wrote wistfully of the superior qualities of piano-wire, that other survey vessels were beginning to use, over rope). More grimly, humans proved to be fragile organisms when improvising such tricky forces around them, and Murray noted that the death-rate of crew members on board the *Challenger* was 'rather above that of a normal man-of-war in commission'.

The solid technical detail – of the often improvised construction of the dredges, deep-sea thermometers, and such – and the prizes so hard-won were duly described: those deep-sea oozes with their trove of sharks' teeth and whale earbones, radiolaria and globigerinids. Once ashore, these were to be parcelled out to keep thirty-six English, six German and two American 'naturalists and scientific men' hard at work upon the treasure trove. Among these, the Brady brothers, whose classic work on the foraminifera is now itself fossilized not just in standard monographic form but as the Brady Medal of the British Micropalaeontological Society.

The *Challenger's* voyage is a classic, which laid the foundations for the kind of palaeontology that is now a *sine qua non* in deciphering ancient climate from cores that reach far deeper into the 'globigerina oozes' than the home-made scoops, tubes and buckets of that good ship ever could. But an earlier voyage, a century before, had marked the start of another, very specific line of palaeoclimatic research, and was also a personal milestone for the half of the human race that does not quite fit Murray's category of 'naturalists and scientific men'. This earlier scientific adventure could certainly have done with its own fly-on-the-wall biography.

This was when Jeanne Baret managed to stay as a working stowaway in plain sight for the best part of three years among the crew of Captain Louis de Bougainville's globe-spanning French scientific expedition aboard the *Étoile*. The reward for de Bougainville (who eventually honorably turned a blind eye to the deception) was botanical immortality. For he was the dedicatee of



Bougainvillea, the type material of which was likely hauled back to ship – and curated and catalogued – by the indefatigable and methodical Baret, while the male of the scientific species (who did not need to stay invisible) tended to his various ailments. Yet another part of Baret's workload became a major player, a few years ago, when a far more modern expedition crashed through the ice of the Palaeocrystic Sea⁵ to drill into its Eocene history. The story of Baret, and of *Azolla*, the small but mighty water-fern, certainly deserves its place in the annals of quirkily intersecting fieldwork.

The official scientist on the *Étoile* was Phillip Commerson, royal botanist, naturalist and physician. He possessed considerable expertise – but was not the most organized of people, and had poor health, suffering from gout and badly injuring a leg just before the expedition. So he took Baret as his partner⁶ and assistant, who possessed strength and organization in abundance – and as women were absolutely forbidden from being part of the ship's company, she posed as a man throughout the voyage. The deception lasted two years – and Jeanne was unmasked not by the other crew members but by the rather more observant natives of Tahiti.

By then she had established a formidable reputation for hard work, organization and growing botanical expertise, often carrying out the more arduous parts of the fieldwork in rough country, armed with musket, game-bag and collecting materials. Captain Bougainville, therefore, did not clap her in irons – but equally he did not want to return to France with a woman now clearly on board a ship in his command. When, near the end of the voyage, in 1768, the *Étoile* stopped off at the French possession of the Isle de France (now Mauritius), the presence there of a friend and fellow naturalist of Commerson's, Pierre Poivre, allowed a diplomatic solution to his predicament. Poivre invited Commerson and Baret to remain to carry out botanical research on the island, and they stayed there the next four years, until Commerson eventually succumbed to his growing ill-health.

On the Isle de France, there was time for the collections to be organized – with Baret's skills and assiduity again to the fore – and then, as 3,986 specimens in some 34 crates, delivered to the safe keeping of the Comte de Buffon and Paris's Jardin de Roi. Among them was the type material of *Bougainvillea* – described by Antoine Laurent de Jussieu a few days before the storming of the Bastille – and of *Azolla*. Baret survived effective widowhood with her characteristic durability. She ran a tavern for a while (and was fined for selling alcohol out of hours), later married a French officer, and returned with him to France where (likely through the intervention of Bougainville) she was awarded a substantial pension in recognition of being 'an extraordinary woman'. Extraordinary, for sure: with that homeward return she became the first woman to circumnavigate the globe.

Azolla, meanwhile, had done this trick, or something like it, some fifty million years previously. It's not the most obviously fern-like of ferns. With small, scale-like leaves budding off tangles of stems, the whole floating on the surface of ponds and lakes in tropical and temperate regions, it looks like a kind of pondweed – and it can grow like crazy. Each leaf includes a fluid-filled cavity, just a fraction of a millimeter across – a kind of microscopic internal lake inhabited by a specific association of microbes, including a nitrogen-fixing cyanobacterium, passed down from fern generation to fern generation, to turbocharge biomass production when the going is good.

⁵ The beautifully poetic name devised for the Arctic Ocean by George Nares, the *Challenger's* captain, and used by Murray; alas, it's now a long-forgotten junior synonym.

⁶ Baret had been Commerson's housekeeper, and Commerson was, most likely, the father of Baret's illegitimate child before the voyage.



A few years ago, *Azolla* took a starring role in a celebrated latter-day oceanographic adventure. This was ACEX, the Arctic Coring Expedition, when IODP, aka the Integrated Ocean Drilling Program, teamed up with Russian icebreakers to plough their way through thick, permanent Arctic sea ice⁷ into the sea floor below. Through this teamwork, they managed to core through the Cenozoic and into Mesozoic strata of the Arctic Ocean floor (where previously nothing older than mid-Pleistocene had been recovered). All kinds of narratives emerged, but the headline act was the mid-Eocene interval, from which enormous amounts of *Azolla* spores were recovered. The Arctic Ocean is now, well, an ocean, but the emphatic presence of this freshwater fern, which cannot tolerate much more than 1 per mil salinity, shows that at that time it was more like an Arctic lake, tightly hemmed in by the northern coastlines of Europe, Asia, North America and Greenland, and fed by rivers pouring off those landmasses, in a hydrological cycle enhanced by greenhouse conditions.

The *Azolla* event⁸, it has been called, lasting about a million years, and preserving a kind of *Azolla* black shale – a carbon sequestration event which, it has been suggested, began the slide from greenhouse to (ultimately) icehouse conditions. The human reaction encompassed what is now a classic dichotomy around such a fossil phenomenon. The oil majors sighted a new commercial target hydrocarbon source rock, while the possibilities of this super-fern for sequestering the resultant greenhouse gases and stabilizing our errant climate were also seized upon, giving rise to an *Azolla* Foundation devoted to this purpose.

Barnum Brown, one suspects, would have had a foot in both camps. And, Jeanne Baret would certainly have been pleased that the plant that she carried on her back had grown mightier than a dinosaur, with a kick hefty enough to, perhaps, move a planet out of its course. There's nothing like fieldwork, both would have said (and Pixie might have digressed lyrically on) to produce such a marriage of ideas.

Jan Zalasiewicz

University of Leicester

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⁷ In far-off 2004, Arctic sea ice still was thick and seemed permanent.

⁸ <<https://www.geolsoc.org.uk/Geoscientist/Archive/June-2014/The-Arctic-Azolla-event>>.



Spotlight on Diversity

Highlighting different experiences in palaeontology. This issue's palaeontologist, Paul Barrett (Natural History Museum), describes the ups and downs of his career, and his experiences dealing with mental health issues.

Following a series of interesting discussions on Twitter, which set out the problems and perils faced by early-career researchers, I thought it might be somewhat therapeutic (for me at least) to sit down and think about the pathway that has led me to my current position. This isn't intended to be preachy, to trivialize the problems faced by others, or to brag, but I thought it might be of interest to the broader discussion about careers in academia and how they might progress.

During my PhD, in the Earth Sciences Department at the University of Cambridge, I had a blast. I was lucky enough to be a member of a large cohort of friends, all of whom were really into what they were doing and who knew how to have a great time while doing it. I had the funding to do what I needed, opportunities to earn extra cash through teaching, was at a university where life was made pretty easy in general, had a terrific social life and a strong mutual support network. As the end of my PhD loomed closer and the spectre of unemployment appeared I started applying for jobs – in total, I applied for something like 20 positions in a relatively short space of time. Of those applications, I only got long-shortlisted for one (which was ultimately unsuccessful) and on the day my funding ran out I had only a couple more irons in the fire and went to sign on for unemployment benefit. Luckily, the last decision I was waiting for struck gold and I got a fully-funded four-year fellowship at Trinity College Cambridge. So, two weeks after I signed-on I went back to the job centre and signed-off as the job started almost immediately. This gave me a financial cushion and the freedom to do what I wanted to academically – I had no 'boss' as such, just my own research proposal to work with. The first six months of my fellowship were spent completing my thesis and the rest of the time pursuing various other projects. In many ways this was a great time – I had a salary, no other responsibilities, could set my own agenda, and I continued to work in a place with established linkages and friends – an ideal first job in most respects.

It wasn't all roses, however – during the second year of my fellowship (a few months after submitting my PhD) I suffered a lengthy bout of clinical depression and had a period of around nine months where I simply wasn't able to function. I couldn't work and could barely bring myself to interact with anyone else – a large portion of this time was spent lying on a sofa staring blankly ahead, with periods of intense, unresolvable restlessness in between. Thanks to support from my partner, friends, family, GP and Trinity I got through it, although I was on medication for around 18 months and had regular counselling during the first (and by far the worst) months of this illness. Trinity responded well, allowing me as much time as I needed to recover and offering to add time to the fellowship to account for the period where I was too ill to work. They didn't offer any other formal help, aside from general moral support, but they did give me reassurance and space to recover. The depression wasn't due to the fact that my future beyond the length of the job was unclear, nor to any stresses involved in the job, but to a combination of other personal reasons, related to the fact that my cohort of friends gradually departed (while I remained), a certain amount of PhD post-partum anxiety, and two other coincident minor, but



worrying, illnesses that got blown out of proportion. Apart from this, the majority of my postdoc period was, on balance, pretty enjoyable. Other than the eventual stress about where the next job might come from as the fellowship ticked down, I was able to set my own agenda and was treated as a grown-up by my colleagues in permanent positions. I was given opportunities to shoulder some collective responsibility – I, along with the other junior fellows, participated in the running of the College in a minor way with the same voting rights and privileges as the other fellows – and I never felt marginalized. Luckily for me, I applied for and got another job while still in the tenure of my fellowship, so went straight into this, without an extended period of failed applications or unemployment.

My next job was a fixed-term lectureship at the University of Oxford. It involved a move to a department that I found much more challenging, not only due to the change in role – which involved more formal teaching as well as the associated administrative demands it made and the need to increase my research profile (not to mention some pressure to get that first grant) – but also due to the different set of personalities I encountered. It was a less enjoyable place to work than my old Department and if it hadn't been for a handful of friendly staff who took me under their wing, I'm not sure how long I would have lasted (although I eventually built up a small research group of my own, which helped buffer me from the isolation I'd felt on arrival). In addition to not being a fan of my new department, I took a quick personal dislike to Oxford – a city too large to retain the charm of the university precinct, but too small to have the diversity and distractions of a bigger city. It was isolating socially and much more hierarchical academically than anything I'd witnessed in Cambridge: although I was a full member of faculty, most decisions in my department were made by a small group of senior professors who rarely consulted more widely. In addition, there were few people who had any inkling or interest in the sorts of things I worked on. My partner was still a PhD student at the time, and still based in Cambridge, so we also had the added strain of maintaining a long-distance relationship while neither of us had much money. Although I lived in Oxford for a while I had no real social life, nor much in the way of an intellectual life either, and when my partner got a job in London and moved there I soon followed. For the next two and a half years I commuted back and forth from London to Oxford: this was physically exhausting and financially burdensome, but it meant I had a social life again. To be fair to my boss at the time, he supported my decision to move and enabled me to work in London one day each week out of term time. I became a visitor at the Natural History Museum, London (NHM), with Fridays becoming a research day in the collections.

The Oxford job was a four-year fixed-term post and as the end drew near there were relatively few opportunities available. This led to another period of anxiety and I spent time applying for the few relevant academic jobs that arose and for individual fellowships (with zero success at making a shortlist) and I began to have serious discussions about alternative career paths. At this time, the NHM dinosaur researcher job came up and I was lucky enough to be shortlisted. Following the interviews, I wasn't the first choice candidate (that honour went to a colleague and close friend who went on to head up another major dinosaur collection), but I was the reserve and when this candidate declined I got the job. In many ways the NHM has been exceptionally kind to me and I find myself in constant awe of the collections, the building, the sense of history, and also my colleagues who are hardworking, brilliant to hang out with and dedicated. As with all permanent jobs, however, there still loomed the prospect of passing my probationary period,



something that wasn't simply a rubber-stamping exercise (several of my near contemporaries failed probation). Nevertheless, I was able to cross the Rubicon and the stability that my now permanent job afforded boosted my productivity, which has enabled me to climb the greasy pole within the Museum's ranks. Even now there are still anxieties – we're a public institution and in times of austerity permanent jobs get cut, and I've seen good, productive colleagues lost to these purges. Although the days of worrying regularly about changing jobs are to some extent behind me, and I'm financially stable, I now have different burdens of expectation in terms of getting consistent grant funding, contributing to managerial and corporate roles, and in maintaining a research profile, despite having less and less research time. These were not stress factors when I was an early-career researcher and my earlier jobs were less pressured and more research oriented. In addition, when you reach middle age other burdens come into play – your own health can be more of a concern, and parents, and – if you have them – kids, take more of a toll on your personal time in terms of finding that work/life balance.

Many of the career-related problems that academics face are not unique to academia. My friends who work in other sectors have also had to change job frequently, including changes of town or city, often with young families in tow, and difficult decisions regarding relationships, children and other life choices have to be made. They've also faced periods of uncertainty and unemployment and a few work in industries where there isn't much support to deal with these issues. I'm sorry to say that the pressures don't go away or lessen as you transition into a permanent job – they just change. Moreover, although I think that things are genuinely tougher for postdocs now than they were in my day (a topic deserving of a fuller discussion), to some extent those in my generation have been there too – facing the same uncertainties over the next job, where it will be, and how this will affect our lives outside of the workplace. I've had two particular lows in my career (my period of depression and my first year working in Oxford) and in neither case were they associated with career worries, but with other factors. Career worries were real also, but I found mechanisms to manage them, which involved keeping a dialogue going and being realistic about the next stage when things didn't look like they were going to work out the way I wanted.

As I said at the outset, I just wanted to set out my own experiences as a potential case study, so those currently going through the early stages of their career can see how things might pan out. Some of you might recognize some of this, others might think I've been fantastically lucky (with no cause to pontificate), and others might be disappointed that the challenges they face now seem tougher than those I had to overcome.

Paul Barrett

Natural History Museum, London



>>**Future** Meetings of Other Bodies



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

The IMERP is aimed at early-stage palaeontologists, from undergraduate students to recent post-doctoral researchers. Geologists, biologists or any scientists with research topics related to palaeontology, as well as palaeoartists, are also welcome. The IMERP has two main objectives: to provide a friendly environment for early-stage researchers to present their research and follow each other's progress; and to share new methods and useful ideas in palaeontology. Another aim is to develop the skills of the attendees with the help of invited expert speakers. There will be a workshop on making professional figures for papers and presentations, and six keynote speakers from all over the globe. For more details please see the website <<https://imerp2019.weebly.com/>>.



18th International Bryozoology Association Conference (IBA)
Technical University of Liberec, Czech Republic 16 – 22 June 2019

The IBA 2019 focuses on bringing together researchers and students to exchange and share experiences and research results on all aspects of bryozoan life. IBA offers a burgeoning field of study as it consists of diverse scientific topics including, but not limited to, taxonomy and systematics of fossil and living bryozoans, their ecology, evolution, response to climatic changes and the history of research. The conference is the premier forum for the presentation of new advances and research results in all the fields of bryozoan studies.

Please see the website for more information: <<http://18iba.tul.cz/>>.



11th North American Paleontological Convention (NAPC)
Riverside, California 23 – 27 June 2019

NAPC is an international conference that meets every 4–5 years, bringing together all branches of palaeontology (vertebrate, invertebrate, palaeobotany, micropalaeontology, palaeo-related organic and inorganic geochemistry, palaeoecology, palaeoclimatology, and astrobiology) for a joint meeting typically hosted on a campus. The meeting attracts professional scientists, graduate and undergraduate students, amateur palaeontologists and interested members of the public. The purpose is to exchange research findings, define future directions and be a forum for extended and relaxed interactions between professionals and early career scientists, most particularly graduate and undergraduate students. NAPC meetings are generally less formal than some meetings and allow time for more extended and relaxed interactions. Pre- and post- meeting field-trips are planned, as well as single day field trips in the middle of the meeting.

Registration and abstract submission are now open, at <<https://www.napc2019.ucr.edu/>>.



Lyell Meeting 2019: Carbon: geochemical and palaeobiological perspectives
Geological Society of London, Burlington House, UK *28 June 2019*

For the 2019 Lyell Meeting we will bring together a broad spectrum of scientists to address the big picture of carbon in the Earth system, drawing on expertise in palaeontology, geochemistry, palaeobotany, atmospheric processes, deep-Earth processes, and anthropogenic impacts. As the fundamental building block of life, carbon is critical to the Earth system. Traditionally biological and chemical approaches to understanding carbon dynamics in the geological past have been considered in relative isolation. This meeting seeks to foster conversation between these disparate communities to facilitate a more holistic approach to considering carbon, and how it cycles between Earth's organic and inorganic reservoirs. Oral and poster abstracts for the meeting should be submitted before 25th March. PalAss members are entitled to register at a reduced rate.

For more information see <<https://www.geolsoc.org.uk/lyell19>>.



52nd Annual meeting of the AASP – The Palynological Society
Ghent University, Belgium *30 June – 5 July 2019*

The meeting will be convened by Stephen Louwye and Thijs Vandenbroucke (Department of Geology), and will cover all aspects of palynology; dedicated technical sessions will focus on Analytical Palynology; Integrative Cenozoic palynology; CIMP Special Session Honouring Jacques Verniers; and Teratology in palynology. Both pre- and post-meeting field-trips are planned, to the Frasnian type area in southern Belgium and Cretaceous and Jurassic outcrops in northern France respectively. Abstract submission closes on 30th April.

Registration is open at <<https://palynology.org/aasp-2019-meeting/>>.



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

Following a highly-successful 1st meeting held in Lisbon (Portugal) in 2013 and a 2nd held in Graz (Austria) in 2015, the 3rd International Congress on Stratigraphy will be held in Italy. The congress venue is Milan, in the historical buildings of the University, with pre- and post-congress field-trips to the Alps, Appennines and the Italian islands. The topics of the congress will range from the Precambrian to the Holocene and will include all the stratigraphic techniques. As in previous instances, the congress will also host meetings of the ICS and its Subcommissions to debate topics and problems in updating and improving the geological time scale. Registration is now open.

The second circular is available at <<http://www.strati2019.it/>>.



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

The congress, organized every four years, is the most important platform of exchange for all disciplines that deal with the geology and palaeontology of the Carboniferous and Permian periods. Four days of cutting-edge scientific sessions and a mid-congress field trip will provide a broad forum and ample time for scientific presentations and discussions, bringing together established researchers and young scientists from all over the world. Field-trips will give opportunities to explore some of classical regions of the Carboniferous, as well as the unique Rotliegend and Zechstein facies of the central European Permian, and the Pennsylvanian to Permian of the Palaeotethys realm.

For more information see the first circular and website at <<https://www.socgeol.it/323n1331/19th-international-congress-on-the-carboniferous-and-permian-xix-iccp-2019.html>>.



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

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



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

Sessions will explore the timing, tempo and drivers of biotic evolution at the interface of Earth system and biological science topics, over a range of geological timescales and throughout Earth's history. The aim of the conference is to foster interactions among scientists and formulate strategies for synergistically exploiting opportunities and reducing limitations of current technology, infrastructure and scientific culture. Contributions are invited that exploit and apply geochronology to a wide range of topics in Earth system and biotic evolution, describe novel approaches, highlight geochronologic needs and foreshadow future developments. The detailed programme will be available from 4th April 2019.

See the website for further information: <<https://www.grc.org/geochronology-conference/2019/>>.

**Mass extinctions, recovery and resilience**

Utrecht University, The Netherlands 28 – 31 August 2019

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

Registration is open until 29th June 2019 at <<https://www.egu-galileo.eu/gc5-mass/>>.

**3rd International Workshop and Fieldtrip of IGCP 655 Toarcian Oceanic Anoxic****Event: Impact on marine organisms and ecosystems**

Erlangen, Germany 2 – 5 September 2019

This workshop is open to all researchers focused on the study of the palaeobiological and palaeoenvironmental perturbations associated with the Pliensbachian–Toarcian boundary and the T-OAE. The main topic will be 'Impact on marine organisms and ecosystems'. The workshop is intended to promote active participation of early-career researchers and students. For that reason, a pre-conference training course is offered focusing on quantitative analysis of biological patterns. As a university city, Erlangen offers an academic and welcoming atmosphere right in the heart of the most iconic Jurassic outcrops, which will be visited during the two-day post-conference field-trip. Abstract submission and early (reduced fee) registration end on 3rd May.

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

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

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

The 13th International Symposium on Fossil Cnidaria and Porifera is the traditional meeting of the International Association for the Study of Fossil Cnidaria and Porifera. Symposia are organized every four years and take place around the globe. In 2019 the Symposium will be in Italy for the first time and aims to bring together participants from all over the world to discuss and share the most recent advances in studies of fossil corals and sponges, coral reefs and associated biota. The importance



of the fossil archives will be highlighted with regard to understanding responses of the biosphere to long term environmental perturbations. The Symposium will aim to promote interdisciplinary approaches from a body of interested palaeontologists and biologists, but also scholars in other disciplines.

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

**3rd International Conference of Continental Ichnology (ICCI 2019)**

Martin Luther University of Halle-Wittenberg, Halle, Germany

23 – 29 September 2019

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

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

**International Meeting on the Ediacaran System and the Ediacaran–Cambrian Transition (IMECT 2019)**

Guadalupe, Spain 17 – 24 October 2019

This meeting is open to presentations on all aspects of the Ediacaran System and its boundaries, including organisms and their interpretation, litho/bio/chrono/chemo- and event stratigraphy, sedimentology, geomicrobiology, (bio)geochemistry, geochronology and geodynamics. Particularly welcome are contributions dealing with the nature of the Ediacaran–Cambrian transition. Another topic of recent interest and debate is the number and nature of Ediacaran glaciations. The registration and abstract deadline is 30th May 2019. Field-trips will provide opportunities to visit key outcrops of the Ediacaran and Ediacaran–Cambrian transition in the Central-Iberian Zone of the Iberian Massif.

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



XV International Palynological Congress and XI International Organization of Palaeobotany Congress (XV IPC-XI IOP)
Prague, Czech Republic 12 – 19 September 2020

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

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

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>>.

Zoë Hughes

Ordinary Member

Lyell Meeting 2019

Carbon: geochemical and palaeobiological perspectives

28 June 2019

The Geological Society, Burlington House



The fundamental building block of life as we know it, carbon, is critical to the Earth system. Traditionally biological and chemical approaches to understanding carbon dynamics in the geological past have been considered in relative isolation.

For the 2019 Lyell Meeting we will bring together a broad spectrum of scientists that address the big picture of carbon

in the Earth system, drawing on expertise in palaeontology, geochemistry, palaeobotany, atmospheric processes, deep-Earth processes, and anthropogenic impacts.

This meeting seeks to foster conversation between these disparate communities to facilitate a more holistic approach to considering carbon, and how it cycles between Earth's organic and inorganic reservoirs.

Call for Abstracts

We invite oral and poster abstract submissions for the meeting, and these should be sent in a Word document to ruth.davey@geolsoc.org.uk by **25th March 2019**. Abstracts should be approximately 250 words and include a title and acknowledgement of authors and their affiliations.

Convenors:

Barry Lomax (Nottingham University)
WT Fraser (Oxford Brookes University)

Further information:


For further information about the conference please contact:

Ruth Davey, Conference Office, The
Geological Society, Burlington House,
Piccadilly, London W1J 0BG

T: 0207 434 9944

E: ruth.davey@geolsoc.org.uk

Web: www.geolsoc.org.uk/lyell19

 Follow this event on Twitter #lyell19





Meeting REPORTS



62nd Annual Meeting of the Palaeontological Association

University of Bristol 14 – 17 December 2018

The 2018 Palaeontological Association Annual Meeting was held in Bristol, a university and city which hold a special place in the heart of many Association members. Following morning workshops showing attendees how to use the computer programs RevBayes and Avizo, the meeting began in earnest with the Symposium, held in the beautiful Great Hall of the Wills Memorial Building. The Symposium showcased recent work in dinosaur palaeobiology, and for the first time, the final three talks were open to members of the public. **Darla Zelenitsky** gave the first talk of the day, highlighting key fossils that have impacted our knowledge of dinosaur nests and eggs. **Victoria Arbour** discussed how to determine whether the anatomical features of an animal might have been adapted for combat. **Jingmai O'Connor** presented some exquisitely preserved birds from the Jehol biota which provide direct evidence of diet. **Xing Xu** closed the session by summarizing recent discoveries relevant to the evolution of bird feathers, flight and toes.

The icebreaker followed, held in the lobby of the Life Sciences building. Attendees socialized and enjoyed canapés and drinks under the unusual owl sculptures suspended from the ceiling. Many purchased a t-shirt featuring Mary Anning or Charles Darwin with a Banksy twist, designed by **Suresh Singh**.

The following morning commenced with three parallel sessions, during which **Jed Atkinson** coined the “Brobdingnag effect” as the increase in body size of a new species in the wake of a mass extinction event, **Bertrand Lefebvre** discussed the exceptional soft-body preservation of echinoderms from the Moroccan Fezouata biota, and **Elizabeth Martin-Silverstone** described the first pterosaur from the Isle of Skye. Following the coffee break, the sessions resumed, including **Luke McDonald** using 3D photonic nanostructures in Pleistocene beetles as a window into the evolution of insect colour, **Emma Landon** investigating the taphonomy behind possible fossil embryos from the Ediacaran Weng’an biota, and **Travis Park** looking for convergent evolution in whale cochlea and its implications for the acquisition of echolocation.

During the lunch break an LGBTQ+ meet-up took place, a highly successful new addition to the Annual Meeting. The first session of the afternoon included talks from **Aubrey Roberts**, who examined the biogeography of Jurassic–Cretaceous marine reptiles, and **Holly Betts**, who used gene duplication events to date life’s last universal common ancestor. This was followed by the Annual General Meeting, with an interesting insight into the results of the recently carried out Diversity Study.

After another coffee break, the Annual Address was delivered by **Jane Francis**, who discussed the contribution of Antarctic fossils to our understanding of climate change across deep time and what that might mean for Antarctica in the future. The poster session



Rainbow trilobite badges by Marta Zaher.



*Icebreaker attendees enjoy drinks in the Life Sciences Building, University of Bristol.
Photo: Phil Donoghue.*



then took place, with a plethora of excellent research on display to peruse. This was followed by the Annual Dinner in the Bristol City Museum, with attendees able to wander the galleries before being treated to some excellent food and top-class DJ-ing.

The next morning began with two parallel sessions. In Session 4A, **Nicola Vuolo** described using synchrotron-based tomography to reveal the *in-situ* arrangement of conodont elements, while **Christopher Rogers** investigated the chemical changes experienced by melanosomes during the fossilization process. In Session 4B, **Emma Dunne** revealed a strong relationship between Late Triassic tetrapod distributions and contemporary palaeoclimate, while **Roland Sookias** closed the session by highlighting ways to make morphological evidence build phylogenies that more closely resemble those built based on DNA. Following a coffee break, we resumed with three parallel sessions, including **Ricardo Pérez-de la Fuente** describing some unusual insect larvae preserved in Cretaceous amber, **Thomas Boag** demonstrating that oxygen likely acted as a key spatial control on multicellular life in the Ediacaran, and **Gemma Benevento** considering the impact of the K–Pg mass extinction on mammalian jaw disparity.

After lunch, a further two parallel sessions were on offer. In Session 6A, **Sean McMahon** discussed the challenges of working with the fossil record of seafloor microbes, while in Session 6B, **Silvia Danise** highlighted the importance of understanding local conditions when considering mass extinction kill mechanisms in the marine realm. After coffee, the last session of the conference included talks from **Xiaoya Ma** on the nature of tissues revealed by exceptional preservation in the Chengjiang biota, and **Alexander Hetherington** on the relatively complex path to the evolution of roots in lycophytes, with the final talk given by **Duncan Murdock** on using conodont fossils to test the role of gene regulation in the evolution of biomineralization.

For those who remained for the final day, two field-trips were on offer. One was to Watchet, with many attendees managing to collect an iridescent ammonite or two. The other was to Aust Cliff to collect microvertebrate remains.



Benjamin Moon (far right) explains the geological history of Watchet. Photo: Jakob Vinther.



The President's Prize this year was given to **Elsa Panciroli** for her excellent talk on the Scottish mammaliaform *Borealestes serendipitus*, making use of 3D animation to bring the animal back to life. The Council Poster Prize was awarded to **Nuria Melisa Morales Garcia**, who produced a highly informative and beautifully-designed poster, explaining her research on the application of 2D extruded finite element analysis as an alternative to using CT scans.

Many thanks are due to **Jakob Vinther** and his vast team of co-organizers and helpers for making this year's Annual Meeting a fantastic experience, showcasing a broad spectrum of intriguing research.

Bethany Allen

University of Leeds



1st Palaeontological Virtual Congress

Virtual environment 1 – 15 December 2018

The 1st Palaeontological Virtual Congress was conceived as a typical palaeontological congress but in a completely virtual environment, where researchers from all over the globe could share their work without having the costs usually associated with a conference. The simplicity and efficiency of this new format gave rise to low-cost registration fees and allowed researchers to participate from groups with limited funds and/or developing countries. The success of this proposal was demonstrated by the high number of delegates, with a total of 376 palaeontologists from 41 different countries and five continents registered for this inaugural meeting.

For the 15 days duration, a total of 154 contributions were presented in a variety of formats (video presentations, slide presentations or posters), distributed in 14 different workshops that covered topics ranging through taphonomy, palaeoentomology, new methodologies, palaeoart, palaeobotany, *etc.*, and four general sessions (for the complete list of contributions see our webpage at <<http://palaevoc.uv.es>>). Also, as with a traditional palaeontological congress, we had three keynote lectures, given by **Alex Dunhill** (University of Leeds) on 'A history of the world imperfectly kept: identifying, quantifying and dealing with sampling bias in the fossil record'; **Emilia Jarochovska** (University of Erlangen-Nuremberg) with her work on 'Turning biostratigraphy into big data'; and **Lars van den Hoek Ostende** (Naturalis Biodiversity Center) with a talk entitled 'The ABC of computer: just a big calculator'.

We also managed to introduce important conference aspects, such as field-trips, by adapting them into the virtual format. We developed two 'virtual field-trips', in which we showed the dinosaur sites of Alpuente (a locality close to Valencia, Spain), and we 'visited' the new Natural History Museum of the University of Valencia where classic zoological and geological collections are held. Furthermore, the organizing committee of the congress has arranged the publication of a special issue of the international journal *Palaeontologia Electronica* to include a selection of contributions presented at the congress; this will be online during 2019. The issue will help to gain visibility for delegates' research, a welcome prospect as a great proportion are PhD students and postdoctoral researchers.



The success of the conference was a direct consequence of the different organizations that offered support and helped to advertise it with their membership (see a complete list of our sponsors at <http://palaeovc.uv.es/index.php/sponsors/>). On this matter the organizers are grateful to the PalAss for supporting the event (via Grant-in-aid number PA-GA201808), thereby allowing us to keep the fees as low as possible and allowing the participation of a great number of people with limited resources. We consider that the inaugural congress has accomplished all goals established for this new type of meeting, opening a new way of networking and sharing science in palaeontology. We hope this will be the first meeting in a series of congresses.

Vicente D. Crespo (on behalf of the organizing committee)
University of Valencia





—OBITUARY—

Ralph E. Chapman

1953 – 2018

In 1953 the Korean War ended, Dwight D. Eisenhower became the 34th President of the United States, Elizabeth Alexandra Mary Windsor was crowned Queen Elizabeth II of the United Kingdom, the first successful ascent of Mount Everest was completed by Edmund Hillary and Tenzing Norgay, the first polio vaccine was trialled by Jonas Salk (on his family) and the structure of DNA was announced by Francis Crick and James Watson. That year was also notable for one other important event: the birth of Ralph E. Chapman. While Ralph didn't become president, a member of European royalty or a mountain climber, he did realize his personal dream of becoming a noteworthy professional palaeontologist, an innovative and forward-thinking entrepreneur and a thoroughly decent human being.



Ralph Chapman in 1988 at the Michigan Morphometrics Workshop.

Ralph was a man of many talents, interests and enthusiasms: trilobites, technology, morphology, music, dinosaurs, museums, teaching, writing, science fiction, art, graphics, and 3D scanning to mention a few (in random order). But most of all Ralph was intrigued by people. They might be students, colleagues, mentors, friends, or opponents; it really didn't matter. If your path crossed his, Ralph was interested. Who were you? What was your background? What was your take on the matters at hand? Indeed, what was your take on matters in general? And more often than not, in what ways could he engage with you productively? Thus, aside from being a scholar, an intellectual and a raconteur, Ralph was, above all, a 'people person'.

His formal training was unusual. Ralph took his undergraduate degree at the University of Bridgeport in Connecticut graduating in 1975. From there, he moved on to an MSc programme at the University of Rochester where he studied trilobite palaeobiology under the supervision of Dave Raup and Jack Sepkoski. With this academic pedigree Ralph was on the fast-track to ride the palaeobiology wave that was cresting in 1977–79, a role he prepared himself for by developing his interest and skills in numerical data analysis. However, as fate would have it, his aspirations hit a snag when the PhD programme he'd selected, at the State University of New York, Stony Brook, disintegrated while he was in residence. Never one to be deterred by a setback, Ralph secured a Visiting Scholar Fellowship at Dick Benson's laboratory in the Department of Paleobiology at the National Museum of Natural History – otherwise know to us as 'the Smithsonian' – in 1981. After completing his fellowship Ralph stayed on at the NMNH by accepting a position as Museum Technician. From there he began what can only be described as a steady climb from the lower ranks of museum technical staff to the Directorship of the Smithsonian's Applied Morphometrics Laboratory, a unit he founded, a mere six years later. While at the Smithsonian Ralph was joined by, and later married, Linda Deck, the love of his life.



I first encountered Ralph's name in 1982 when I was a graduate student in Texas with a keen interest in morphometrics, but no one locally who could teach me anything about it. One day a new issue of *Paleobiology* landed on my desk with a review article written by Dick Benson, Ralph and Andy Siegel: *On the Measurement of Morphology and its Change*. This review covered work that had been done on procedures whereby shape change could be expressed as the summed pairwise differences in sets of 2D landmark coordinates after they had been translated, scaled and rotated rigidly to positions such that differences in the locations of corresponding landmarks were minimised globally over the form using the least-squares criterion. Benson had used a previous version of this algorithm, which he referred to as Theta-Rho (or θ - ρ) analysis, in his investigation of shape differences in the ostracode genus *Costa* (Benson 1976a-c) and the algorithm had recently been extended by Siegel (Siegel and Benson 1982) to render its results robust to inhomogeneous deviations confined to one or a few localized landmarks. Geometric morphometricians will be more familiar with Theta-Rho analysis by its mainstream mathematical name, Procrustes analysis, and with Siegel's extension of this procedure as Resistant-Fit Procrustes Analysis, which remains the preferred method for dealing with datasets that contain evidence of inhomogeneous landmark deformations, better known as the 'Pinocchio Effect'; a term Ralph coined. To that time I had trained myself in the procedures favoured by numerical taxonomists and the multivariate morphometrics school (see Blackith and Reyment 1971) which was primarily concerned with the representation of morphology using traditional linear distance measurements. Dick, Ralph and Andy's idea of treating landmark coordinates themselves as data was a revelation to me, though others were also experimenting with a variety of procedures based on this radically new type of data at the time (Younker and Ehrlich 1977; Bookstein 1978; 1980; Lohmann 1983).

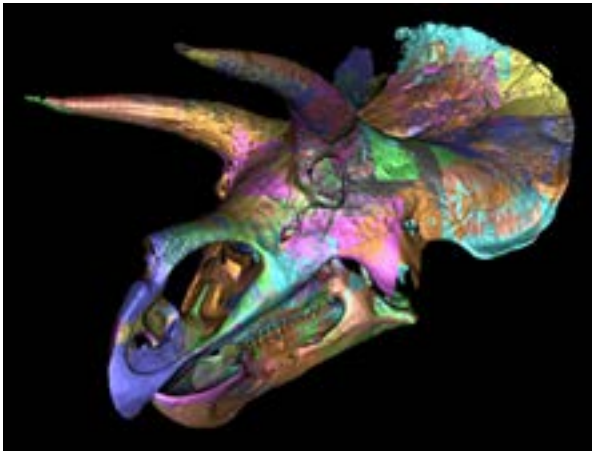
Several years later, when I was working at the University of Michigan's Museum of Paleontology, I was invited by Jennifer Kitchell to help organize an NSF-sponsored morphometrics symposium that would bring representatives of all the various 'schools' of morphometric practice together for discussions, presentations and workshops, and (hopefully) assist in the forging of a synthesis that would serve the needs of researchers who wanted to analyse organismal morphology quantitatively. Ralph was the 'representative' from the Theta-Rho (or Procrustes) school and that was my first opportunity to meet the man in person. The 1988 Michigan Morphometrics Workshop was the nexus out of which geometric morphometrics sprang (see Rohlf and Bookstein 1990) and, during those 12 days in May – some of which were quite intense – Ralph's talents for engaging with people, teaching and explaining complex mathematical concepts in simple terms that even math-phobic systematists could understand were on full and repeated display.

In the capsule histories of the grand 'morphometric synthesis' that have been written to date, David Kendall (*e.g.* Kendall 1984) and Colin Goodall (*e.g.* Goodall 1991) are usually cited as the primary advocates of Procrustes analysis. To a large extent this is correct in that their mathematical treatments were the most advanced and, as a consequence, were the ones focused on by Fred Bookstein (1991) and others. But biologists were far more familiar with the work of Benson, Siegel and Chapman in the run up to the synthesis. I've long hoped that, when the full history of this advance is written, Ralph and his colleagues will get the credit, and the recognition, they deserve.

Aside from publishing both his own research on the applications of morphometrics to (palaeo) biological, archaeological and botanical, forensic and meteoritic problems, teaching, running the Smithsonian AM Lab and collaborating with colleagues (especially students), Ralph could always



be counted on to spot new developments in technology that would become important long before they became commonplace. Perhaps the best example of this ability of Ralph's was his advocacy of 3D scanning, not just as a tool for research, but also for educational and commercial applications. While Ralph made a number of important scans, by far his most famous project in this area was Hatcher, the Smithsonian's *Triceratops*. The NMNH *Triceratops* mount joined the museum's Dinosaur Gallery in 1905 and, as the first 'complete' *Triceratops* to be put on display anywhere, was an immediate hit, drawing large crowds of admiring visitors to its corner routinely, decade after decade. However, unbeknownst to the overwhelming majority of its fans, this mount was a composite, assembled from as many as ten different individuals (including one that was not a *Triceratops*), all of different sizes and levels of completeness. More importantly though, the mount was diseased with pyrite. During all the years it stood in its gallery the Smithsonian's *Triceratops* had been slowly and quietly deteriorating, a fact that became all too obvious in 1996 when part of its pelvis fell off! What to do? Enter Ralph Chapman who led a team of laser scanning specialists to save the *Triceratops* by scanning it. The scanning programme took years. But not only did it allow the bones to be recast and reassembled, size differences between different parts of the skeleton could now be corrected and the pose updated based on the best advice provided by *Triceratops* specialists. As a result of Ralph's work this became the world's first digital dinosaur (Chapman *et al.* 1999). Thanks to the vision and skills of Ralph and Linda (who was the project's Exhibit Director) a commanding piece of the history of our field was saved from destruction so it could continue to inspire both interest in, and support for, our science.



Hatcher's virtual skull with the different scans that became part of the reconstruction shown in different colours. Image courtesy of the Smithsonian Institution.

Ralph left the NMNH in 2002 to form the Idaho State University's Idaho Virtualization Laboratory at the Idaho Museum of Natural History, which maintains an active and innovative natural history 3D scanning programme to this day. In 2007 Ralph followed Linda to Los Alamos, New Mexico where she took up the position of Director of the Bradbury Science Museum and he started several businesses involving 3D scanning systems and virtualization. In addition to these professional activities Ralph always taught and served as a mentor to countless students, not only through his professional activities at the NMNH and various universities, but also more informally at meetings, conferences, symposia and by providing classroom lectures for students of all ages and at all levels.



The passing of Ralph Chapman, in addition to being a tragedy for his family and friends, was a loss to all palaeontologists because Ralph was one of those rare individuals who served not only as a vital contributor to our science, but also as an educator, technologist, developer, strategist, public advocate, successful business leader and general-purpose cheerleader. His enthusiasm was infectious, insight profound, and collaboration critical to the success of many projects more closely associated with others rather than himself. In his life his work wasn't recognized with awards from professional societies or election to honorary positions. Ralph largely spent his time working behind the scenes and managed to get by almost solely on the basis of the joy he took from his work, along with the encouragement he received from family, friends, students and colleagues. All this was always delivered with Ralph's characteristic grace, high spirits and indelible sense of fun.

Ralph was one of the all-round 'good guys' of our field. He is, and will be, missed.

Norman MacLeod

Natural History Museum, London

Acknowledgements

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Research Grant REPORTS

Resolving the evolutionary relationships of the Ediacaran biota with new quantitative methods

Jennifer F. Hoyal Cuthill

Earth-Life Science Institute, Tokyo Institute of Technology

Department of Earth Sciences, University of Cambridge

The extension of the macro-fossil record back into the Neoproterozoic stands as one of the most remarkable achievements in twentieth century palaeontology. Despite considerable efforts and corresponding debate, however, the evolutionary relationships of the Ediacaran biota had not previously been phylogenetically established. This project set out to test the possible evolutionary relationships of key taxa by formal morphological phylogenetic analysis. This focused on the large, soft-bodied, 'frondose', members of the Ediacaran and Cambrian biotas, whose relationships have been perhaps most enigmatic. Phylogenetic analysis of distinctive fossil groups presents particular challenges, not least that hypotheses of character homology must be built from the ground up without the long-established precedents available for extant groups. A second challenge was the exceptional diversity of evolutionary affinities that had been hypothesized in the Ediacaran literature, from protozoans (Seilacher 1989) to bilaterians (Gold *et al.* 2015).

This project aimed to formally test the diversity of possible relationships for key Ediacaran and Cambrian genera by combining three approaches which were new for this field. First, hypotheses of character homology were grounded in a quantitative model of growth and development for one of the included groups, the rangeomorphs (Hoyal Cuthill and Conway Morris 2014; 2017), and encoded based on specific observations of fossil morphology, including quantitative measurements from documented specimens. Second, a wide range of eleven outgroup taxa, from giant protozoa to algae, fungi and animals, were included to test a diversity of possible affinities. This meant that character coding had to permit both comparisons within the distinctive Ediacaran biota itself and resolution of wider relationships across these very different outgroups. Third, character coding was documented using annotated photographs of fossil specimens in the online data management system, Morphobank (project 2695 <<https://morphobank.org/>>). This considerably aided the character coding process as well as facilitating open access release of 74 photographs of Ediacaran and Cambrian fossil specimens taken for the project (Hoyal Cuthill and Han 2018a).

The fundamental basis for this phylogenetic study was on-site examination of Ediacaran and Cambrian fossil specimens from the world class, type and figured fossil collections of the South Australian Museum, National Earth Sciences Museum of Namibia (e.g. Figure 1) and Northwest University, China. A Palaeontological Association Research Grant made the Ediacaran component of this research project possible, allowing visits to both the South Australian Museum and the Namibian Geological Survey in 2015. The staff of both museums were incredibly hospitable, providing both access to their spectacular fossil collections and valuable discussion.



Figure 1. A classic specimen of the Ediacaran fossil genus *Rangea*. Specimen F-392 held in the National Earth Sciences Museum of Namibia. Length of specimen is 4.3 cm.

Two papers informed by these research visits were published in 2017 and 2018: a quantitative study examining environmental effects on Ediacaran growth (Hoyal Cuthill and Conway Morris 2017) and the phylogenetic analysis that was the principal aim of the PalAss-funded research (Hoyal Cuthill and Han 2018b).

This phylogenetic analysis had three main conclusions. First, long-noted morphological similarities between members of the Ediacaran biota (Pflug 1972; Seilacher 1989) collectively provide very strong phylogenetic support for a distinct clade (Figure 2), which we call Petalonamae (Hoyal Cuthill and Han 2018b) based on phylogenetic extension of the phylum originally proposed by Hans Pflug (Pflug 1972). The studied Ediacaran genera grouped within clade Petalonamae were *Rangea*, *Pteridinium*, *Ernietta*, *Swartpuntia*, *Arborea*, *Pambikalbae* and *Dickinsonia*. Second, evidence for active movement and locomotion in *Dickinsonia* (Ivantsov 2011) provides phylogenetic support for the placement of Petalonamae as a clade of early animals, located as sister group to the Eumetazoa (Buss and Seilacher 1994; Jenkins and Nedin 2007; Vickers-Rich 2007; Brasier and Antcliffe 2008; Sperling and Vinther 2010; Dufour and McLroy 2018). This is in-line with additional biomarker evidence that *Dickinsonia* was an animal (Bobrovskiy *et al.* 2018). Third, the morphologically similar frondose genus *Stromatoveris* from the lower Cambrian Chengjiang biota is also placed within clade Petalonamae. This provides formal phylogenetic evidence that some representatives of this distinctive Ediacaran clade survived beyond the onset of the Cambrian explosion (Conway Morris 1993; Jensen *et al.* 1998; Hagadorn *et al.* 2000; Shu *et al.* 2006).

Acknowledgments

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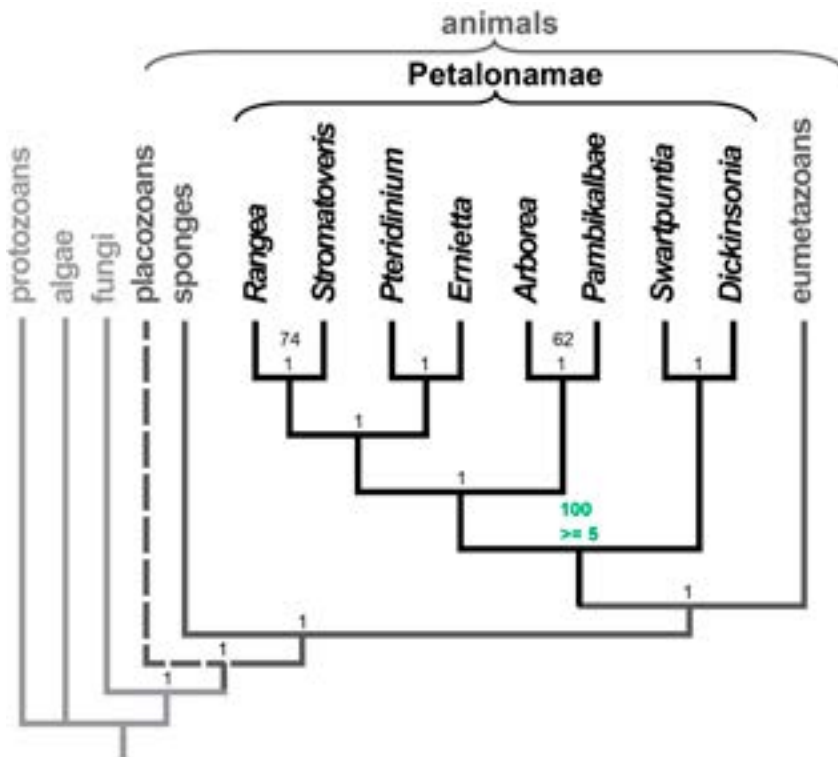


Figure 2. Morphological phylogeny placing Ediacaran and Cambrian fossil genera (black labels) in the tree of life. Strict consensus tree reconstructed using parsimony analysis of 42 photo-referenced morphological characters (Hoyal Cuthill and Han 2018b). Condensed outgroup clades shown with grey labels. Tree length = 66, CI = 0.65 RI = 0.85. Upper numbers show bootstrap support values (>50); lower, decay index. Support values for clade Petalonamae are shown in green.

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Small Grant REPORTS

Reconstructing diets of non-mammalian fossil taxa from the Solnhofen archipelago

Jordan Bestwick

School of Geography, Geology and the Environment, University of Leicester

Introduction

Dental microwear textural analysis (DMTA) is a robust technique for testing dietary hypotheses in extant and fossil taxa (Purnell *et al.* 2013; Gill *et al.* 2014). Microwear is produced when organisms feed, as interactions with food items cause scratching and chipping of tooth enamel. Microwear formation is thus determined by the material properties of food and provides direct evidence of consumed items without assuming a relationship between the morphology and inferred functions of teeth (Purnell *et al.* 2012; Daegling *et al.* 2013). Most fossil DMTA research has focused on mammals as microwear from extant mammals is linked with known dietary differences and thus serves as suitable modern analogues (Purnell *et al.* 2013). My PhD is providing the first evidence that microwear from extant reptiles, from both terrestrial and aquatic taxa, also contains dietary signals. Extant reptiles can thus serve as suitable analogues for inferring diets of non-mammalian fossil taxa, which can help reconstruct a larger number of extinct food webs (Bestwick *et al.* 2018).

An important extinct food web to test DMTA is the biota of the Solnhofen archipelago, Germany. This Upper Jurassic Lagerstätte is renowned for its well-preserved, articulated skeletons of numerous unrelated reptiles, including pterosaurs, lepidosaurs, marine crocodyliforms and most famous of all, the first bird, *Archaeopteryx* (Kemp 2001). Proposed diets for Solnhofen taxa are based on qualitative comparisons of morphological structures, such as the shape and arrangement of teeth, with few means of testing these ideas (Kemp 2001; Bestwick *et al.* 2018). The Solnhofen biota thus serves as a representative case study to determine for the first time: (i) whether DMTA can detect dietary differences from the microwear of non-mammalian fossil taxa; and (ii) robustly test hypotheses of competition for food between Solnhofen taxa.

Microwear collection and analyses

The Sylvester-Bradley Award from PalAss allowed me to sample Solnhofen specimens from the Bayerische Staatsammlung für Paläontologie und Geologie, Munich (BSPG), Staatliches Museum für Naturkunde, Karlsruhe (SMNK) and Staatliches Museum für Naturkunde, Stuttgart (SMNS). A range of Solnhofen taxa were sampled, including pterosaurs, metriorhynchid crocodyliforms, sphenodontids (Sphenodontia; rhynchocephalian lepidosaurs) and ichthyosaurs (Figure 1 A–D respectively). High-resolution moulds were taken of teeth using a polyvinylsiloxane compound which replicates features on tooth surfaces down to the nanometre-scale (Goodall *et al.* 2015) and is non-destructive and harmless to specimens. These moulds were subsequently infiltrated with an epoxy resin to produce high quality cast replicas of the teeth. Microwear data were then collected

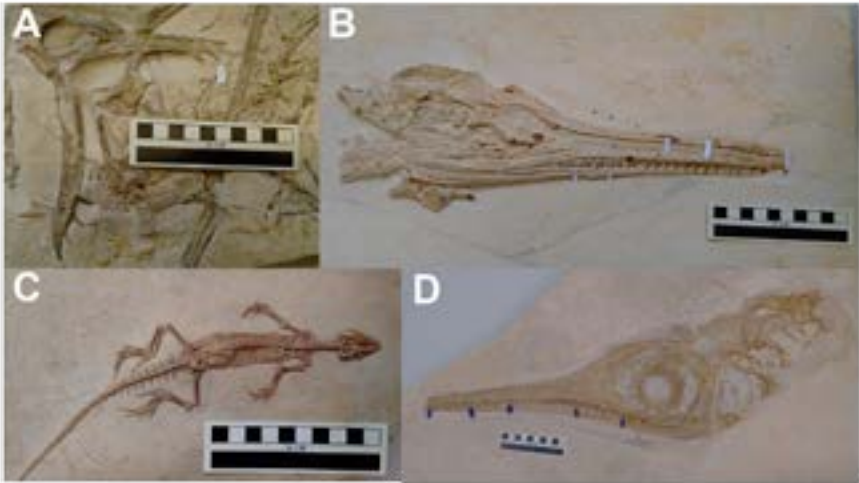


Figure 1. Example Solnhofen specimens and taxa sampled as part of the project: A. *Rhamphorhynchus*, a pterosaur (BSPG 1929 I 69), B. *Geosaurus*, a metriorhynchid crocodyliform (BSPG 1977 XIX 38). C. *Homoeosaurus*, a sphenodont reptile (BSPG 1911 I 34) and; D. an *indet. ichthyosaur* (SMNS 54067).

from the labial, non-chewing tooth surfaces using an Alicona InfiniteFocus microscope. The dataset was bolstered by adding data from Solnhofen pterosaurs in the Natural History Museum, London (NHMUK) and Museum für Naturkunde, Berlin (BMMS), collected on previous visits. DMTA work from my PhD is revealing that subtle textural differences from the labial, non-chewing tooth surfaces of modern crocodylians and varanid lizards are determined by dietary differences, such as vertebrate and invertebrate-dominated diets. Microwear data from the Solnhofen taxa were thus projected into the modern reptile dataset to infer the likely diets of the extinct taxa.

Preliminary results

Solnhofen taxa exhibit a range of rough and smooth microwear textures which, thanks to the modern reptile comparative dataset, indicates dietary differences between the extinct taxa. *Archaeopteryx* microwear overlaps with microwear from the emerald tree monitor lizard (Figure 2), a consumer of high proportions of orthopteran insects (crickets and grasshoppers) (Losos and Greene 1988), which are classified as ‘intermediate’ invertebrates, *i.e.* intermediate levels of force are needed to pierce their exoskeletons (Aguirre *et al.* 2003). This does not mean that *Archaeopteryx* consumed orthopterans, but rather it consumed items with similar material properties. Microwear data from other Solnhofen flying reptiles, *e.g.* pterosaurs, indicate different diets. *Rhamphorhynchus* microwear overlaps with fish-eating crocodylians *e.g.* the gharial (Figure 2), and *Pterodactylus* microwear is similar to the omnivorous Gray’s monitor lizard (fruits and snails) (Bennett 2014). This is the first quantitative evidence of niche partitioning between pterosaurs and birds and provides vital information for the debate on whether these animals competed for food (Benson *et al.* 2014).

Dietary overlap, and thus potential competition, is likely for the marine reptiles. Metriorhynchid crocodyliform (*Cricosaurus* and *Geosaurus*) and ichthyosaur microwear indicate similar mixed-diets of vertebrates (fish and/or other marine reptiles) and invertebrates. This could indicate that Solnhofen waters were very resource-rich to have supported several contemporaneous taxa with

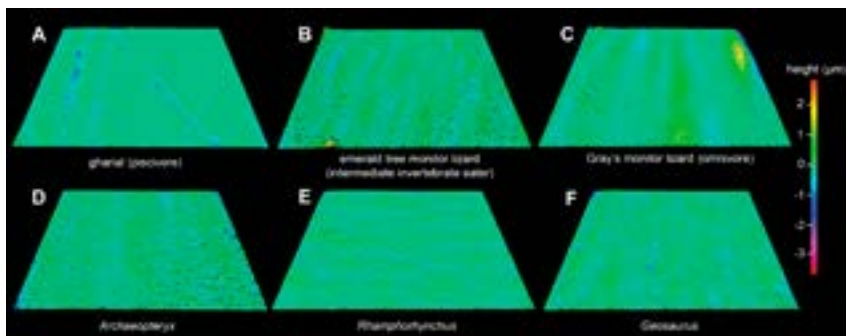


Figure 2. Example scale-limited tooth surface textures. A–C, modern reptiles: A. gharial (piscivore); B. emerald tree monitor lizard ('intermediate' invertebrate eater); and Gray's monitor lizard (omnivore). D–F, Solnhofen taxa: D. Archaeopteryx, the first bird; E. Rhamphorhynchus, a pterosaur; and F. Geosaurus, a metriorhynchid crocodyliform. Measured areas are 146 x 110 μm in size. Topographic scale is in micrometres.

similar diets (Kemp, 2001). Lastly, *Homoeosaurus* and *Pleurosaurus* are terrestrial and semi-aquatic sphenodontids respectively (Kemp 2001), and their microwear suggests they both may have fed on 'hard' invertebrates comparable to modern crustaceans and shelled gastropods. This indicates the complexity of this extinct food web, as taxa that occupy different biotopes perform similar ecological roles, in this case, hard-item feeders.

Conclusion

This project has demonstrated that 3D DMTA can detect dietary signals from the non-chewing tooth surfaces of extinct, unrelated reptiles from non-mammalian-dominated palaeoecosystems. This provides the first quantitative information on the diets of the Solnhofen biota, which is vital for representatively reconstructing this famous Mesozoic ecosystem. DMTA can thus be applied to other palaeoecosystems to infer the diets of respective taxa and quantitatively test hypotheses of competition and coexistence.

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Testing global oceanic anoxia as an alternative cause for the Hirnantian (latest Ordovician) mass extinction

Julie De Weirdt

Department of Geology, Ghent University

Introduction

Cooling and glacial episodes that coincide with $\delta^{13}\text{C}_{\text{carb}}$ excursions have long been considered the main driver of Late Ordovician–Silurian (mass) extinction events. Over the last decade however, emerging palaeontological, geological and geochemical evidence for protracted cooling during most of the Ordovician and the misalignment between major regressions and faunal turnovers in the Upper Ordovician (Ghienne *et al.* 2014) suggest a more complex relationship between glaciations and extinctions. Emsbo *et al.* (2010) demonstrated dramatic enrichments in redox-sensitive metals during the early Wenlock Ireviken extinction event and suggested ocean anoxia as an alternative global kill-mechanism. Vandenbroucke *et al.* (2015) built on this idea and recorded a similar increase of redox-sensitive metals at the onset of the mid-Pridoli extinction event, coinciding with peak abundances of malformed (teratological) fossil microplankton (acritarchs and chitinozoans). Different metal peaks were measured in the host rock and in the malformed microfossils. By analogy with metal-induced malformations in modern marine microplankton, teratology might serve as an independent proxy for monitoring changes in the metal concentration of the Palaeozoic oceans. These data from the Ireviken and Pridoli events are the foundation for the hypothesis that many, if not all, of these Late Ordovician–Silurian extinctions are linked to large-scale oceanic anoxic events (OAEs). My project aimed to test the hypothesis that OAE scenarios are applicable to other Late Ordovician and Silurian (O–S) biogeochemical events.



Microprobe and LA-ICP MS analyses

In order to test this hypothesis, we systematically evaluated plankton population dynamics and palynomorph (chitinozoans, acritarchs) geochemistry at high resolution through O–S events and corresponding $\delta^{13}\text{C}$ excursions. In the initial phase, a total of 125 bulk rock samples (pXRF and ICP) were analysed, spanning the Hirnantian strata (Vauréal, Ellis Bay and Becscie formations) of Anticosti Island, Canada (Figure 1). Our choice of sections was guided by the presence of teratological acritarchs that overlap the base of the extinction horizon (Delabroye *et al.* 2012). The geochemical data revealed distinct signatures in redox-sensitive metals, which correlate with the levels of teratology and extinction. These data support ocean anoxia and metal pollution as contributors in the Hirnantian extinction.

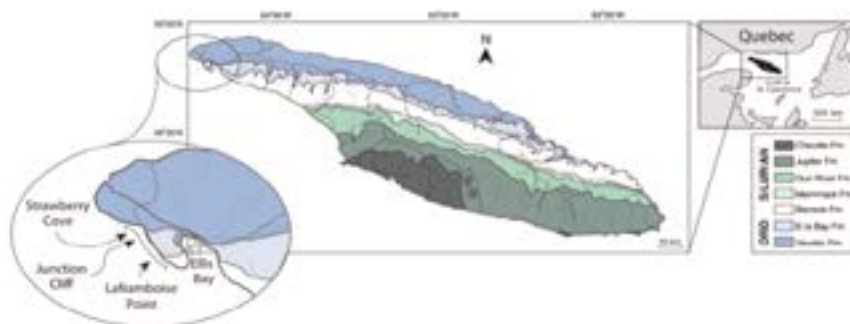


Figure 1. Geological map of Anticosti Island, Canada, showing formation outcrop patterns with geographic sampling locations (modified from Delabroye *et al.* 2012).

In order to confirm that these geochemical signatures are true palaeoceanic signatures and directly affected the fauna, we have now analysed a suite of isolated palynomorphs across the event. Vandembroucke *et al.* (2015) used ToF-SIMS to analyse chitinozoans; however, although the trends are informative in a single section, these data were semi-quantitative. Thus, we have developed a new methodology that combines electron microprobe analysis and LA-ICP-MS to fully quantify the major and trace element compositions of the microfossils. The Sylvester-Bradley Award enabled me to travel to the geochemistry labs of the US Geological Survey (Denver, Colorado) where we fine-tuned this quantitative state-of-the-art method for analysing the chemical composition of palynomorphs. This novel approach has overcome issues associated with fossil mounting and polishing and developed chemical standardization techniques.

Application of this new method has characterized the trace element composition of a total of 592 palynomorphs across the Upper Ordovician strata of Anticosti Island and revealed chemical trends in the palynomorphs that coincide with periods of biological and environmental change. Importantly, a series of single-specimen analyses seems to demonstrate taxon differentiation for certain trace elements, which raises the tantalizing possibility that the elemental signature represents the *in vivo* composition. In fact primary, these chemical signatures might help unravel the biology of these organisms and their sensitivity/tolerance to metals that may ultimately identify chemical changes in marine environments. These preliminary findings suggest that chemical palynology is an exciting frontier with the potential to revolutionize our understanding of biological and geochemical interactions, helping illuminate Earth's deep history.



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A new Burgess Shale-type locality from British Columbia

Javier Ortega-Hernández

Department of Organismic and Evolutionary Biology, Harvard University

For more than a century, the Burgess Shale biota has cast new light on the early evolution and diversification of some of the oldest communities in the fossil record. The best-known localities are found on Mount Stephen (e.g. Trilobite Beds) and Fossil Ridge (e.g. Walcott Quarry) in Yoho National Park (British Columbia, Canada). However, recent studies have expanded the geographic distribution of Burgess Shale-type localities throughout the Western Canadian Sedimentary Basin (e.g. Butterfield and Nicholas 1996; Johnston *et al.* 2009a, b; Caron *et al.* 2010). Here, I provide a preliminary account of the fossil biota preserved at the 'Mummy Lake site', a new Burgess Shale-type locality in Kootenay National Park, British Columbia, as well as its wider palaeontological significance.

Results

The fossiliferous site is located in the vicinity of Mummy Lake, in close proximity to the border between Kootenay National Park and Banff National Park (Alberta). The biota is diverse, composed primarily of biomineralizing organisms with relatively rare instances of soft-bodied fossils. The most conspicuous components are trilobites, represented by up to a dozen different species (Figure 1); *Olenoides serratus* (Figure 1A) and *Ptychoparella (Elrathina) cordillerae* (Figures 1B, I) are the most common forms. The trilobite fauna is particularly interesting in the palaeontological context of



Figure 1. Trilobite diversity in Mummy Lake locality, Stephen Formation (Middle Cambrian), British Columbia. A. *Olenoides serratus* (Rominger 1877). B. Slab with various individuals of *Ptychoparella* (*Elrathina*) *cordillerae* (Rominger, 1887). C. *Elrathia* ?*permulta* (Walcott, 1918). D. *Chancia palliseri* (Walcott, 1980). E. *Oryctocephalus burgessensis* Resser, 1938. F. *Oryctocephalus reynoldsi* Reed 1899. G. *Kootenia burgessensis* Resser, 1942. H. *Ptychagnostus praecurrens* (Westergaard, 1936). I. Slab with *P. cordillerae* and *P. praecurrens*. J. *Bathyriscus* ?*adaeus* Walcott, 1916. K. *Ehmaniella waptaensis* Rasetti, 1951. L. *Ogygopsis klotzi* (Rominger 1887). M. Metamorphically deformed pygidium of *O. serratus* collected to the SE of the main Mummy Lake locality. N. *Bathyriscus rotundatus* (Rominger, 1887).



the region, as all of the identified species have also been reported from the Trilobite Beds in Mount Stephen that belong to the Middle Cambrian Stephen Formation (see Rudkin 2009). The presence of the trilobite *Ogygopsis klotzi* (Figure 1L) at the Mummy Lake site, although rare, is very significant as it provides strong biostratigraphic evidence correlating the Mummy Lake biota specifically with those found in Mount Stephen. The Mummy Lake trilobite fauna also shares some species with other recently discovered localities in the area, namely The Monarch (Johnston *et al.* 2009a), Haiduk and Tangle Peaks (Johnston *et al.* 2009b), and to a lesser degree at Stanley Glacier in Kootenay National Park (Caron *et al.* 2010) (Table 1).

Table 1. Trilobite species found in the Mummy Lake site, and comparison with trilobite diversity from other Burgess Shale-type localities in Western Canada. The Monarch (Johnston *et al.* 2009a); Haiduk and Tangle Peaks (Johnston *et al.* 2009b); Trilobite Beds, thick Stephen Formation (Briggs *et al.* 1994; Rudkin 2009); Stanley Glacier, thin Stephen Formation. (Caron *et al.* 2010). *Indicative of great abundance in Mummy Lake site.

No.	Taxon	Trilobite Beds	The Monarch	Haiduk and Tangle Peaks	Stanley Glacier
1	<i>Bathyriscus ?adaeus</i>	Yes	—	Yes (genus)	—
2	<i>Bathyriscus rotundatus</i>	Yes	—	Yes (genus)	—
3	<i>Chancia palliseri</i>	Yes	Yes	—	—
4	<i>Ehmaniella waptaensis</i>	Yes	Yes	—	Yes (genus)
5	<i>Elrathia ?permulta</i>	Yes	—	Yes (genus)	—
6	<i>Kootenia burgessensis</i>	Yes	Yes	—	—
7	<i>Ogygopsis klotzi</i>	Yes	—	—	—
8	* <i>Olenoides serratus</i>	Yes	Yes	Yes (genus)	—
9	<i>Oryctocephalus burgessensis</i>	Yes	—	—	—
10	<i>Oryctocephalus reynoldsi</i>	Yes	—	—	—
11	* <i>Ptychoparella (Elrathina) cordillerae</i>	Yes	Yes	—	—
12	<i>Ptychagnostus praecurrens</i>	Yes	Yes	Yes (genus)	—

The Mummy Lake site also preserves a number of non-arthropod biomineralizing organisms, including brachiopods, sponges, cancelloriids, cnidarians and primitive echinoderms (Table 2). *Chancelloria eros* is noticeably abundant and well preserved within a localized area in the outcrop, which suggests that the fossil biota was buried *in situ* thus allowing the intact preservation of these delicate organisms. Finally, there is a low diversity of non-shelly organisms preserved in the Mummy Lake site, such as algae and remains of *Eldonia* guts.

Similar to the trilobite fauna, the non-arthropodian fossil composition of the Mummy Lake biota bears a close similarity to those reported from various localities in Mount Stephen, and to a lesser degree in Monarch Cirque and Haiduk and Tangle Peaks. The Mummy Lake site also preserves a number of more unusual forms, including articulated calyces of the crinoid-like organism *Echmatocrinus brachiatus* (see Sprinkle and Collins 1998) and well-preserved specimens of the rare Burgess Shale sponge *Feldospongia bellilineata*, (see Rigby and Collins 2004).

Discussion

The biostratigraphic profile of the Mummy Lake site confirms that it belongs to the Middle Cambrian Stephen Formation, within the *Bathyriscus-Ptychoparella (Elrathina)* trilobite biozone (see Rudkin 2009). However, it is uncertain whether the exposed rocks are equivalent to the so-called “thick” Stephen Formation (mainly exposed at Mount Stephen in Yoho National Park) or the recently reported “thin” Stephen Formation observed at Stanley Glacier at Kootenay National Park (see



Caron *et al.* 2010). The extent of the Stephen Formation exposed near Mummy Lake never reaches more than 60 m in thickness, and the close vicinity to the exposures of thin Stephen Formation from Stanley Glacier (Caron *et al.* 2010) suggests that the Mummy Lake site could also correspond stratigraphically to the latter subunit. However, this conclusion is not supported by the marked discrepancies in terms of the preserved biota observed in both localities, particularly the trilobites, which rather indicate that the Mummy Lake site is palaeontologically more similar to the outcrops in Mount Stephen that correspond to the thick Stephen Formation (e.g. Trilobite Beds) (see Tables 1 and 2).

Table 2. Non-arthropod species found in the Mummy Lake locality, and comparison with fossil diversity from other Burgess Shale-type localities in Western Canada. The Monarch (Johnston *et al.* 2009a); Haiduk and Tangle Peaks (Johnston *et al.* 2009b); Trilobite Beds, thick Stephen Formation (Briggs *et al.* 1994; Rigby and Collins 2004; Rudkin 2009); Stanley Glacier, thin Stephen Formation (Caron *et al.* 2010).

No.	Taxon	Mount Stephen	The Monarch	Haiduk and Tangle Peaks	Stanley Glacier
1	? <i>Acrothyra gregaria</i> (brachiopod)	Yes	Yes	Yes	Yes
2	<i>Byronia annulata</i> (?cnidarian)	Yes	Yes	Yes	-
3	<i>Chancelloria eros</i> (chancelloriid / incertae sedis)	Yes	Yes	Yes	-
4	<i>Diraphora bellicostata</i> (brachiopod)	Yes	Yes	-	-
5	<i>Echmatocrinus brachiatus</i> (echinoderm)	Yes	-	-	-
6	<i>Eldonia ludwigi</i> (?echinoderm)	Yes	-	Yes	-
7	<i>Fieldospongia bellilineata</i> (sponge)	-	Yes	-	-
8	<i>Gogia stephenensis</i> (echinoderm)	Yes	-	-	-
9	<i>Margerita dorus</i> (alga)	Yes	Yes	Yes	Yes
10	<i>Vauxia cf. ampliata</i> (sponge)	Yes	Yes (genus)	Yes (genus)	-

Further work on the Mummy Lake biota will focus on the palaeoecological implications of this diverse fossil assemblage (e.g. Johnston *et al.* 2009a), and also aim to clarify the biostratigraphic significance of this site in the context of other Burgess Shale-type localities in Kootenay.

Acknowledgements

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Evaluating bite marks and predation of heterostracan ostracoderms (fossil, jawless vertebrates) during the rise of jawed vertebrates

Emma Randle

School of Earth and Environmental Sciences, University of Manchester

Introduction

One of the most important events in our own evolutionary history is the evolution and rise to dominance of gnathostomes (jawed vertebrates). However, just as important is the decline and subsequent extinction of our jawless relatives (ostracoderms) during the Devonian. There are many hypotheses surrounding this event including: the inability of ostracoderms to adapt to changing environments; their limited dispersal capabilities; and competitive displacement or predation by jawed vertebrates (Janvier 1996; Purnell 2001; Anderson *et al.* 2011; Blicek 2011; Friedman and Sallan 2012; Sansom *et al.* 2015). The circumstances surrounding this event are much debated, however raw diversity indices (Anderson *et al.* 2011; Sansom *et al.* 2015) show a clear shift from jawless vertebrate dominated assemblages in the Silurian to jawed vertebrate dominated



assemblages towards the end of the Devonian. Predation of jawless vertebrates has previously been identified in isolated examples, for example, bite marks have been found in the dermoskeletons of heterostracans from the Welsh Borders of the UK, Baltic and Podolian deposits and a single occurrence in the Emsian of the Western-USA (Early-Late Devonian) (White 1935; Tarrant 1991; Lebedev *et al.* 2009; Elliott and Petriello 2011; Johanson *et al.* 2013; Tuuling 2015; Glinskiy and Mark-Kurik 2016). The aim of this project is to investigate predation of jawless vertebrates by their jawed cousins by addressing the following questions: does ostracoderm predation trace occurrence increase through time; and how does this relate to the rise to dominance of jawed vertebrates? Predation trace marks on heterostracan fossils were identified via first-hand observations of museum collections, as well as through literature review. These data were subsequently collated through time. Traces were identified by one or more of the following criteria: i) traces having a regular geometric shape; ii) traces are distributed non-randomly (for example in a linear pattern); iii) evidence of gouges and scratches; iv) evidence of sub-lethal damage, *i.e.* the jawless fish escaped and healed; v) deformation cracks around the wound; vi) evidence of complementary traces on both sides of the animal (Figure 1). The abundance of these predation traces was then systematically compared to diversity indices for ostracoderms and gnathostomes through the Middle Silurian to Upper Devonian.

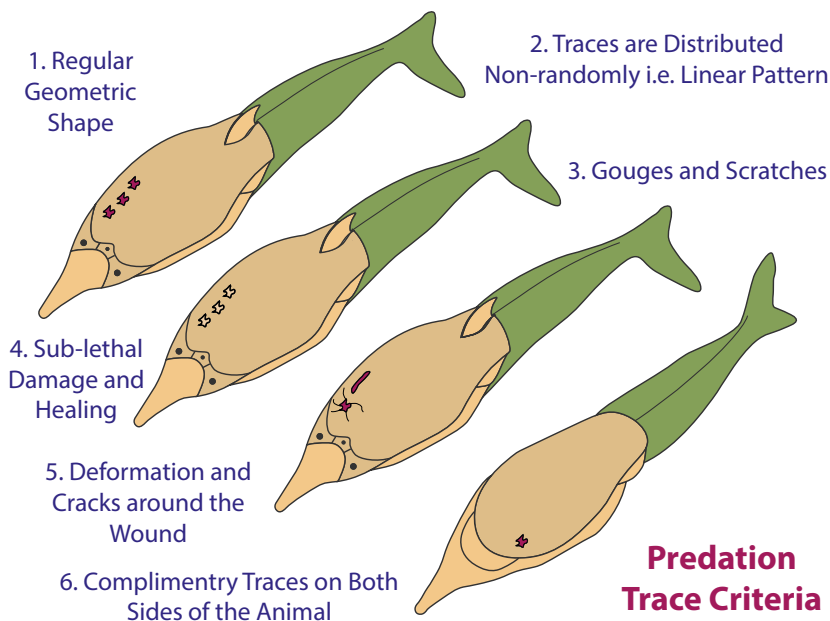


Figure 1. Criteria for identifying predation traces on jawless vertebrates.

Museum data collection

The Palaeontological Association's Stan Wood Award enabled me to visit the University of Alberta early vertebrate collections (Figure 2 A-B), which contain very important fossils predominantly from the Man on the Hill (MOTH) site in the Mackenzie Mountains, Northwest Territories of Canada. The MOTH site and surrounding localities preserve some of the earliest records of many taxa including

major clades of Heterostraci (Soehn and Wilson 1990). The locality is renowned for its extraordinary preservation of articulated early vertebrates, such as the Wenlock age (Middle Silurian) *Atheneagis*, the oldest articulated heterostracan (Soehn and Wilson 1990; Hanke and Wilson 2006; Hanke and Davis 2008; Scott and Wilson 2012; 2015).

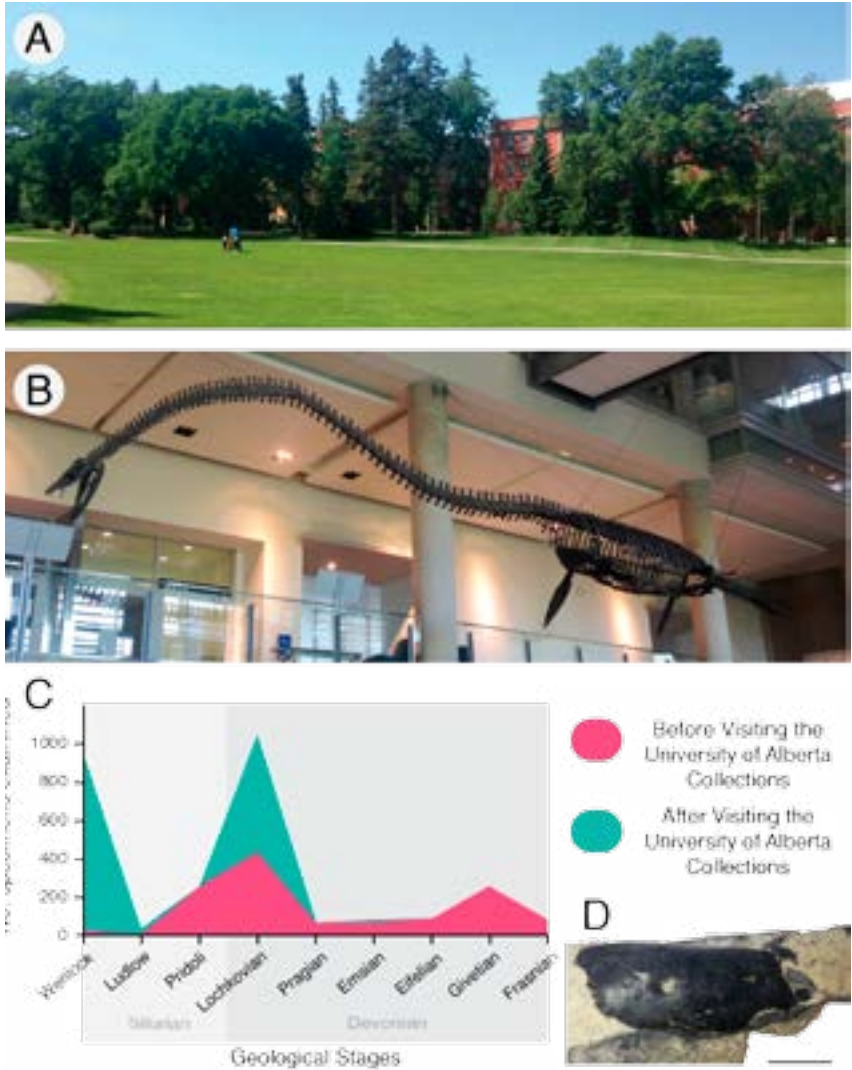


Figure 2. A. University of Alberta, Edmonton. B. Plesiosaur in the Faculty of Sciences at the University of Alberta. C. Number of jawless vertebrates (Heterostraci) examined before and after the University of Alberta collections visit. D. Specimen of an unknown cyathaspid UALVP34698 with potential predation trace. Scale bar is 10 mm.



Prior to my visit to the University of Alberta collections I had severely under-sampled the earliest stages of heterostracan evolutionary history (Figure 2C). The visit increased my sample size from 22 to 951 specimens in the Wenlock alone. Whilst in the collections I examined 1,561 specimens, of which two contained potential predation traces. These predation traces were identified in a *Pionaspis* specimen on display in the University of Alberta Museum and in an unidentified cyathaspid specimen in the collections. Both traces were identified based on their circular shape and deformation of the head shield around the puncture mark. The specimens examined ranged from disarticulated remains to fully articulated forms, some even preserving the caudal region. Taxa examined included many forms belonging to the Cyathaspididae, ?Traquiraspididae, Pteraspidiformes and problematica heterostracans.

Future Work

The data collected on my research trip to the University of Alberta collections have contributed towards a project entitled 'Evaluating bite marks and predation of heterostracan ostracoderms (fossil, jawless vertebrates) during the rise of jawed vertebrates', which is currently in preparation for submission. The project assesses the distribution of predation traces through time and the co-occurrence of jawed vertebrate taxa (*i.e.* potential predators) with jawless forms. The grant also permitted me to collect valuable data for my heterostracan phylogenetics project, as I was able to examine specimens and taxa that I had previously only seen in the literature. The trip thus enabled me to gain a deeper understanding and appreciation of heterostracan anatomy and morphological variation.

Acknowledgements

I would like to thank the Palaeontological Association for the Stan Wood Award (PA-SW201602), along with John Bruner, Dr Mark Wilson and Dr Alison Murray (all University of Alberta) for hosting me and allowing me to visit their collections, along with all other museum staff for enabling my visit.

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Undergraduate Bursary **REPORTS**

Postcranial anatomy of a new plesiosaur from the Oxford Clay

Elizabeth Griffiths

Department of Earth Sciences, University of Oxford

Introduction

Plesiosaurs are a group of Mesozoic marine reptiles that represent the most successful radiation of Sauropterygia. They ranged from the Late Triassic through to the Late Cretaceous period, spanning approximately 185 million years (Benson and Druckenmiller 2014). There are two main morphotypes that plesiosaurs fit into: the plesiosaumorph (long neck, small head) and pliosaumorph (short neck, large head), each of which evolved multiple times within the lineage. As such, neck length is an important character to assess given the huge disparity in vertebral counts displayed across the clade (Soul and Benson 2017). This project was based around the fossil of a Cryptoclidid plesiosaur from the late Middle Jurassic, discovered in the Oxford Clay formation near Peterborough, UK. Cryptoclididae include both morphotypes but most specimens are fragmented and well-preserved cranial and postcranial material in a single fossil is rare.

The specimen comprises a virtually complete skull and an extensive postcranial skeleton with presacral, sacral and anterior caudal vertebrae. Much of the postcranial skeleton is contained within carbonate nodules – it is both costly and difficult to physically extract the skeleton from these concretions and the large size makes lab-based micro-CT scanning ineffective. In order to obtain the data needed, high-powered CT scanning was carried out in collaboration with the Warwick Manufacturing Group (University of Warwick). These CT scans were segmented using Mimics software, and the 3D models produced were then analysed for comparative anatomy and phylogenetics (Figure 1).

CT scan results and comparative anatomy

A series of 24 free cervical vertebrae plus a further 15 still encased in rock can be identified, giving a minimum total of 41 cervical vertebrae (including the atlas and axis). The anterior free vertebral series is not necessarily continuous and some vertebrae may be missing. The cervical zygapophyses face dorsomedially and there is a median contact present from most of the anteroposterior length splitting the zygapophyses into two distinct facets which are transversely concave. Both the prezygapophyses and postzygapophyses are transversely narrower than the centrum width at $\sim 1/3$, compared to the much wider prezygapophyses of *Tricleidus seeleyi* which are $\sim 1/2$ of the centrum width and *Kimmerosaurus* which are even wider at ~ 0.7 of the centrum width. On the prezygapophyses which are fully preserved there is evidence of a small process on the posterior dorsal edge (Figure 2). This posterior process is not observed in any of the other taxa compared and is thought to be an autapomorphy for this species.

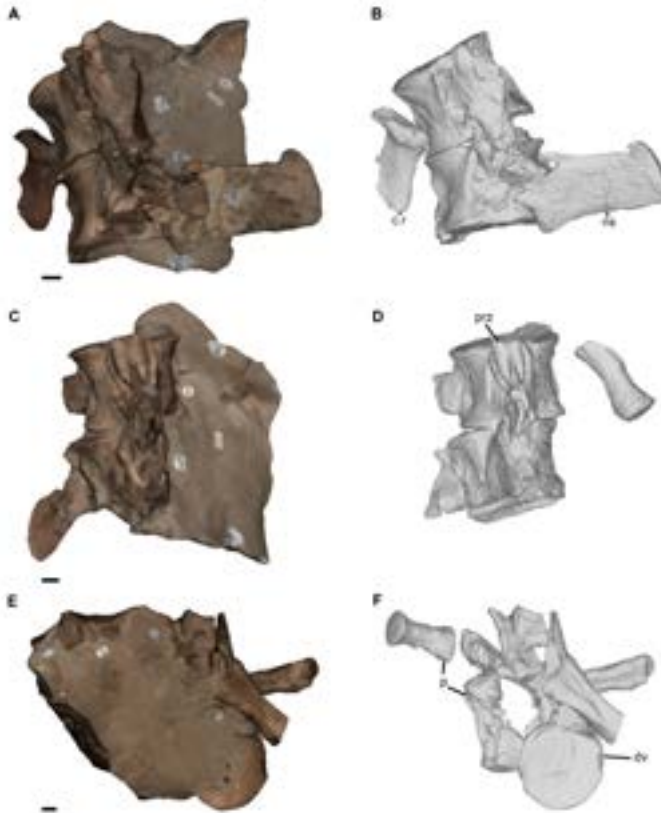


Figure 1. Nodules AA, BB and HH showing cervical and dorsal vertebrae. Abbreviations cr = cervical ribs; ns = neural spine; prz = prezygapophyses; dv = dorsal vertebra; p = phalanx. Scale bars are 10 mm.

There are four free dorsal vertebrae preserved along with three encased in nodules which have been successfully scanned and imaged, one in nodule LL which has not been scanned and another five or six in nodule GG which have not been scanned and are therefore only partially observed. Neural arches and spines are preserved in three of the four free vertebrae and the neural arches with partial spines are present in the two scanned dorsals. Of the unscanned nodule, four complete neural spines protrude from the rock (these are yet to be measured, however). The neural spine height is much greater than the centrum height in all cases measured, with a spine to centrum height ratio of 2 in [036-38]. Spines are transversely narrower than their anteroposterior length and show anteroposterior constriction at the base. Both the posterior cervical and dorsal neural spines show a hook-like structure on the anterodorsal edge, which is more pronounced in some vertebrae than others. This protrusion is not evident in the posterior dorsal series, although this may be due to damage and is also not observed in *Cryptoclidus eurymerus*, *Kimmerosaurus*, *Muraenosaurus leedsi*, *Picroclidus beloclis* or *Tricleidus seeleyi* (Brown 1981; Andrews 1910; Knutsen *et al.* 2012).

The sacral vertebrae are contained within nodule MM along with three sacral ribs visible on the surface of the nodule. There are a possible eight vertebrae contained within nodule MM, only one



of which can be definitively confirmed as a sacral vertebra from surface observations. There are only six free caudal vertebrae present and a possible five or six more encased in the nodules. There are no neural spines preserved in the free vertebrae although the neural arches are present to some extent in all.

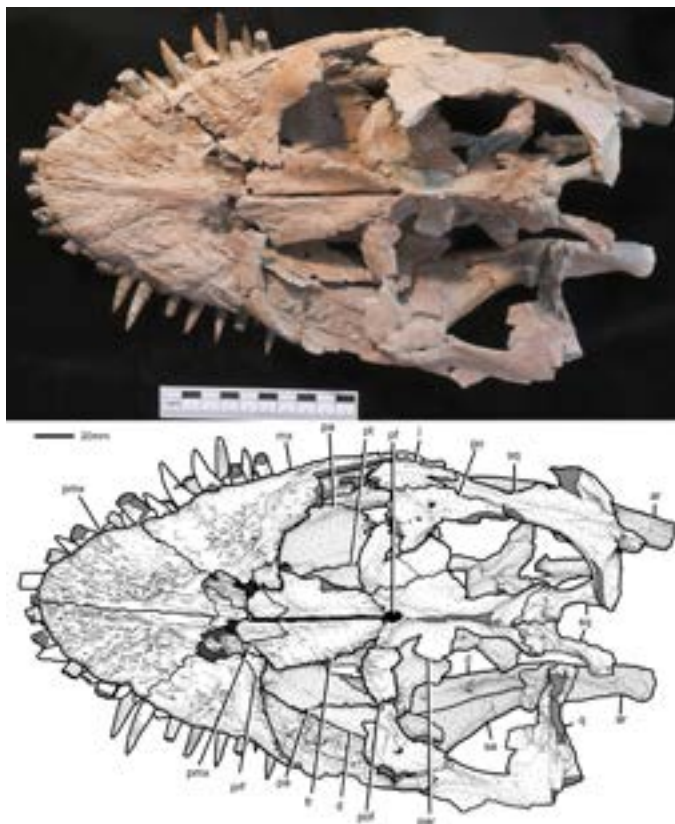


Figure 2. Skull dorsal view. Abbreviations: *pmx* = premaxilla; *mx* = maxilla; *pt* = pterygoid; *pf* = pineal foramen; *j* = jugal; *po* = post orbital; *sq* = squamosal; *prf* = prefrontal; *fr* = frontal; *d* = dentary; *pof* = postfrontal; *par* = parietal; *sa* = surangular; *q* = quadrate; *ar* = articular.

The skull, which is virtually complete, has been physically extracted from the concretion and reconstructed for display in the Oxford University Natural History Museum along with the rest of the specimen (Figure 2). The phylogenetic relationships of this new Cryptoclidid are as yet unknown, but the morphological data provided by this specimen should allow for this analysis and provide valuable insight into this enigmatic group.

Acknowledgements

I would like to thank Roger Benson, Hillary Ketchum, the Oxford University Natural History Museum and Warwick Manufacturing Group (University of Warwick) for their support and cooperation during this project, as well as the Palaeontological Association for the Research Bursary (grant number PA-UB201803) that made this possible.



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The oldest urolith? Investigating a possible kidney stone from the Kimmeridgian (Jurassic) of Dorset

Thomas Henton

School of Geography, Earth and Environmental Sciences, University of Birmingham

Introduction

Uroliths such as kidney or bladder stones are near-spherical objects with a layered phosphatic structure, sometimes with a hollow centre. Each layer is composed of parallel crystals oriented perpendicular to the surface, a defining feature. They are known in the archaeological record but are almost entirely absent from the fossil record, most likely a consequence of simply not being recognized for what they are. Superficially, they could easily be dismissed as nodules of geological rather than biological origin. A specimen collected by Steve Etches in the mid-2000s from the Upper Kimmeridge Clay marine deposit at Kimmeridge in Dorset, UK (Upper Jurassic, 152 Ma) was subsequently recognized as a potential urolith by Nigel Larkin and could be the earliest known example of this type of trace fossil by far. The previous oldest known example was from a terrestrial Oligocene (35–40 Ma) deposit in Colorado, USA and is thought to be of mammalian origin (Rothschild *et al.* 2013).

Methodologies

In order to try and confirm the identity of the Kimmeridge specimen it was examined using a combination of macroscopic, microscopic and geochemical analytical techniques, and compared with a number of mammalian uroliths loaned from the Royal College of Surgeons and the UCL Pathology Museum. X-ray diffraction (XRD) work had previously been undertaken by Peter Tandy (Natural History Museum, London) on the Kimmeridge specimen and this was augmented by energy dispersive X-Ray spectrometry (EDS) using doubly-polished thin sections that had been histologically studied using Nomarski differential interference optics.

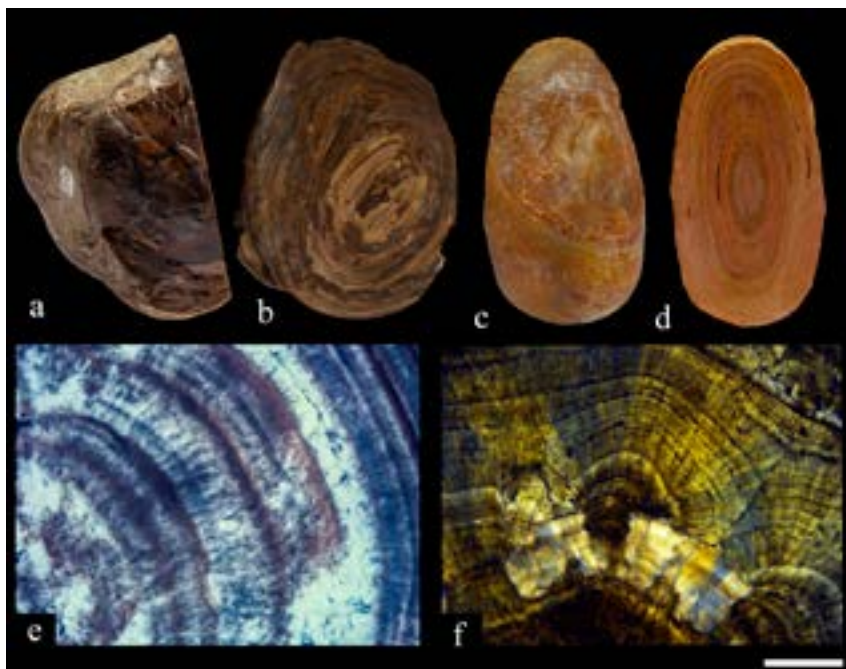


Figure 1. Kimmeridge urolith in (a) external and (b) cut surface views; human urolith in (c) external and (d) cut surface views. Photomicrographs of thin sections of (e) Kimmeridge specimen and (f) human urolith illustrating incremental growth and crystallite orientation. Scale bar represents 2cm (a,b), 3cm (c,d), 1mm (e) or 1.5mm (f).

Results

Macroscopic examination of the Kimmeridge specimen and mammalian uroliths showed the same gross external appearance with a mamillated texture whilst the interior illustrated the lamellar construction in both fossil and recent material. Microscopic examination revealed prominent crystallites orientated largely perpendicular to the individual lamellae in common, with microcrystalline quartz (presumably of diagenetic origin) replacing some of the original fabric in the Kimmeridge specimen and infilling voids in the lamellae. XRD and EDS results confirmed the presence of quartz in the Kimmeridge specimen as well as identifying the primary lamellar material as calcium phosphate (a known constituent of uroliths).

Conclusions

The Kimmeridge specimen displays several of the key features associated with uroliths. The surface mamillated texture is consistent with modern day uroliths. In cut surfaces, a lamellar structure is clearly visible, and interlamellar gaps/holes have been subsequently infilled with diagenetic mineral phases. In thin section, crystallites are evident running perpendicular to the lamellae, again a diagnostic feature of uroliths. A primary composition of calcium phosphate has been determined from the lamellar original fabric, whilst the diagenetic and infilling mineralogy is predominately quartz. Overall, analyses strongly suggest the Kimmeridge specimen is indeed a urolith. Given that it was found in the Upper Kimmeridge Clay which is an Upper Jurassic marine deposit, as well



as the size of the specimen, the most likely source of the urolith is a large marine reptile, with ichthyosaurs, plesiosaurs and pliosaurs all potential progenitors of the specimen. This also adds to the diverse and exceptional range of unusual fossils recovered from the unit (Etches *et al.* 2009). This extends the range of known uroliths in the fossil record by at least 112 million years, as well as extending the range to include marine environments and probably to large marine reptiles. More uroliths must exist in the fossil record and possibly even in museum collections already but are unlikely to have been recognized as such, perhaps being misinterpreted as geological rather than biologically-produced stones.

Acknowledgements

I would like to thank the Palaeontological Association for providing the opportunity to undertake this project (grant number PA-UB201810), as well as giving thanks to Ivan Sansom (University of Birmingham), Nigel Larkin (University of Cambridge), Dick Shelton (University of Birmingham) and Steve Etches (The Etches Collection) for their assistance and contributions to the project.

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Endocranial anatomy of a durophagous Permian actinopterygian

George Willment

Department of Earth Sciences, University of Oxford

Introduction

Actinopterygians (ray-finned fishes) contain just over half of living vertebrate diversity, split unevenly into cladistians, chondrosteans, holosteans and teleosts, containing ~12, ~25, ~8 and ~36,000 species respectively (Faircloth *et al.* 2013; Giles *et al.* 2017). The Palaeozoic record of actinopterygians is filled with a diverse but nebulous series of indeterminate ‘palaeonisciforms’, a paraphyletic assemblage of mostly inadequately described taxa (Sallan 2014; Friedman 2015; Giles *et al.* 2017). Continuous reassessment and revision of the descriptions of these fossils is helping to plug the gaps in actinopterygian history; the placement of scanilepids as stem polypterids, for example. Recent analyses have suggested another ‘palaeonisciform’ group, the deep-bodied platysomids, as branching from the depauperate chondrostean stem (Giles *et al.* 2017; Latimer and Giles 2018), but this is yet to be explicitly tested with targeted anatomical study.

Platysomids are a group of Permian–Carboniferous (~360–250Ma) dorsoventrally elongate, laterally-compressed and sharp-snouted fish that may represent some of the earliest actinopterygian ecological experimentations (as durophages; Agassiz 1838; Moy-Thomas and Miles 1971). Platysomids suffer from the problem of antiquated taxonomic divisions, where polyphyletic collections were erected on the basis of convergent body plans, and are now in need of serious



taxonomic revision (Moy-Thomas and Dyne 1938). Subsequently, deep-bodied taxa were separated into Platyosomidae, Amphicentridae and Bobasatraniidae, but later taxonomic work suggests that platyosomids nest within Bobasatraniidae (Campbell and Le Duy Phuoc 1983), perhaps hinting at a genuine cladistic association. Exhaustive description of taxa assigned to *Platysomus* are scarce, with descriptions of the endocranium particularly so, and it is likely that the genus is paraphyletic (Zidek 1992; Mickle and Bader 2009). Even where data are available, they are rarely incorporated into phylogenetic analyses, with the diversity of platyosomids typically represented by just a single genus.

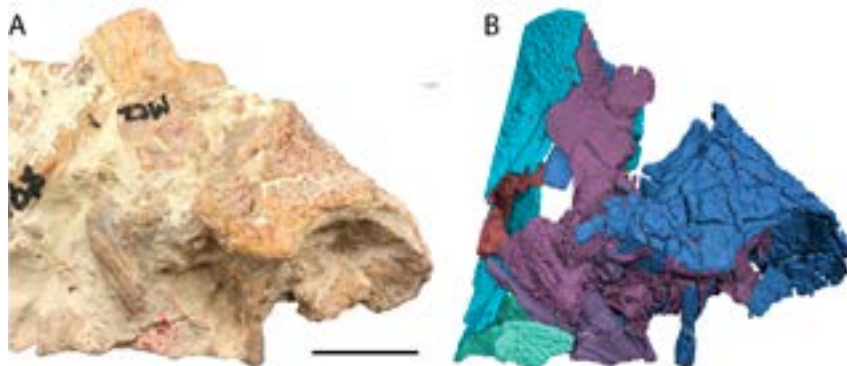


Figure 1. Photograph (A) and digital render (B) of *Platysomus* sp. in right lateral view. Skull roof in blue, braincase and parasphenoid in purple, shoulder girdle in turquoise, operculogular system in green. Scale bar is 1 cm.

Aims and methods

The aim of this project is to describe an articulated, three-dimensionally preserved cranium of *Platysomus* sp. from the Permian of Texas, curated in the Museum of Comparative Zoology, Harvard, and CT-scanned at the University of Michigan. New anatomical data provided from this study will represent a framework in which to later test *Platysomus* monophyly and the relationships of the group to living actinopterygian radiation. Segmentation was completed in Materialise Mimics Suite, with the resultant models exported to and imaged in Blender. CT-scanning revealed that the fossil was significantly more deformed than was apparent from external observation. The left half of the skull roof and braincase has collapsed, and the braincase is very fractured. As a result, segmentation was much more challenging than anticipated and took longer than originally planned for.

Anatomical description

Dermal bone structure. The dermal bones are extraordinarily thick, and their histology is clear in the scan, although the bone is often fractured. The top layer of the skeleton is made up of tubercles with large pulp cavities. Below this is a thick layer with few large elongate openings. The basal layer of bone is thinly layered. Dermal bones are deeply interdigitated with each other at suture lines. The entire dermal skeleton is covered with well-developed rugose ornament, and tubercles are particularly large on the skull roof.

Skull Roof. The skull roof is composed of several large plates that are tightly sutured together, with joins between separate bones occasionally visible on their under surface. The posterodorsal margin of the orbit is marked by a large octagonal bone pierced by a large canal that runs the length of the ascending process of the parasphenoid. The orbit appears to be roofed by three irregular

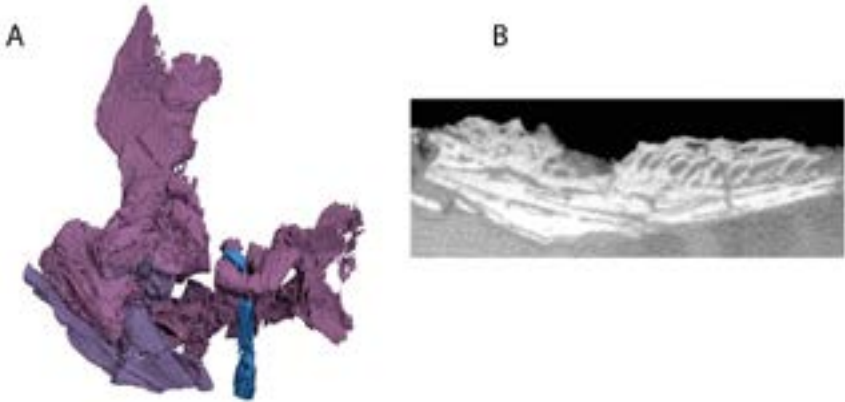


Figure 2. A. Braincase (light purple), parasphenoid (dark purple) and ascending process of the parasphenoid (blue) in right lateral view. B. Section through skull roofing bone showing histology.

bones, with rectangular nasal and postrostrals anterior to the orbit. The parietals and frontals are large, and rise to a peak along the dorsal midline of the specimen. The posterodorsal corner of the skull roof is expanded into a large, unornamented lenticular region, most likely for overlap with the bones of the shoulder girdle. Two or three small, rounded bones sit on this overlap area, although it is not clear whether they represent presupracleithra or extrascapulars.

Shoulder girdle. The bones of the shoulder girdle are separated from the skull roof due to specimen breakage. At least three extrascapulars are present on each side. The supracleithrum is very large, with an unornamented overlap area along its dorsal margin. The posttemporal is large and rectangular, and forms a dorsal ‘peak’ along the top of the skull.

Operculo-gular system. Only fragments of the operculum and left suboperculum are present in the scan. The dorsal margin of each bone is gently curved. The ornament is made up of widely-spaced rounded tubercles.

Parasphenoid. The anterior half of the parasphenoid is not preserved. The posterior part sits directly beneath the braincase, and is V-shaped with posterior wings ‘hugging’ the lateral faces of the braincase and reaching its posterior margin. The ascending processes are also preserved. These are well-ossified and contact the skull roof dorsally, carrying a wide canal – possibly for the spiracle – along their entire length. This process is articulated on the right side of the braincase but highly fragmented on the left.

Braincase. The braincase is highly incomplete, and is difficult to interpret where it has been broken and distorted. The occipital portion is clearest. Its posterior face is flared laterally into craniospinal processes. It is pierced by a notch for the dorsal aorta, a cylindrical notochordal canal and a large, triangular foramen magnum. A groove for the jugular canal is present on the left side of the braincase and can be traced anteriorly to the postorbital process, which it pierces. One of the most obvious features of the braincase is the prominent supraoccipital crest, a dorsal extension of the occiput. Its base is pierced by two canals, which appear to run into the cranial cavity. The braincase is T-shaped in anterior view, and a little of the interorbital septum is preserved.



Endocast. The endocast is also highly incomplete as the specimen has broken and sheared along the midline of the braincase. The otic region of the labyrinth is best preserved, with parts of the horizontal and anterior semi-circular canals interpretable. These join at slight bulges, which represent anterior and exterior ampullae and the utriculus. Little else of the labyrinth can be reconstructed, although a posterior and ventral bulge likely represents the sacculus. Within this, an irregularly-mineralized pear-shaped ossification may be an otolith. The main part of the endocast is an irregular, bulbous block, terminating posteriorly at the foramen magnum. Ventral to this is an elongate, roughly cylindrical cast, a trace of the notochordal canal, which remains separate from the endocast along its length.

Comparison with other platysomids

A number of platysomids have been reported from the Permian of Texas before (*Platysomus palmaris*, Cope 1891; *Platysomus* sp., Wilson 1950; *Schaefferichthys leuderensis*, Dalquest 1966). However, these are largely known from flattened postcrania and scales, making comparison with the specimen described here difficult. Broad similarities can be drawn with other platysomids, including the tightly-sutured dermal bones, and with platysomids and bobasatraniiids, including the pronounced dorsal peak of the braincase and skull roof. The braincase and parasphenoid are poorly known in other platysomids, although large posterior wings of the parasphenoid are known in *Platysomus superbus* (Traquair 1881) and *Bobasatrania mahavavica* (Lehman 1952). While neither of these taxa appear to possess canal-bearing ascending processes, presence of this feature is confirmed in unpublished scan data of the Carboniferous *Platysomus 'parvulus'* (S. Giles pers. comm.).

Comparison with chondrosteans

Unfortunately, there is little anatomical data to support a close relationship with chondrosteans. The skull roof of chondrosteans is heavily reduced, and it is difficult to assess the presence or absence of braincase similarities. The parasphenoid of chondrosteans does not bear long ascending processes or broad posterior wings, and it is deeply notched at the posterior midline. More data, particularly from the endocranium of other platysomids and bobasatraniiids, are needed to test this hypothesis in a phylogenetic framework. It will also be important to revisit the anatomy of other purported stem chondrosteans.

Acknowledgements

Firstly I would like to thank Dr Sam Giles for initially offering the project, and for all of her immensely useful advice and effort during the subsequent segmentation and write-up. Prof. Matt Friedman identified the fossil and provided the CT-scan. I would also like to thank the Palaeontological Association for the award of Undergraduate Research Bursary number PA-UB201809 to fund the project, and St Anne's College (University of Oxford) for providing a vacation residence grant to help with costs.

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Morphometric data from new Paleocene dermochelyid may help clarify comparative rates of evolution in marine turtles

Stephanie Wright

Department of Earth Sciences, University of Oxford

Introduction

Sea turtles (Chelonioidae) today comprise two families: Cheloniidae and Dermochelyidae (Bonin *et al.* 2006). The Dermochelyidae are taxonomically depauperate, having only one extant representative, the leatherback turtle (*Dermochelys coriacea*). This turtle shows more extensive adaptation to marine life than other marine turtles, demonstrating truly pelagic habits. A new



specimen of a dermochelyid from the Palaeocene of Morocco reveals new information on stasis in the leatherback turtle lineage. The well-preserved skull is similar to modern leatherbacks. In particular, it has a beak region that is similar to the extant leatherback, suggesting that it had a similar feeding ecology, despite its age (~60 Ma). This suggests that rates of cranial evolution on the dermochelyid stem-lineage, which originated in the Cretaceous (e.g. Cadena and Parham 2015), may have been very slow in the Cenozoic in comparison to relatives. Using a database of 3D scans of living and fossil chelonioid skulls, including all extant species, and geometric morphometrics, we demonstrate that *Dermochelys* represents a morphologically conservative evolutionary lineage compared to other chelonioids.

Materials and methods

Sea turtle skulls were digitally landmarked using Avizo 8. Digital models of skulls were mostly from CT data, and some were surface-scanned. A combination of segmented digital models, literature and photographs of specimens were used to place the landmarks in the correct places. A total of 64 landmarks and 22 sliding semilandmark curves were placed. In fossil specimens where the skull was incomplete and not all landmarks could be placed, the full landmark constellations were reconstructed using the most complete side of the skull.

The geomorph package in R was used to implement principal components analyses (PCA) of the landmark data. Some specimens were incomplete, and each PCA uses only those landmarks that could be placed in every specimen included in each analysis, selecting specimens carefully to allow high levels of completeness. The new dermochelyid was added to the phylogenetic matrix of Evers *et al.* (in review), 100 most parsimonious trees (MPTs) were subsampled, and time-scaled in R v. 3.5.1 (R Development Core Team 2018) with *a posteriori* scaling methods using the cal3 method of (Bapst 2013). Principal components scores, and ten pruned time-calibrated phylogenies, were then used to estimate relative rates of evolution in the full skull, just the beak, and the non-beak region of the skull, using VarRates in BayesTraitsV3 (<<http://www.evolution.rdg.ac.uk/>>). This uses independent contrasts and a reversible jump Markov Chain Monte Carlo algorithm to detect rate shifts in a lineage using multivariate trait data.

Results

Principal component axis 1 (PC1) explains 41.15 % of the variance in our sample of extant turtles (Figure 1), and describes the difference between dermochelyids (at negative values) and cheloniids (at positive values). The shape changes are shown in Figure 2. Negative values indicate a generalized dermochelyid-like morphology that is present in both *Dermochelys* and the new fossil, with recognizable features such as the deep notch in the trituration surface of the maxilla, and the tiny supraoccipital crest. Positive values of PC1 describe a generalized Cheloniid, with a straighter trituration surface and large supraoccipital crest. PC2 describes within-group variation seen in both dermochelyids and chelonioids, with negative values describing a more dorsoventrally compressed skull, with a less prominent cheek emargination and more prominent temporal emargination. Positive values of PC2 describe a taller skull, with a more prominent cheek emargination and less prominent temporal emargination.

More complex morphological variation is evident when analysing a more complete sample of fossil chelonioids (Figure 3), nevertheless, dermochelyids cluster together with low PC scores for both PC1 and PC2. Protostegids and cheloniids seem to cluster together with higher values of both PC1 and

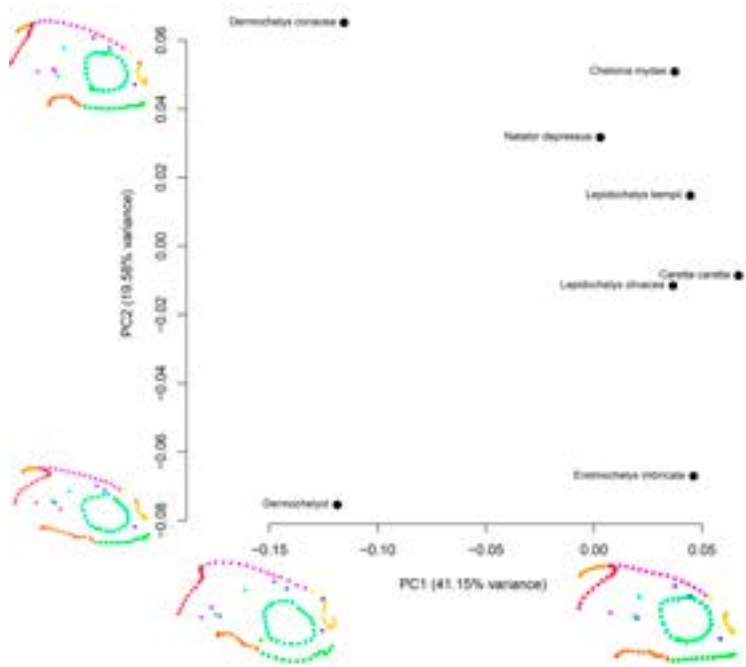


Figure 1. Principal components analysis including all extant sea turtles and the new Dermochelyid with visualizations of maximum and minimum principal components scores for PC1 and PC2.

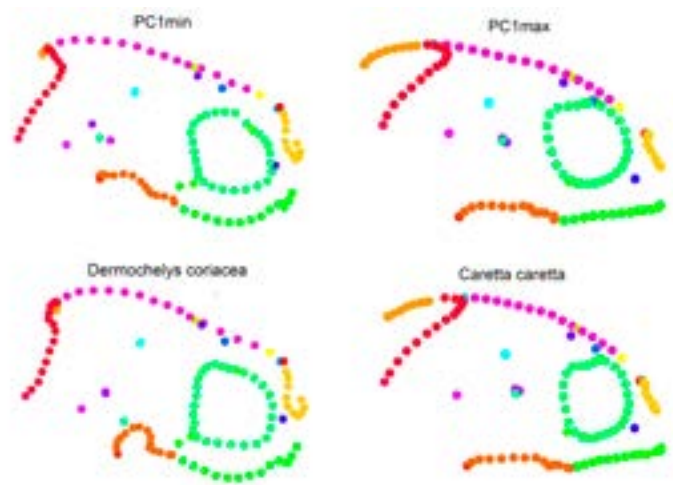


Figure 2. Visualizations of minimum and maximum principal components scores for PC1, and visualizations of the landmark placements of Dermochelys coriacea and Caretta caretta for comparison.

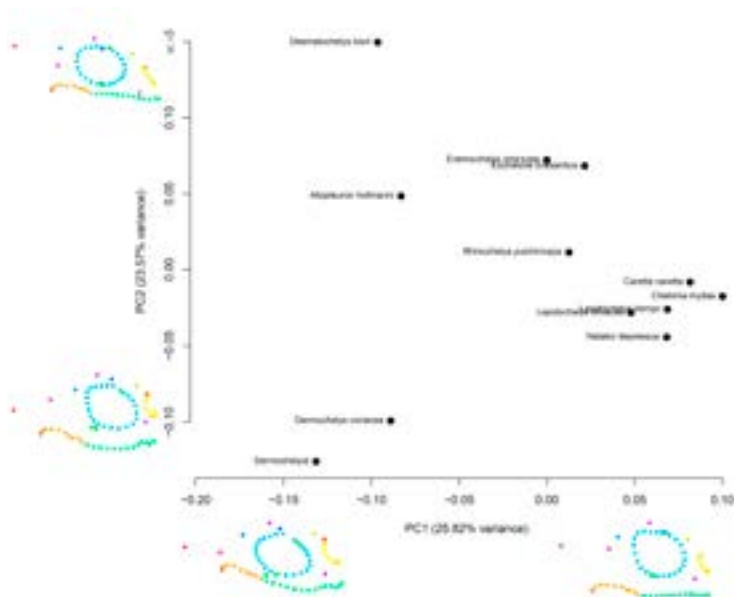


Figure 3. Principal components analysis including all extant sea turtles, the new *Dermochelyid*, and a selection of near-complete fossils, with visualizations of maximum and minimum principal components scores for PC1 and PC2.

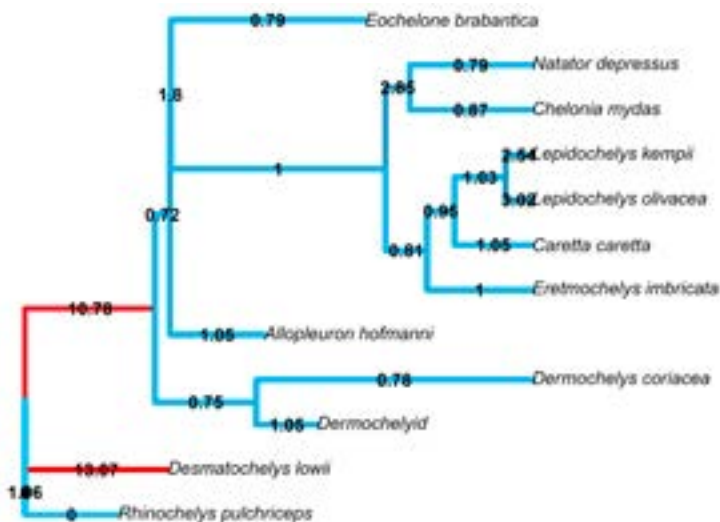


Figure 4. Phylogenetic tree of turtles with branch lengths representing time, and branch colour and branch labels representing relative rates of evolution of the beak.



PC2. This emphasizes the relative similarity of the new fossil to *Dermochelys* in the wider context of the total-group of Chelonioidea.

The results of our multivariate analysis of evolutionary rates are shown in Figure 4, using just one of the ten time-calibrated phylogenies. Nevertheless, results on other phylogenies were similar. *Dermochelys coriacea* shows comparatively low rates of evolution with reference to the beak, on a relatively long branch. In other words, the beak of *Dermochelys* has changed little since it diverged with the other dermochelyid in this study.

Discussion

The new Dermochelyid provides insight into dermochelyid evolution. Some recognizable traits seen in the extant *Dermochelys* evolved early in the Paleogene, such as the deep notch in the triturating surface of the maxilla, and the tiny supraoccipital crest. The shape of the beak, a trait that has clear ecomorphological significance, has been quantitatively found to be an example of stasis. Modern *Dermochelys* survive almost entirely on jellyfish, and the comparatively small amount of change in a part of its anatomy intimately related to feeding suggests that perhaps so too did its Palaeocene ancestors. The fact it is the beak in particular that has shown stasis could also be an indication of a sort of modularity in the turtle skull, wherein some inter-related sections of the skull (modules) evolve at different rates to others.

This work was carried out with Prof. Roger Benson and Dr Serjoscha Evers, with grant number PA-UB201701.

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Book Reviews

The Rise and Fall of the Dinosaurs: A New History of a Lost World

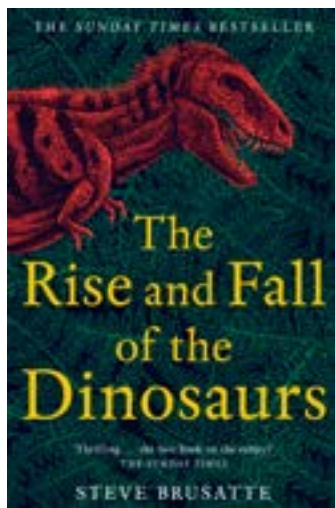
Steve Brusatte. 2018. Pan Macmillan. 416pp. £20 (hardcover).

ISBN: 9781509830060.

The Rise and Fall of the Dinosaurs is Steve Brusatte's first book aimed at an adult, non-specialist audience. Steve is no stranger to the world of book-writing, having previously written a textbook on dinosaur palaeobiology and a children's book. Steve is Reader in Vertebrate Palaeontology at the University of Edinburgh, where his research focuses on the origin and early evolution of the dinosaurs, and the end-Cretaceous mass extinction. Brusatte's writing style is fluent and engaging, and he has the ability to capture the imagination of his audience using vivid imagery, compelling the reader to turn the pages. The book is very accessible to those with some prior knowledge of dinosaur palaeobiology, and those coming to the subject for the first time.

The book starts with the origin and evolution of the dinosaurs and their rise to dominance. There are two chapters dedicated to probably the most famous dinosaur of all time, *Tyrannosaurus rex*, in which Brusatte details the most cutting-edge science to have been carried out on this animal to date. The tale is then resumed, with a focus on the origin of flight, the evolution of birds, and finally the extinction of the non-avian dinosaurs. The last section, written from the perspective of a *T. rex* that witnessed the meteorite impact, was one of the highlights of the book for us, a harrowing account of the extinction event that leaves little to the imagination. Steve's own research, and his numerous contributions to the story, are woven into the narrative, and he describes complex palaeontological methodologies and findings clearly and comprehensibly.

Part autobiographical and part popular science, throughout the book the reader is introduced to a cast of characters who have influenced Brusatte's career, from undergraduate mentors to collaborators. Some of these accounts smack somewhat of hero-worship, and others are a touch patronizing: the repeated referral to a number of colleagues who hold senior university positions (and are in their late thirties, at best) as 'young guns' was a bit irritating, although there is no doubt that Brusatte's characterizations enrich the story and the science. His stories of travel to far-flung places to examine specimens could come across as a bit of a humblebrag, but do add some insights on how important international relations can be for the subject as a whole. We particularly enjoyed the account of the life of Baron Franz Nopcsa von Felső-Szilvás, an aristocrat, palaeontologist and Austro-Hungarian spy from the early part of the twentieth century. The almost unbelievably flamboyant, fascinating and ultimately tragic life of a man whose contributions to the literature





are still extremely important, and some of whose finds can be viewed today in the Natural History Museum, London, is told with both sensitivity and humour.

Brusatte's writing is at its best when he is conjuring up imagery to explain complex methods or palaeobiological events. His description of the last day of the Cretaceous, when a meteorite hit the Earth and caused one of the largest mass extinctions to have occurred in the last 541 million years, from the perspective of a *T. rex*, is vivid and delightful. A flash of light so bright that it would have blinded animals in North America; the Earth's surface turning to a "trampoline", as magnitude eleven earthquakes rocked the continent. Brusatte also provides evidence for these events, detailing how geologists and physicists worked out what happened during the cataclysm. This elevates the narrative from a 'Jurassic Park' style work of fiction to a detailed, rigorous scientific account. We thoroughly enjoyed these parts of the book and both of us found it difficult to put down.

The middle section of the book, which focuses on *T. rex*, was harder going and from our perspective, less interesting. Brusatte first details the evolutionary history of the broader group of the tyrannosaurs, describing the discovery and subsequent study of several members of the group, to which he himself has contributed. After this, an entire chapter is dedicated to the most recent and cutting-edge research that has been done on *T. rex*, from feeding, to locomotion, to visual acuity, sense of smell, and the function of its seemingly pointless tiny remnants of arms. While Brusatte is very good at choosing appropriate analogies to explain complex biomechanical and engineering techniques to a non-specialist audience, all of this information about a single animal, even if it is an icon of a lost world, was a little too much for us, and we found this the least interesting section. But this is very much a personal account, and the way the book is written, from the chatty style full of Americanisms to the descriptions of Brusatte's own work, mean that at least some focus on *T. rex* was inevitable, and the content of this chapter certainly delivers that.

For those who are about to begin their studies in dinosaur palaeobiology or for those considering such a career choice, the book serves as a good primer on up-to-date palaeontological research techniques, as well as giving an insightful and very readable account of life as a palaeontologist. The descriptions of key events during the age of the dinosaurs are engaging and exciting and the book as a whole does a good job of inspiring the reader to start to learn more on the subject themselves.

Overall, we think this book will be a huge hit among dinosaur fans everywhere. Many a student CV has been crowned with a sentence about how much they love the 'meat-eating' theropods, and this book will find a dedicated and enthusiastic audience among theropod geeks everywhere. However, Brusatte's broad general knowledge, the diversity of the work that he himself has carried out and his ability to vividly reimagine the past, elevate it from dinogeekdom, meaning that it should also be taken seriously by those with a broad general interest in the world of the past, and who want to find out more about the scientific methods that are used to investigate it.

Susannah Maidment

Natural History Museum, London

Joe Bonsor

University of Bath and Natural History Museum, London



Books available to review

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

- *The White River Badlands: Geology and Palaeontology*, by Rachel C. Benton, Dennis O. Terry Jr., Emmett Evanoff and H. Gregory McDonald.
- *Acrocanthosaurus Inside and Out*, by Kenneth Carpenter.
- *Across the Bridge*, by Henry Gee.
- *Fossil Frogs and Toads of North America*, by J. Alan Holman.
- *The Tyrannosaur Chronicles*, by David Hone.
- *Trilobites of the British Isles*, by Robert Kennedy and Sinclair Stammers.
- *Fossilien im Alpstein: Kreide und Eozän der Nordostschweiz*, by Peter Kürsteiner and Christian Klug.
- *Dinosaurs: The Textbook*. (6th Edition), by Spencer G. Lucas.
- *Burning Planet*, by Andrew Scott.
- *Smilodon: The Iconic Sabertooth*, edited by Lars Werdelin, H. Gregory McDonald and Christopher A. Shaw.
- *William Smith's Fossils Reunited*, by Peter Wigley (ed.), Jill Darrell, Diana Clements and Hugh Torrens.
- *The Palaeoartist's Handbook: Recreating Prehistoric Animals in Art*, by Mark P. Witton.

Dr Tom Challands

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





Innovations in Palaeontology Lecture Series

The Palaeontological Association invites institutions to host the 2019/20 *PalAss Exceptional Lecturer* Stephan Lautenschlager. Applications can be made before the 1st of May 2019 via www.palass.org.



Dr Stephan Lautenschlager (2019/20 *PalAss Exceptional Lecturer*)

Palaeontology 2.0 - reconstructing lost worlds using digital visualisation and computational analyses

Traditionally, palaeontology has a reputation of being a dry and dusty discipline. However, recent advances in computer technology have transformed the way fossils can be studied. Virtual reality, digital restoration and reconstruction and computer simulations to test fossil form and function relations, now allow obtaining a plethora of new data from old fossils and rigorous, hypothesis-driven studies. Integrating classic palaeontological research with these novel, digital approaches holds a vast potential to address large-scale evolutionary questions and to reconstruct fossil organisms and ecosystems.

In this lecture, I will introduce different methods and approaches within the newly emerging field of "Virtual Palaeontology" and outline specific applications based on case studies:

- (1) The use of digital tools to virtually prepare, repair and restore fossils
- (2) Digital reconstruction of soft-tissue structures (musculature, brain, inner ear) in fossil vertebrates to obtain and infer palaeobiology and palaeobehaviour
- (3) Biomechanical analysis using digital models to investigate functional properties of fossil organisms and to address macroevolutionary questions.

While these examples largely focus on vertebrate fossils, the potential for wider application to various fossil organisms and related disciplines, including geology and biology, exists and could ultimately be used in an interdisciplinary and complementary approach.



Palaeontology

VOLUME 62 • PART 1

CONTENTS

Symposium

- Probabilistic methods outperform parsimony in the phylogenetic analysis of data simulated without a probabilistic model 1
MARK N. PUTTICK, JOSEPH E. O'REILLY, DAVIDE PISANI *and* PHILIP C. J. DONOGHUE
<<https://doi.org/10.1111/pala.12388>>

Original Articles

- Three new naraoiid species from the Burgess Shale, with a morphometric and phylogenetic reinvestigation of Naraoiidae 19
BENJAMIN MAYERS, CÉDRIC ARIA *and* JEAN-BERNARD CARON
<<https://doi.org/10.1111/pala.12383>>
- The mosasaur fossil record through the lens of fossil completeness 51
DANIEL A. DRISCOLL, ALEXANDER M. DUNHILL, THOMAS L. STUBBS *and* MICHAEL J. BENTON
<<https://doi.org/10.1111/pala.12381>>
- Regional impacts of global climate change: a local humid phase in central Iberia in a late Miocene drying world 77
DANIEL DeMIGUEL, BEATRIZ AZANZA *and* JORGE MORALES
<<https://doi.org/10.1111/pala.12382>>
- A new phylogenetic hypothesis of turtles with implications for the timing and number of evolutionary transitions to marine lifestyles in the group 93
SERJOSCHA W. EVERS *and* ROGER B. J. BENSON
<<https://doi.org/10.1111/pala.12384>>
- Sediment-encased maturation: a novel method for simulating diagenesis in organic fossil preservation 135
EVAN T. SAITTA, THOMAS G. KAYE *and* JAKOB VINTHER
<<https://doi.org/10.1111/pala.12386>>
- Dictyonema* Hall and its importance for the evolutionary history of the Graptoloidea 151
JÖRG MALETZ
<<https://doi.org/10.1111/pala.12394>>
- A re-interpretation of the ambulacral system of *Eumorphocystis* (Blastozoa, Echinodermata) and its bearing on the evolution of early crinoids 163
SARAH L. SHEFFIELD *and* COLIN D. SUMRALL
<<https://doi.org/10.1111/pala.12396>>



Palaeontology

VOLUME 62 • PART 2

CONTENTS

Symposium

- Spatial processes and evolutionary models: a critical review 175
 P. DAVID POLLY
 <<https://doi.org/10.1111/pala.12410>>

Original Articles

- Does postcranial palaeoneurology provide insight into pterosaur behaviour and lifestyle? 197
 New data from the azhdarchoid *Vectidraco* and the ornithocheirids *Coloborhynchus* and *Anhanguera*
 ELIZABETH MARTIN-SILVERSTONE, DANIEL SYKES and DARREN NAISH
 <<https://doi.org/10.1111/pala.12390>>
- Archosauromorph extinction selectivity during the Triassic–Jurassic mass extinction 211
 BETHANY J. ALLEN, THOMAS L. STUBBS, MICHAEL J. BENTON and MARK N. PUTTICK
 <<https://doi.org/10.1111/pala.12399>>
- A fish and tetrapod fauna from Romer's Gap preserved in Scottish Tournaisian floodplain deposits 225
 BENJAMIN K. A. OTOO, JENNIFER A. CLACK, TIMOTHY R. SMITHSON, CARYS E. BENNETT, TIMOTHY I. KEARSEY and MICHAEL I. COATES
 <<https://doi.org/10.1111/pala.12395>>
- Ontogeny of the *Massospondylus* labyrinth: implications for locomotory shifts in a basal sauropodomorph dinosaur 255
 JAMES M. NEENAN, KIMBERLEY E. J. CHAPPELLE, VINCENT FERNANDEZ and JONAH N. CHOINIÈRE
 <<https://doi.org/10.1111/pala.12400>>
- Evolutionary and biogeographical shifts in response to the Late Ordovician mass extinction 267
 CURTIS R. CONGREVE, ANDREW Z. KRUG and MARK E. PATZKOWSKY
 <<https://doi.org/10.1111/pala.12397>>
- Eocene isopods on electric rays: tracking ancient biological interactions from a complex fossil record 287
 NINON ROBIN, GIUSEPPE MARRAMÀ, RONALD VONK, JÜRGEN KRIWET and GIORGIO CARNEVALE
 <<https://doi.org/10.1111/pala.12398>>
- Use and misuse of discrete character data for morphospace and disparity analyses 305
 SYLVAIN GERBER
 <<https://doi.org/10.1111/pala.12407>>
- #### Discussion
- Tuatara and a new morphometric dataset for Rhynchocephalia: Comments on Herrera-Flores *et al.* 321
 FELIX VAUX, MARY MORGAN-RICHARDS, ELIZABETH E. DALY and STEVEN A. TREWICK
 <<https://doi.org/10.1111/pala.12402>>
- Reply to comments on: Macroevolutionary patterns in Rhynchocephalia: is the tuatara (*Sphenodon punctatus*) a living fossil? 335
 JORGE A. HERRERA-FLORES, THOMAS L. STUBBS and MICHAEL J. BENTON
 <<https://doi.org/10.1111/pala.12404>>



Papers in Palaeontology

VOLUME 5 | PART 1

CONTENTS

- Postcranial morphology of the Early Triassic epicynodont *Galesaurus planiceps* (Owen) 1
from the Karoo Basin, South Africa
ELIZE BUTLER, FERNANDO ABDALA *and* JENNIFER BOTHA-BRINK
<<https://doi.org/10.1002/spp2.1220>>
- New species of *Karydomys* (Rodentia) from the Miocene of Chios Island (Greece) and 33
phylogenetic relationships of this rare democricetodontine genus
RAQUEL LÓPEZ-ANTOÑANZAS, PABLO PELÁEZ-CAMPOMANES, JÉRÔME PRIETO *and*
FABIEN KNOLL
<<https://doi.org/10.1002/spp2.1224>>
- Charophytes from the Cretaceous–Paleocene boundary in the Songliao Basin (north-eastern 47
China): a Chinese biozonation and its calibration to the Geomagnetic Polarity Time Scale
SHA LI, QIFEI WANG, HAICHUN ZHANG, XIAOQIAO WAN *and* CARLES MARTÍN-CLOSAS
<<https://doi.org/10.1002/spp2.1225>>
- An Eocene paraclupeid fish (Teleostei, Ellimmichthyiformes) from Bolca, Italy: the youngest 83
marine record of double-armoured herrings
GIUSEPPE MARRAMÀ, ALEXANDRE F. BANNIKOV, JÜRGEN KRIWET *and* GIORGIO CARNEVALE
<<https://doi.org/10.1002/spp2.1230>>
- A new radiodont (stem Euarthropoda) frontal appendage with a mosaic of characters from 99
the Cambrian (Series 2 Stage 3) Chengjiang biota
JIN GUO, STEPHEN PATES, PEIYUN CONG, ALLISON C. DALEY, GREGORY D. EDGECOMBE,
TAIMIN CHEN *and* XIANGUANG HOU
<<https://doi.org/10.1002/spp2.1231>>
- The Middle Triassic procolophonid *Kapes bentoni*: computed tomography of the skull and 111
skeleton
MARTA ZAHER, ROBERT A. CORAM *and* MICHAEL J. BENTON
<<https://doi.org/10.1002/spp2.1232>>
- Morphology of the petrosal and stapes of *Borealestes* (Mammaliaformes, Docodonta) from 139
the Middle Jurassic of Skye, Scotland
ELSA PANCIROLI, JULIA A. SCHULTZ *and* ZHE-XI LUO
<<https://doi.org/10.1002/spp2.1233>>
- Anatomy of the Ediacaran rangeomorph *Charnia masoni* 157
FRANCES S. DUNN, PHILIP R. WILBY, CHARLOTTE G. KENCHINGTON, DMITRIY V. GRAZHDANKIN,
PHILIP C. J. DONOGHUE *and* ALEXANDER G. LIU
<<https://doi.org/10.1002/spp2.1234>>
- A new species of *Mauremys* (Testudines, Geoemydidae) from the late Miocene–Pliocene of 177
Central Macedonia (northern Greece) with exceptionally wide vertebral scutes
EVANGELOS VLACHOS, JULIANA STERLI, KATERINA VASILEIADOU *and* GEORGE SYRIDES
<<https://doi.org/10.1002/spp2.1235>>



Overseas Representatives

- Argentina: DR M. O. MANCERIDO, Division Paleozoologia invertebrados, Facultad de Ciencias Naturales y Museo, Paseo del Bosque, 1900 La Plata, Argentina.
- Australia: DR RUDY LEROSEY-AUBRIL, School of Environmental & Rural Science, University of New England, Armidale NSW 2351, Australia.
- Canada: PROFESSOR R. K. PICKERILL, Dept of Geology, University of New Brunswick, Fredericton, New Brunswick, Canada E3B 5A3.
- China: DR Z. ZHONGE, Institute of Vertebrate Palaeontology and Palaeoanthropology, Academia Sinica, P.O. Box 643, Beijing 100044.
- France: DR J. VANNIER, Centre des Sciences de la Terre, Université Claude Bernard Lyon 1, 43 Blvd du 11 Novembre 1918, 69622 Villeurbanne, France.
- Germany: PROFESSOR F. T. FÜRSICH, GeoZentrum Nordbayern, Fachgruppe Paläoumwelt, Universität Erlangen-Nürnberg, Loewenichstrasse 28, D-91054 Erlangen, Germany.
- New Zealand: DR R. A. COOPER, GNS Science, P.O. 30368, Lower Hutt, New Zealand.
- USA: PROFESSOR P. SELDEN, The Paleontological Institute, University of Kansas, Lawrence, Kansas, 66045, USA.
- PROFESSOR N. M. SAVAGE, Department of Geology, University of Oregon, Eugene, Oregon 97403, USA.
- PROFESSOR M. A. WILSON, Department of Geology, College of Wooster, Wooster, Ohio 44961, USA.

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