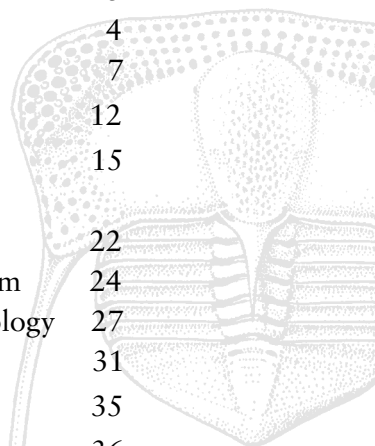


The Palaeontology Newsletter

93

Contents

Editorial	2
Association Business	3
Annual Meeting	3
Awards & Prizes	4
Grants	7
Association Meetings	12
News	15
From our correspondents	
Legends of Rock: O. C. Marsh	22
Behind the scenes at the Museum	24
‘Fossillegal’: ethics in palaeontology	27
A monstrous injustice	31
<i>Advertisement: Hills of Hame</i>	35
Future meetings of other bodies	36
Meeting Reports	40
Obituary: William Gilbert Chaloner	52
Grant and Bursary Reports	53
Book Reviews	73
Careering off course!	79
<i>Palaeontology</i> vol. 59 parts 5 & 6	81–83
<i>Papers in Palaeontology</i> vol 2., 2,3,4	84–86
Annual Meeting Supplement	>88



Reminder: The deadline for copy for Issue no. 94 is 8th February 2017.

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

ISSN: 0954-9900



Editorial

At this time of year my thoughts always turn to the PalAss Annual Meeting, which for many of us is the high point of the research year. The meeting represents a chance to see and hear first-hand the latest developments in a wide range of palaeontological disciplines, from new fossils to new techniques and new approaches, not to mention opportunities to meet new up-and-coming researchers, forge new research ventures, discuss data, and catch up with colleagues and friends, all accompanied by ample refreshments, often in fine surrounds. This year's Annual Meeting promises no less, and indeed comes with double the fun via parallel sessions for part of the schedule. There will even be a gastronomic adventure of the nautical kind via Annual Dinner on a boat – a PalAss first. Those attendees with extra gusto can explore the local palaeontological sights (in the field or the nearby Autun museum) on the final day of the meeting.

Good luck to all presenters (including those sprightly enough to qualify for the President's Prize and Poster Prize!) and we look forward to seeing you all in Lyon.

Maria McNamara

Newsletter Editor

<newsletter@palass.org>

 @ThePalAss

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



Association Business

Annual Meeting 2016 and AGM

Notification is given of the 60th Annual General Meeting

The AGM will be held during the Annual Meeting at Université Claude Bernard Lyon 1, France, on 15th December 2016, following the scientific sessions.

AGENDA

1. Apologies for absence
2. Minutes of the 59th AGM, Cardiff University*
3. Trustees Annual Report for 2015 *
4. Accounts and Balance Sheet for 2015 *
5. Election of Council and vote of thanks to retiring members
6. Report on Council Awards
7. Annual address

* Papers pertaining to these agenda items were published in the previous *Newsletter*, available online at <www.palass.org>, and are printed in full in the Programme and Abstracts of the Annual Meeting.

Nominations for Council

At the AGM in December 2016, the following vacancies will occur on Council:

- Vice-President
- Secretary
- Newsletter Editor
- Publicity Officer
- Outreach Officer
- Education Officer
- Internet Officer
- Three Ordinary Members

Nominations received by the deadline are as follows:

- Vice President: Prof. Richard J. Twitchett
- Secretary: Dr Crispin T.S. Little
- Newsletter Editor: Dr Maria E. McNamara
- Publicity Officer: Dr Liam Herringshaw (2nd term)
- Outreach Officer: Dr Lucy McCobb
- Education Officer: Dr Caroline Buttler (2nd term)
- Internet Officer: Dr Alan R.T. Spencer (2nd term)
- Ordinary Members (three posts): Prof. Andy Gale; Dr Alexander Dunhill; Dr David Bond

No other nominations were received by the deadline.



Awards And Prizes

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

Lapworth Medal

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



The medal is normally awarded each year. Candidates must be nominated by at least two members of the Association. Nominations should include a single page that summarizes the candidate's career, and further supported by a brief statement from the two nominating members. A list of 10 principal publications should accompany the nomination. Letters of support by others may also be submitted. Council will reserve the right not to make an award in any particular year.

The career summary, statements of support and publication list should be submitted in MS Word or PDF format, ideally as a single document if possible.

Nominations should be sent to <secretary@palass.org> by **31st March**.

The Lapworth Medal is announced at the AGM and presented at the Annual Meeting.

President's Medal

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



The medal is normally awarded each year. The candidate must be nominated by at least two members of the Association. Nominations should include a single page that summarizes the candidate's career, and further supported by a brief statement from the two nominating members. A list of 10 principal publications should accompany the nomination. Letters of support by others may also be submitted. Council will reserve the right not to make an award in any one year. If a candidate has taken time out from her/his professional career for family and other purposes, this should be highlighted.

The career summary, statements of support and publication lists should be attached in MS Word or PDF format, ideally as a single document if possible.

Nominations should be sent to <secretary@palass.org> by **31st March**.

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



Hodson Award

The Hodson Award is conferred on a palaeontologist who has had no more than 10 years of full time experience after her/his PhD, excluding periods of parental or other leave, but not excluding periods spent working in industry, and who has made a notable contribution to the science.

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

The academic case, statements of support and publication list should be attached in MS Word or PDF format.

Nominations should be sent to <secretary@palass.org> by **31st March**.

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

Mary Anning Award

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

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

Nominations should be attached in MS Word or PDF format and should include the full contact details of the candidate.

Nominations should be sent to <secretary@palass.org> by **31st March**.

The Award comprises a cash prize of £200 plus a framed scroll, and is presented at the Annual Meeting.

Honorary Life Membership

To be awarded to individuals whom Council deem to have been significant benefactors and/or supporters of the Association. Recipients will receive free membership.

Nominations should be sent to <secretary@palass.org> by **31st March**.

Honorary Life memberships are announced at the Annual Meeting.



Annual Meeting President's Prize

This prize is awarded for the best talk at the Annual Meeting. All student members of the Palaeontological Association, and all members of the Association who are early career stage researchers within one year of award of a higher degree (PhD, MSc, *etc.*), excluding periods of parental or other leave, are eligible for consideration for this award. The prize, of £200, is announced at the end of the Annual Meeting.

Annual Meeting Council Poster Prize

This prize is awarded for the best poster at the Annual Meeting. All student members of the Palaeontological Association, and all members of the Association who are early career stage researchers, *i.e.* those within one year of the award of a higher degree (PhD, MSc, *etc.*), excluding periods of parental or other leave, are eligible for consideration for this award. The prize, of £200, is announced 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 will be offered 'Gold open access' paid for by the Association for one nominated paper submitted to *Palaeontology/Papers in Palaeontology* within the following 18 months (and subsequently accepted). In the case of joint authorship papers, the corresponding author can, by agreement, transfer the prize to one of the co-authors. 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.

Golden Trilobite Award

Golden Trilobite Awards recognize high-quality amateur and institutional websites that promote the charitable aims of the Association. Nominations for websites, which should consist of a link to the site and a brief supporting case, should be sent to the secretary (<secretary@palass.org>) by **31st March**. The award comprises a 'Golden Trilobite banner' and links to the Association website. Awards will be announced in the *Newsletter* and on the Association website.





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 is also available on the Association's website (<www.palass.org>).

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

The Association is happy to receive applications for grants from the organizers of scientific meetings, workshops and short courses that lie conformably with its charitable purpose, which is to promote research in palaeontology and its allied sciences. Application should be made in good time by the scientific organizer(s) of the meeting on the online application form. Such requests will be considered by Council at its March and October 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. Inquiries may be made to the Secretary (<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.



Outreach and 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. Under exceptional circumstances, a budget of up to £15,000 for an individual application will be considered. Grants can support either stand-alone complete projects, or they can be 'proof of concept' case studies that have their own outcomes but that form the groundwork for a larger bid elsewhere. The award is open to both amateur and professional palaeontologists and the principal applicant must be a member of the Association. Preference will normally be given to candidates who have not previously received a grant.

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

For more information, please contact the Association's Outreach Officer, Dr Fiona Gill, School of Earth and Environment, University of Leeds, Leeds, LS2 9JT; e-mail <outreach@palass.org>.

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

Small Grants Scheme

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

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

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



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

- An account of project aims and objectives and expected outcomes
- A breakdown and justification of the proposed expenditure
- A curriculum vitae
- Two references: one to review the project, and one personal reference for the applicant
- A summary suitable for the non-specialist, which will be published in the *Newsletter* when the award is made

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

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

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

The awards will be announced at the AGM, and funds will normally be available from 1st January.



Undergraduate Research Bursary

The Palaeontological Association Undergraduate Research Bursaries are aimed at giving undergraduate students the opportunity to acquire research skills and experience that will significantly transform their academic career. The bursaries will support projects co-designed by students and their supervisor(s) that give students registered for an undergraduate degree their first experience of undertaking a palaeontological research project. The bursaries provide a stipend for the student of £200 per week for up to eight weeks. The scheme is not intended to fund students to undertake routine work for the supervisor(s) and the Association expects the supervisor(s) to provide significant personal mentoring of successful student applicants.

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

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

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

Further details, including eligibility criteria for supervisors and students, and a full list of terms and conditions for the Undergraduate Research Bursary Scheme, can be found on the appropriate page of the Association's website. Inquiries may be made to the Secretary (<secretary@palass.org>).

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

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



Research Grants

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

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

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

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

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

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

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

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



ASSOCIATION MEETINGS



60th Annual Meeting of the Palaeontological Association

Université Claude Bernard Lyon 1, France 14 – 17 December 2016

The Annual Meeting of the Palaeontological Association will be held Laënnec Campus, Domaine de la Buire, University Claude Bernard Lyon 1, organised by Gilles Cuny, Bertrand Lebfèvre, Vincent Perrier and Jean Vannier, with the help of the “Cellule Congrès” of the University. Please address all queries to <palass2016@univ-lyon1.fr>.

Information about the meeting is provided in the coloured supplement at the back of this *Newsletter* and on the PalAss website at <<http://www.palass.org/meetings-events/annual-meeting/2016/annual-meeting-2016-lyon-overview>>.

The final deadline for registration is Tuesday 15th November 2015. The abstracts for the talks and posters will be available on the PalAss website and will be included in the conference pack at the Meeting. We look forward to seeing you in Lyon in December!

Abstract of Annual Address

The Annual Address will be given on Thursday 15th December.

Molecular thermometers: ancestral sequence reconstruction uncovers the history of adaptation to environmental temperature along the tree of life.

Professor Manolo Gouy

Laboratoire de Biométrie et Biologie Evolutive, Université de Lyon, France

<manolo.gouy@univ-lyon1.fr>

It has recently been recognized that the effects of environmental temperature on ancestral organisms have left genetic footprints that can be uncovered in extant genomes. These effects allow us to define “molecular thermometers” that relate ancestral environmental temperatures to the composition of ancestral molecules in nucleotides and amino acids. The accuracy of the reconstruction of ancestral molecular compositions is therefore crucial for an effective application of molecular thermometers. Recent progress in the definition of probabilistic models of the evolutionary process has improved the biological realism of these models by accounting for the variation of patterns of molecular evolution among lineages. These new non-homogeneous methods allow us to reconstruct ancestral molecular compositions more accurately than traditional homogeneous methods. Analyses of genomic data using these tools allow attempts to reconstruct the evolutionary history of the adaptation to environmental temperatures at the scale of the tree of life. The evidence supports a mesophilic lifestyle for LUCA, the last universal common ancestor, but hyperthermophilic lifestyles for LBCA and LACA, the last common ancestors of the bacterial and archaeal domains, respectively.



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

Cellule Congrès-Lyon 1



Frontiers in Earth Science



Groupe Français du Paléozoïque



Isoprime Ltd



Nature Ecology & Evolution



Région Auvergne-Rhône-Alpes



Siri Scientific Press



Taylor & Francis



The Paleontological Institute




Université de Lyon





LEICESTER PROGPAL 2017

 @ProgPal2017 #progpal2017

Join us for the annual **Progressive Palaeontology** conference on

1st – 3rd June 2017

at the Department of Geology, University of Leicester



Registration is **free!**



New this year!

Delegates to have their say on field trip localities

Competitive travel grants available

Supported by our Crowdfunder initiative:

www.crowdfunder.co.uk/progpal2017

Icebreaker reception with the 'Rutland dinosaur'

Talks live-streamed and recorded by Palaeocast



Expert-led workshops
Dedicated poster session
Lightning talks
Full talks

Follow **@ProgPal2017**

www.facebook.com/groups/progpal2017

www.palass.org/meetings-events/progressive-palaeontology



Palaeontology in the News

There are various things that intrigue me about how palaeontology gets picked up in the news. Perhaps the main one is the subject. Aside from dinosaurs (or fossils that journalists think are dinosaurs), which fossils actually attract coverage? Is this predictable? Then there's the timeline of the coverage: does the story burst briefly into life over a day or two, then vanish just as quickly, or does it have legs, and longevity?

Three articles published in Association journals recently caught the eye of the media, and they provide interesting case studies with which to look at these questions.

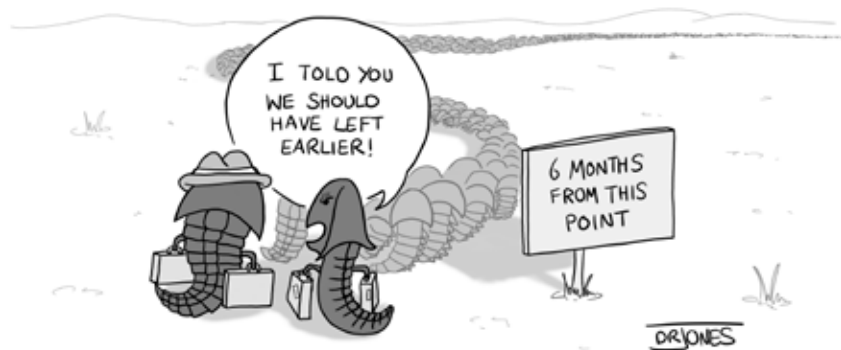
The first is the article by Lomax and Massare (2016) describing two new species of *Ichthyosaurus*. It's always nice when one of our *Papers In Palaeontology* makes a splash. In this case, the BBC framed their coverage in terms of sea dragons that were new to science: <<http://www.bbc.co.uk/news/science-environment-37569244>>, noting that the specimens had been on display for decades, one in the University of Bristol, the other in the National Academy of Sciences in Philadelphia, without being properly identified. The *Daily Mail* followed a similar line, but made sure the longevity of public ignorance was emphasized, in that it had been 'over a CENTURY' since the Philadelphian specimen had gone on display: <<http://www.dailymail.co.uk/sciencetech/article-3827002/Forgotten-fossil-lay-museum-CENTURY-new-species-British-ichthyosaur.html>>. Over the next couple of days, more outlets covered the story, with CNET preferring to describe the ichthyosaurs as 'hiding in plain sight' (<<https://www.cnet.com/news/new-ichthyosaur-species-was-hiding-in-plain-sight-for-decades/>>), and noting that Mr Lomax is getting quite adept at unearthing such specimens. There may be further news stories to come.

The University of Bristol certainly could not be accused of overlooking the lobopodian *Pambdelurion whittingtoni*, assessed by Vinther *et al.* (2016). Lead author Jakob Vinther found the most enticing of bait with which to attract a few big fish: a Star Wars beast with the mouth of a penis worm. A flurry of coverage of a 'Cambrian Sarlacc' appeared online on or shortly after 26th September, as a Google News search demonstrates: <https://www.google.com/search?hl=en&gl=uk&tbn=NEWS&authuser=0&q=sarlacc+fossil&oq=sarlacc+fossil&gs_l=news-cc.3..43j43i53.822195.824475.0.824697.14.4.0.5.0.1.213.713.0j2j2.4.0...0.0...1ac.1.3uoA67TjMIE>. The Star Wars angle provided plenty of opportunity for digression, with *Inverse.com* speculating that "[h]ad Boba Fett been up against a penis worm instead of a Sarlacc, he wouldn't have survived half as long" (<<https://www.inverse.com/article/21399-star-wars-sarlacc-penis-worm>>), while the *Daily Mirror* helpfully pointed out that whilst Sarlacc lived in the Great Pit of Carkoon in the Dune Sea of Tatooine, *Pambdelurion* was found in the mountains of Greenland (<<http://www.mirror.co.uk/news/weird-news/star-wars-monster-doppelganger-roamed-8939150>>).

The *Daily Express* were a bit slow off the mark, waited till 11th October to publish their version of the story, and promptly got very confused, conflating anomalocaridids and priapulids, and implying that the work had been published in *ScienceNordic* rather than *Palaeontology*: <<http://www.express.co.uk/news/nature/719946/prehistoric-penis-worm-teeth-devour-prey-scientist-find>>. Still, better late than never, I suppose.



Perhaps my favourite recent coverage, though, was that of Blazejowski *et al.* (2016), and their study of Devonian trilobites that appeared to have formed migratory lines across the sea floor, following each other by chemotaxis. The paper was first published online in late August, but only a few outlets picked it up at that time. *Science* did so in asking 'what queues up better than the British? Trilobites!' (<<http://www.sciencemag.org/news/2016/08/what-queues-better-british-trilobites>>). This rather stole the Twitter thunder of one palaeontological colleague, who'd made the joke a couple of days earlier, leading to a discussion of the evolution of queueing.



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

Our old friend Colin Barras then wrote up the story for *BBC Earth* on 6th September, describing it as the oldest mass migration known (<<http://www.bbc.co.uk/earth/story/20160905-the-oldest-mass-migration-known>>) and impressively managing to include references to prehistoric congas, and migratory caravans, though noting also that tunnelling rather than queueing could explain the fossilized lines. Later to join the queue was the *New York Times*, on 9th September (<http://www.nytimes.com/2016/09/10/science/marching-one-by-one-trilobites-traversed-the-seafloor.html?_r=0>), possibly because it takes a while for such stories to crawl across an ocean. This was a rather brief article, and its opening paragraphs were reminiscent of the piece Dr Barras had written for the BBC, so perhaps these trilobites were capable of mimicry as well as queueing.

So, what are the conclusions for palaeontological publicity? Well, it's always dangerous to generalize, but if your research involves marine reptiles, you're in with a chance of getting in the news, especially if the specimens have been overlooked previously (and perhaps partly because some of the journalists will think you're working on dinosaurs). Similarly, if your research features arthropods doing something both curious and familiar, such as forming orderly queues, media interest might be piqued, albeit a little more slowly. Last but not least, if your fossil allows the media to repeatedly use the word 'penis', bears a striking resemblance to a sci-fi monster, and gives the tabloids an example to baffle their readers, you're almost certainly onto a winner.

Liam Herringshaw

<publicity@palass.org>



REFERENCES

- BLAZEJOWSKI, B., BRETT, C.E., KIN, A., RADWANSKI, A. and GRUSZCZYNSKI, M., 2016. Ancient animal migration: a case study of eyeless, dimorphic Devonian trilobites from Poland. *Palaeontology*, 59, 743–751. <<http://onlinelibrary.wiley.com/doi/10.1111/pala.12252/full>>.
- LOMAX, D.R. and MASSARE, J.A., 2016. Two new species of *Ichthyosaurus* from the lowermost Jurassic (Hettangian) of Somerset, England. *Papers In Palaeontology*, in press: <<http://onlinelibrary.wiley.com/doi/10.1002/spp2.1065/full>>.
- VINTHER, J., PORRAS, L., YOUNG, F.J., BUDD, G.E. and EDGEcombe, G.D., 2016. The mouth apparatus of the Cambrian gilled lobopodian *Pambdelurion whittingtoni*. *Palaeontology*, in press: <<http://onlinelibrary.wiley.com/doi/10.1111/pala.12256/full>>.

Museum of Jurassic Marine Life opens in Kimmeridge

The Etches Collection Museum of Jurassic Marine Life in Kimmeridge, UK, opened on 21st October 2016. The Museum houses the remarkable collection of one man's passion, bringing to life stories from deep time through a unique and amazing array of marine fossils, many of which are unique to science. Steve Etches' collection of over 2,500 specimens is housed in a purpose-built £5 million lottery-funded building that uses CGI projection technology in the exhibition ceiling to immerse visitors in the life of the Kimmeridgian seas while they explore the amazing exhibits below, resulting in an exciting visitor experience. Visitors are able to watch Steve as he cleans and conserves new finds in his workshop. The building can also accommodate conferences, lectures or other special events. Please see the website for more details: <<http://www.theetchescollection.org>>.

Carla Crook

The Etches Collection





Where are the fossils?

As a field palaeontologist I spend lots of time and taxpayers' money randomly searching for Permian fossils in strange places¹. Usually I have at least some idea about the age of the strata and the depositional setting, but there is never a guarantee of finding fossils, whether macro- or micro-. A new modelling approach outlined by Sebastián Block and colleagues from Adelaide and Kiel promises to remove some of the randomness that has afflicted palaeontologists since Cuvier's day.

Block *et al.*'s paper in *PLoS One* combines climate-envelope, taphonomic and discovery-related models as they explore "Where to Dig for Fossils". They propose a new method to assist in finding fossils at continental scales that factors in the (known) past distribution of species, the geological suitability of fossil preservation, and the likelihood of fossil discovery in the field. Block *et al.* tested their models using taxa belonging to the Australian megafauna that perished in the Late Quaternary. Perhaps unsurprisingly, combining knowledge about taxon range with that of climate, taphonomy and erosion permits better prediction of locations with greater "fossil potential" (Fig. 2), and the authors suggest regions to go hunting for *Diprotodon* (Fig. 1), *Zygomaturus*, *Protemnodon*, *Thylacoleo* and *Genyornis*.

Most significantly, Block *et al.*'s model can be applied to any continent, without the need for overwhelming volumes of data (the area of suitable palaeoclimate for taxa occurrence has been successfully modelled with as few as 14 *Zygomaturus* records from different points in space and time). Block *et al.* extracted their fossil data from the FosSahul database but one might equally use the Paleobiology Database or, as I have done, assimilate data from truly obscure publications in the Russian and Chinese literature (even the most complete databases contain only a small percentage of the relevant literature, which itself covers only a tiny fraction of the fossil record).



Figure 1: A particularly grumpy-looking *Diprotodon* ("two forward teeth"), the largest known marsupial. A new model helps predict locations where fossils of this glamorous beast might be found. Reconstruction by Dmitry Bogdanov, used under the CC-BY 3.0 licence.

The paper concludes, "as suitable climate proxies and reconstructions pierce ever-backward in time, the capacity to model palaeo-distributions of both extinct and extant species will become more powerful and ecologically realistic". The message is clear – when searching for new fossil

¹ This might sound flippant but is actually not far from the reality when it comes to fieldwork in Siberia.

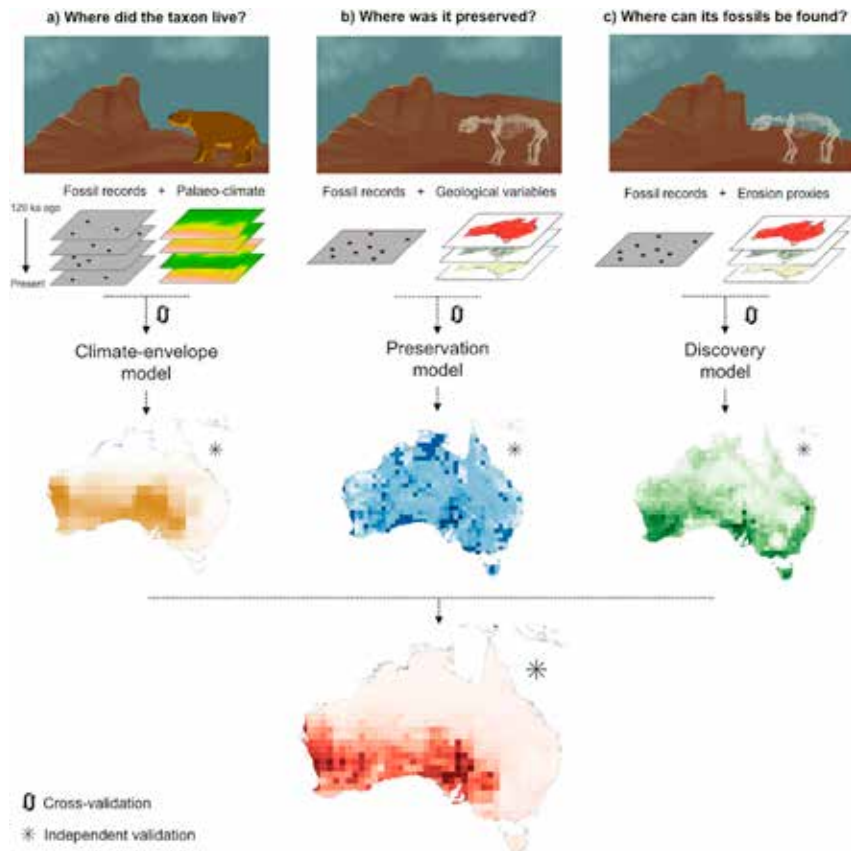


Figure 2: For a given taxon, the areas with greatest potential to yield new fossils (red map) are those where the species used to live (brown map), where its fossils could be preserved (blue map), and where it is now possible to find its fossils (green map). From Block et al., 2016.

localities we must give serious consideration to palaeoclimate, taphonomic, and post-depositional processes. Advances in our science mean that these can now be modelled and our approach can be less “needle-in-haystack” and more informed by the great body of work from two centuries of palaeontological collecting and curation. As ever there is no magic button or black box with all the answers: I still expect to return from Russia this summer with nothing more than some bags of boring Triassic shale, but this new approach could remove many of the uncertainties.

David Bond

School of Environmental Sciences, University of Hull

REFERENCE

BLOCK, S., SALTRÉ, F., RODRÍGUEZ-REY, M., FORDHAM, D.A., UNKEL, I. and BRADSHAW, C.J.A., 2016. Where to dig for fossils: combining climate-envelope, taphonomy and discovery models. *PLoS One*, 11(3): e0151090. doi:<10.1371/journal.pone.0151090>.



Could the Past Earth Network help your work?

The Engineering and Physical Sciences Research Council (EPSRC)-funded Past Earth Network (PEN) currently consists of over 200 members from around the world, whose research interests range from climate proxy and palaeoclimate analysis to complex computer modelling and pure statistics. The idea behind PEN is that much can be learned about how our climate models will perform in a changed climate, by studying past climate. To make this happen, the Network aims to improve communication between palaeoclimate scientists and statisticians. The PEN holds conferences, workshops and meetings to discuss our four network themes: Data, Models, Data-Model Comparisons, and Forecasting. Our meetings, workshops and conferences promote discourse between disciplines and direct research concerning climate, palaeodata and models.



The next upcoming PEN events are a session at the AGU 2016 Fall meeting, “Marrying palaeodata records and paleoclimate modelling within a statistical framework” hosted by Prof. Alan Haywood, Dr Aisling Dolan and Dr Tamsin Edwards; and a session at the XIV Palynological Congress in Salvador, “Understanding Climate Variability in a warmer than present Pliocene World” hosted by Prof. Ulrich Salzmann and Dr Matthew Pound.

For more information, and to become a member of the PEN, visit our website, at <www.pastearth.net>. Membership is free and benefits include access to PEN funding, opportunities to collaborate with multidisciplinary scientists in studies and workshops, and access to the PEN newsletter with updates of PEN activities and funding opportunities.

Edward Yorke
University of Leeds

Do you know any unsung heroes?

The Marsh Christian Trust has opened a call for nominations for their annual Marsh Awards, two of which – the Awards for Palaeontology and Mineralogy, respectively – are awarded in conjunction with the Natural History Museum. The Awards aim to recognize unsung heroes who have made a major contribution to the promotion of palaeontology or mineralogy in the UK and abroad. The deadline for receipt of nominations is 20th December 2016.



For further information on the Awards, including award criteria and application details, please see <<http://www.nhm.ac.uk/marsh-awards-2016>>.

Martha Richter
Natural History Museum, London



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 2017 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 (28–30 April 2017) or Yorkshire (22–24 September 2017). We also need a letter of support from your supervisor.

Please send these documents to the Executive Officer (e-mail <executive@palass.org>) by 31st January. Whilst undertaking these outreach activities all travel and living expenses will be covered by the Association.

Fiona Gill

PalAss Outreach Officer



Volunteering opportunities at the Lyme Regis and Yorkshire Fossil Festivals.



Legends of Rock

O. C. Marsh: *fossil feuds and enormous egos in the Old West*

In the history of palaeontology, few events are as well-known as the Bone Wars of the nineteenth century. Edward Drinker Cope and Othniel Charles Marsh were friends turned bitter rivals, both obsessed with finding more new fossil species than the other, often to the detriment of the scientific process.

Marsh (who preferred “O. C.” to Othniel) was born on a farm in rural New York and rescued from a life of modest means by his uncle, George Peabody, who sent him to Yale at the age of 20. After 11 years of study (never worry about your own procrastination again) he finally earned his master’s degree. After a time spent studying in various German institutions, he returned to Yale with a large chunk of his uncle’s money and a plan to build the Peabody Museum of Natural History. Naturally, in 1866 the first Yale chair of palaeontology was established for Marsh.

Meanwhile, the first American dinosaurs were being discovered. The first was found by Joseph Leidy in 1856; he went on to discover a nearly complete *Hadrosaurus* two years later. His protégé Cope named the carnivorous *Laelaps* (= *Dryptosaurus*) in 1866. Cope and Marsh had met while Marsh was studying in Berlin, and had become fast friends. Their willingness to share manuscripts and fossils with each other, however, dwindled as they became more and more competitive over discoveries. Fossils promised to one man found their way to the other, and correspondence was often filled with pettily-worded corrections of the other’s publications. This rivalry was compounded by the ever-looming promise of the Western Frontier, a wealth of undiscovered fossils for those brave enough to venture out there.

Marsh set out to look for fossils in the Midwest in 1870, closely followed by Cope and Leidy in subsequent years. During their time in the West, the three palaeontologists raced to name a wealth of new species but the results of their competition ultimately became as much of a headache as they were a triumph. The mammal *Uintatherium*, for example, was named multiple times by all three, and led to a long argument between Marsh and Cope on naming priority in numerous publications which often devolved into personal attacks. Leidy eventually quit palaeontology, leaving Cope and Marsh to battle it out. In the end, Marsh tried to obtain fossils from a debt-ridden Cope using his position as head of the new U.S. Geological Survey, and Cope handed evidence of Marsh’s shady dealings to a reporter which resulted in the loss of that position. Both men died poor and alone.

Whilst Marsh was undoubtedly a calculating, cantankerous man, he also campaigned strongly in Washington for the welfare of the Lakota people whom he encountered while fossil hunting, and continued to be a friend to them for the rest of his life. His scientific legacy still stands strong today: Marsh is responsible for the incredible discovery of transitional horse fossils



Marsh (back row centre) and his 1872 expedition party, complete with armed assistants.

(which bolstered Darwinian theory), and for naming many beloved dinosaurs (including the re-established *Brontosaurus*). He was the victor of the Bone Wars based on the number of dinosaur species that are still valid (35/98 to Cope's 9/64) but the problems he caused with his rival by assigning multiple names to the same taxa still plague palaeontology to this day. Despite this, Marsh (and his compatriots) helped to build palaeontology into a major field of science and establish the United States as a world leader in palaeontological research.

Terri Cleary

Natural History Museum, London

REFERENCES

- JAFFE, M. (2000) *The gilded dinosaur: the fossil war between ED Cope and OC Marsh and the rise of American science*. New York City: Crown Publishing.
- WALLACE, D.R. (2000) *The bonehunters' revenge: dinosaurs, greed, and the greatest scientific feud of the Gilded Age*. New York City: Houghton Mifflin Harcourt.



Behind the Scenes at the Museum

The Dorset County Museum



The Victorian Gallery. Image courtesy Jenny Cripp.

In 1845 the industrial revolution collided with Dorset's ancient past when the construction of a new railway line was destined to destroy Dorchester's Roman sites at Poundbury Hillfort and Maumbury Rings. In response, a group of men with an interest in Dorset's history, including Reverend Henry Moule, and the authors William Barnes and Thomas Hardy, came together to form an organisation to protect these and other sites from the threat of industrialisation. They formed the Dorset Natural History and Archaeology Society and in 1845, founded the Dorset County Museum and Library to protect and preserve the cultural heritage and natural history of the Dorset area.

The Museum was originally housed on West High Street in Dorchester, in the same house that the 'Bloody Assizes' were conducted in 1685, before being moved to Trinity Street and then back again to West High Street, this time in a former public house. Unfortunately, these buildings lacked the space the Museum needed so could open only on Thursdays and Saturdays. In 1883, the Museum was moved to a purpose-built site, where it still stands, with the classic Victorian feel many museum-goers around the country will find familiar. This allowed the Museum to expand and open many new galleries over the years. In 1937 a specialist Geology Gallery was opened, with a Natural History Gallery opening in 1952, a Multipurpose Gallery and conservation laboratory opening in 1973, and an Archaeology Gallery that was completed in 1984. More recently, Heritage Lottery Funding has helped refurbish many of the original galleries, and to build the Writers' Dorset Gallery, the Dorchester Gallery, and the Jurassic Coast Gallery.



David Attenborough with *Goniopholis kiplingi*. Image courtesy Jenny Cripp.

Today, more than 4 million objects are held in the Museum's collections, all relating to the County of Dorset. Unsurprisingly, many of the geological objects in the Museum come from the Jurassic Coast, which visitors to the Museum can view through the new interactive exhibit "Walk through Time" that spans 185 million years. One of the highlights of the exhibit is the 'Swanage Snapper', the type specimen of a 140 million-

year-old Cretaceous crocodile from the Purbeck Formation (famous for its fossil forests) called *Goniopholis kiplingi*, named after the author and nature enthusiast Rudyard Kipling. The displays also show freshwater turtle bones from *Dorsetochelys delairi*, named for its discovery on the Dorset coast, which may have been a regular meal for the Swanage Snapper. Another big predator in the fossil collections is the Weymouth Bay Pliosaur, *Pliosaurus kevani*. This was the largest marine reptile that ever lived, in its day up to 16 metres long. Fossils of such national scientific importance are rarely kept locally but this pliosaur is on permanent display in the Jurassic Coast Gallery. Particularly impressive is a large ammonite with its original mother of pearl still preserved, as well as ichthyosaur skeletons, and even a pterosaur wing found by a member of the public and donated after the Museum helped to identify the remarkable fossil.

The Museum also holds many archaeological treasures. The South Dorset Ridgeway Area was an important ceremonial site in the Bronze Age (2400–2000 BC) that was filled with barrows (burial chambers) where people were laid to rest, often with valuable treasures like golden jewellery, mirrors and swords. The Museum recently acquired a beautiful crescent-shaped golden necklace, covered in intricate geometric decorations, dating to the early Bronze Age; it was made using techniques that still can't be fully replicated with modern technology.

Visitors might be confused by the sight of beautiful exotic birds, which appear to have no obvious connection to Dorset. These were collected by the naturalist Alfred Russel Wallace, a long-standing member of the Dorset Natural History and Archaeology Society, who donated the birds to the Museum after returning from his travels around the world. Society members like Wallace have played an important role in expanding the museum collections over the years. Thomas Hardy donated a complete set of his original works to the Museum, and following his death his many manuscripts, notebooks, and furniture were also donated to the Museum, adding up to more than 16,000 items, including the entire contents of his study. The Museum's textiles collection even includes some of the Hardy family's clothes and period dresses. Literary fans can now visit Hardy's original study and gain a rare insight into his thoughts from his notes, described by Museum curator Jenny Cripps as his "scribblings". These were on everything from his own books to his copy of the Bible, where he left many comments for us to read today.



Located in such a popular tourist destination, Dorset County Museum is also involved in several outreach projects that encourage the public to investigate the amazing history of the County. Each year the Museum hosts school visits, lectures for adults and children, and has regular family activities. The Museum's current exhibition, "Speed to the West", evokes the golden-age of railway travel and contains over 50 famous examples relating to the railways. Every Monday morning the Museum hosts 'Museum Makers' in the Victorian Gallery for adults with learning disabilities. This event uses theatre and arts to explore artefacts and relevant sites from throughout Dorset and lets the participants curate their own exhibitions.

In the near future, the Museum will be undergoing major refurbishment and expansion, including the development of new galleries and buildings. This will allow members of the public to see how the collections are used by scientists and historians so that people can truly explore "behind the scenes at the museum".

Peter Adamson

*Dorset County Museum and Library, High West Street, Dorchester, Dorset, DT1 1XA
Tel: 01305 262735*



Jurassic coast display. Image courtesy Jenny Cripp.

Dorset County Museum is open Monday to Saturday all year round, from 10 am to 5 pm from March to October and from 10 am to 4 pm from November to March.

On the Web: <<http://www.dorsetcountymuseum.org/home>>



<<https://www.facebook.com/dorsetcountymuseum>>



‘Fossillegal’: a symposium on ethics in palaeontology

The recent European Association of Vertebrate Palaeontologists (EAVP) 14th annual meeting, held in Haarlem in the Netherlands at the start of July (see Meeting Reports) continued the recent surge in attendance and abstracts for EAVP with record levels of each. In the evocative 18th century Teylers Museum setting an unusually wide range of symposia were presented, from island vertebrate palaeontology to early tetrapods, and the North Sea basin to hominids. There was also the ‘FossilLegal’ symposium, focusing on ethical palaeontological practices for a wide range of stakeholders.

The symposium resulted from the previous year’s meeting; having delivered a presentation looking at the ethical problems relating to Chinese fossil material and how these tie into funding, publishing, ownership and poor legislation, I was surrounded afterwards by other delegates with similar stories to tell. In order to discuss the issue in a much broader forum I suggested the symposium. I wanted a different analysis to the wearisome approach of some people in the community, who enthusiastically aid in demonising the commercial trade while simultaneously turning a blind eye to unethical or illegal activities of academic colleagues. Pretending that the issues are one-way is not only simplistic, it is detrimental: not only is private collecting for subsequent sale to researchers the very origin of our science (otherwise, as Dave Martill (University of Portsmouth) put it, Mary Anning is one of the most heinous criminals in the history of our field), but it remains essential in an age where little priority is given by most academic institutions to prospecting for new localities. Given that private and amateur collectors produce

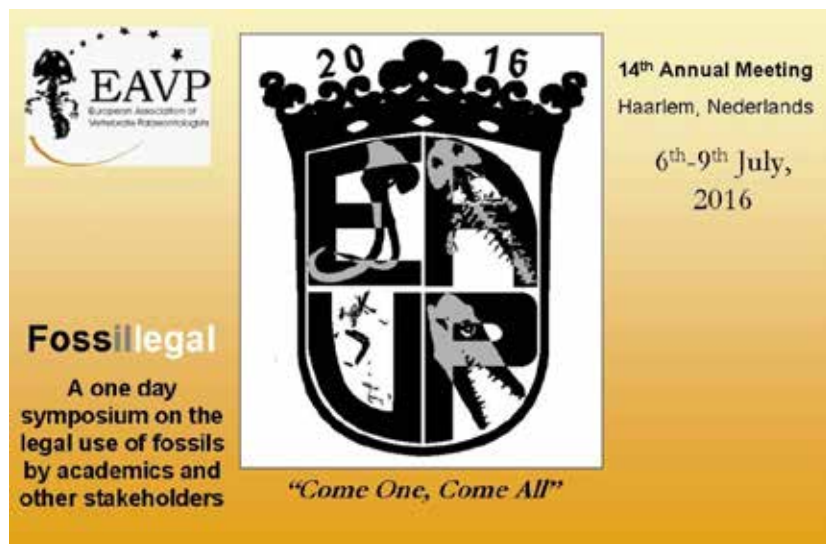


Figure 1. The FossilLegal symposium meeting logo (with the logo of the EAVP 2016 meeting, designed by Dennis Voeten and Melanie During), the grey area in the middle showing that the subject is not as simple as black and white.



the vast majority of important specimens that allow our science to leap forward, there is little to be gained for academics by alienating them. Demonizing commercial trade is a lazy way of simplifying the ethical issues in palaeontology, effectively suppressing wider discussion and preventing development.

I originally became involved in ethics whilst working at Yunnan University in southern China where I encountered an academic who had illegally taken material out of the country from a restricted study area, prior to publishing the work, seemingly unchallenged, in a high-impact journal. Last year, a four-legged snake from Brazil brought this to the fore again, being published on in another high-impact journal despite its provenance being uncertain. Some journals now have policies requiring full provenance disclosure and responsible collecting, and call for deposition in a recognized repository, as well as ensuring that the original specimen collection complied with local legislation via the inclusion of permit details (for those looking to adopt suitable policies, evidence of legal export would also be useful). The publishing dimension highlights that this is a dance between science, politics and financial gain. This underpinned my invitation to **Nicola Stead** from *PLoS ONE* to speak at the symposium; she presented on their model for ethical scientific publishing. Indeed, would it not have over-emphasized publishing within the scope of the symposium, I would have been tempted to explore those links further as they extend into the area of open access.

A recurrent problem raised in the symposium was that of bad legislation, enacted by those with little knowledge of that for which they are legislating (e.g. the new 'Kulturschutzgesetz' or Culture Protection Act, a German fossil protection law) and often overseen by individuals with little understanding of the requirements of our science. Archaeology is an extremely poor background for such considerations, rooted as it is in cultural identification that is entirely inappropriate for our subject, and art history, as has been used by the UK government, is even worse. This is one of the mires that regularly results from fossils inappropriately being referred to as 'cultural'; as John Nudds (University of Manchester), the organizer of the 2001 GCG seminar on the commercial fossil trade put it, "the evolution of life did not take cognizance of today's political boundaries". To lump fossils in with cultural objects/cultural property/cultural heritage means that their primary significance as scientific objects is lost from any assessment process, and their inherent value obscured by shallow considerations of aesthetic or monetary value. Palaeontologists rarely have any discourse with those overseeing the legislation that their material falls under, so the scientific value of fossils under consideration is rarely taken into any account. I asked **John Martin** (University of Leicester) to give the keynote of the symposium, with an exploration of the terminology that tends to ensnare palaeontology – i.e. cultural heritage – and the wide range of different meanings to individuals and groups of people from lawyers to field-workers.

Anthony Maltese (Rocky Mountain Dinosaur Resource Center) focused on the misuse of the term 'commercial palaeontology' – people being paid to do palaeontological work, which can include academics just as much as fossil dealers – and how that is very distinct from fossil poachers, as in the case of the Mongolian *Tarbosaurus* discussed in *Newsletter 90*. The commercial part is not the issue but it is the poaching that is the problem, and the two terms are very much not synonymous.

Taissa Rodrigues (Universidade Federal do Espírito Santo) spoke from the perspective of one of the 'source' nations (as in Schmidt 2000) on the Brazilian legislation and ways that material and collaboration can be obtained, as well as protection for fossil sites. In my experience, there has



Figure 2. John Martin delivers the keynote of the symposium. Photo courtesy of Tom Trapman.

been an almost neo-imperialistic attitude from some researchers, whereby they suggest they did not understand the laws/language of their hosts, and question their experience or facilities for research, resorting to illegal or legal export and exclusion of local researchers. More respect is needed in international engagement if it is to have some real integrity and not simply be a veneer over a latent imperial attitude to the resources of other nations. This is an issue that requires open global discussion, and the trend to criminalize private collectors, as noted by **Dino Frey** (Staatliches Museum für Naturkunde Karlsruhe) simply drives more specimens out of sight for science. Presentations on ethics have so far not been accepted at SVP, meaning that this fundamental issue is not being widely discussed at the largest annual gathering in the vertebrate palaeontological community. Without airing it as an important issue, there will be no global debate or understanding, ensuring that divisions and issues will continue.

The variability of access to specimens, a point that naturally arises in connection with private collections, was explored by **Dave Unwin** (University of Leicester). Although recognized museums are hailed as the ideal, access standards vary widely with some public institutions thought guilty of 'hoarding' access, as well as disposing of collections that were supposed to be theirs in perpetuity. Some recognized repositories are not fully public (for example, the American Museum of Natural History), and there may be differences in relative standards of care between private collections and other repositories. As **Kirby Siber** (Sauriermuseum Aathal) noted, the question should be one of ongoing scientific access, and not confused with one of ownership – a point echoed by **Paul Barrett** (Natural History Museum, London), who argued for primacy of scientific access for reproducibility of results. In contrast, **Oliver Rauhut** (Bayerische Staatssammlung für



Paläontologie und Geologie) contended that as reproducibility was not required for many natural phenomena (trackways being an example), the study of which was never questioned, that this should be secondary to the availability of the data in the first place.

Charlie Underwood (Birkbeck, University of London) made a similar point regarding variable access, in terms of legislation restricting fossil site access to specific favoured institutions. As well as Kirby Siber, **Raimund Albersdörfer** (Dinosaurierpark Altmühltal) echoed Dave Martill's comment that fossil legislation almost always limits the number of fossils available to science, as well as promoting a black market. The new owner of a private quarry that had previously broken down over 98% of its Solnhofen lithographic limestone for building plaster, Albersdörfer demonstrated (extrapolating from what has been recovered from the 1.5 % that he has excavated in the last few years) the number of specimens that were likely to have been lost to science, through being converted to plaster over the previous 40 years of the quarry's working life: 50 dinosaurs, 1,000 pterosaurs, 1,800 turtles, 18,000 fish specimens and 600 sphenodonts. In contrast, from the 1.5 % that he had excavated and retailed, some had indeed reached public collections. Albersdörfer observed that the history of a lack of restrictions for collecting in Bavaria was very much a positive one, and in contrast with the rest of the German provinces, and with the rest of the world. He suggested that the real force removing specimens from science is not the commercial sector, but quarrying and natural erosion, to which no one raises objections.

At the end of the presentations was a roundtable discussion with a group of such different individuals that it had the potential to become inflammatory. As such, I found myself in the role of an inverted Jerry Springer, trying to ensure open discussion while avoiding conflict. However, there was no antagonism whatsoever; instead the consensus coalesced around education as the default problem that everyone complained about, and agreed on. Uninformed legislators are likely to produce poor legislation, resulting in ineffective rearguard actions from palaeontologists. To help address this recurring problem, **Dino Frey** proposed that the EAVP survey its members before the next annual meeting to assess what we as vertebrate palaeontologists want with respect to regulations regarding excavation and trade, whether from a commercial or a scientific perspective. With such a wide variety of member countries in the Association, the results are sure to be interesting.

Perhaps two points emerged consistently from the day. First, in a science that relies on the private sector for the majority of its discoveries, alienating the commercial community is self-destructive. Secondly, in a world where legislation automatically creates black markets with attendant exploitation, we as a community have to be certain that any legislation that results, and the administration of that legislation, is both necessary and effective, and worth the problems that it creates, however inadvertently.

Those further interested in this topic will find the entire symposium, including the after talks roundtable discussion, available to view online at Palaeocast <www.palaeocast.com/eavp-2016> and I express my gratitude to Dave Marshall for filming it for us. Proceedings of the meeting are scheduled to become available in *Geological Curator* next year.

Jeff Liston

Yunnan University

Vice-President of EAVP



FURTHER READING

- LISTON, J. J. and YOU, H-L. 2015. Chinese fossil protection law and the illegal export of vertebrate fossils from China. *Journal of Vertebrate Paleontology*, **35**, 1–7.
- LISTON, J. J. 2014. Fossil protection legislation: Chinese issues, global problems. *Biological Journal of the Linnean Society*, **113**, 694–706.
- LISTON, J. J. 2013. Out of China: dinosaur eggs and the law on 'Kong Long Dan'. *Geological Curator*, **9**, 545–555.
- SCHMIDT, A. C. 2000. The *Confuciusornis sanctus*: an examination of Chinese cultural property law and policy in action. *Boston College International and Comparative Law Review*, **22**, 185–228.

A monstrous injustice

Now that the information superhighway is here and bolted firmly into the landscape, stretching from horizon to horizon, its pitiless light can shine almost anywhere. Al Gore probably did not have this in mind as he laid the foundations for this newly indispensable hyperobject¹, but its reach now extends even so far as the minor, transient niggles of an invertebrate palaeontologist's life. The precise question it illuminates here is the one frequently asked, generally plaintively if not downright querulously, in such circles, usually after the second beer of the evening. Just why is it that the vertebrates – and *particularly* those omnipresent dinosaurs – get all the attention, and in particular why do they hog Hollywood's silver screen: that dreamlike place where taxonomy and taphonomy are transmuted into stirring tales of romance, adventure, perilous encounters, fame and fortune?

In the past, one could wave one's arm to give the impression of 'all', and perhaps summon up one or two titles of the latest dinosaurian blockbusters as supporting evidence. Now, of course, at the click of a button, one can gaze at an 'all' that has become vast – and quantitative, too, as befits a science with claims to exactitude and rigour. The process lays bare the scale of the injustice.

The marvellous Wikipedia has made a list of films featuring dinosaurs – though it hastens to add that the list is incomplete and adds politely that it would be grateful if the list was added to by public-spirited cinematosaurian cognoscenti. Even incomplete, the list is impressive enough: my count came to one hundred and seventy-five.

The list is alphabetical, and includes the year of release. So one can see two candidates for the earliest dinosaur film, both made in 1914. One has a curious pedigree: *Brute Force* was made by the 'Inventor of Hollywood', D.W. Wright, as a cavemen-plus-dinosaurs yarn, meaning that Hollywood's stratigraphic confusion set its pattern right at the very beginning. It featured an early role for Lionel Barrymore, though the casting information does not divulge whether he is playing a caveman or one of the languid Jazz Age aristocrats that the film opens and closes with (the deep time stuff, one hastens to add, is a dream sequence after one of the aristocrats has a tad too much tipple). The film lives up to its title, in territory that Jared Diamond would subsequently cover in his excellent but depressing *Guns, Germs and Steel*. Its theme is inter-tribe

¹ An invention of that imaginative and amiable English scholar and philosopher Timothy Morton.



homicide, abduction, infanticide, regicide and genocide. The dinosaur makes a brief, entirely gratuitous appearance of no relevance to the plot whatsoever, and is notable as the only member of the cast not over-acting wildly.

The other dinosaur film of 1914 features quite a different, and more central, saurian. *Gertie the Dinosaur* is an animated sauropod, indeed one of the first animated versions of anything in cinema. In her five minutes of groundbreaking fame she has to endure (with resigned humour) the orders by a circus trainer to raise one foot, and then the other. But she expresses her independence by throwing a mammoth into a nearby lake, treating both a passing dragon and emergent sea-monster with disdain, and generally behaving in a frisky, irresponsible and curiously cat-like manner. Gertie is genuinely charming. Apparently, the young Walt Disney watched her, and developed ideas that led to another kind of evolution.

After that, the deluge of dinosaur films? Well, not quite. At first, it was more of a trickle. There were two more dinosaur films in that decade, then just a couple more each in the 1920s and 1930s. Between 1940 and 1950, the number crept up to three. Then, the floodgates opened: the 1950s saw 11 dinosaur films, and the 1960s, 19.

What had happened? Was this Hollywood faithfully reflecting major scientific advances in vertebrate palaeontology? It's a nice thought, and a few of the films listed did indeed have a smidgeon of such public-spiritedness – or indeed more than a smidgeon, in the case of Walt Disney's *Fantasia*, where the free spirit of Gertie can be glimpsed, just now and then, in that wonderful and well-researched history-of-Earth epic played out to the strains of Stravinsky's *Rite of Spring*². Purists will note that *Fantasia* was made in 1940, but the 1950s did include a seriously intended documentary film *The Animal World*, by Irwen Allen, a film-maker better known for disaster movies such as *The Towering Inferno*. Though graced by (and advertised via) Ray Harryhausen's fine dinosaur animations, Irwen was very careful that *The Animal World* stayed well clear of disaster of a different sort by not using the word 'evolution' in the film. The need was, he explained, to strike a balance between scientific verisimilitude and the threat of picketing by those liable to be offended by that inflammatory word. Things have moved on a little since then. Hopefully.

A closer look at the list for that decade will show another pattern. Of those 11 1950s' films, no fewer than six also feature the atom bomb. This new force, unleashed by humans, was variously invoked to wake a hideous monster that had been sleeping (in ice, usually) since the Mesozoic, or to be used to despatch the beast – after there had been time, naturally, for an elegant sufficiency of city-destroying mayhem. Dinosaurs here are not so much mighty representatives of an ancient past as the carriers of the existential angst of a new generation faced with a new world, new powers and new responsibilities (and not knowing quite what to do about any of them). Gertie would have been horrified (or more likely would have giggled and rolled over on her back).

Once Hollywood got into the dinosaur groove, though, there was little stopping it. There were signs, admittedly, of dinosaur fatigue in the 1970s (down to 14) and 1980s (only 11) but the terrible lizards roared back in the 1990s (34 films) and even more in the first decade of this millennium (with 42). From 2010 on there have already been 22 dinosaur films, and so they still bestride Tinseltown like colossi, armed in tooth and claw and likely with cigar-chomping agents in tow, hustling for a better deal.

² Stravinsky was reputedly not amused.



It's clearly a good franchise, and one where a little repetition doesn't hurt. *The Lost World* was filmed six times, between 1951 and 2001, not counting when that famous name was appended to the 1997 *Jurassic Park*. That's still, though, in single figures. *The Land before Time* saw 14 animated films of that name, where the suffix following the colon ranged from invoking standard adventure fare (*The Mysterious Island*, in 1997) to focusing on the feel-good factor (*The Wisdom of Friends*, in 2007), to plunging into the realms of the quite unforgivably cutesy (*Invasion of the Tinysauruses*). If one makes the escape to safer and more reliably monstrous territory, *Godzilla* reputedly has 30 films in the franchise, though only 19 seem to have made it onto the Wikipedia dinosaur film list. Those that have made this particular grade are clearly vying with each other for attention, either through upping the ante on the mayhem factor (*Godzilla vs Destroyorah*, from 1992), playing unashamedly on name recognition (*Godzilla vs Mechagodzilla*³), or just going for broke with no hope of either retreat or sanity clause (*Godzilla, Mothra and King Ghidorah: Giant Monsters All-Out Attack*, from 2001). Viewers of a delicate nature, though, should avoid *Bambi meets Godzilla* (1969). It does not have a happy ending.

Dinosaurs rule, therefore, from Hollywood (most of the above) to Bollywood (*Adhisaya Ulagam*, from 2012) and beyond (*Planeta Bur*, from the Soviet school of 1962). But, for all their size and scales and teeth, dinosaurs are just a small branch on our planet's majestic tree of life. So what of other fossils? How do they fare in popular film? As before, one can scour the burgeoning electronic archives. Alas, compared with the stellar brightness of the dinosaurs, there is but the feeblest flicker, here and there amid the endless cladograms of the invertebrates.

Pride of place for charisma among the spineless probably has to go to the trilobites, which were not only satisfyingly carapacious, but could take a range of shapes that might come out of a catalogue of alien invaders, and that could be armed with a blood-curdling range of spiky protrusions. Given these attributes, one might imagine a few films exploiting such an array of potential primitive hoodlums.

Indeed, searching here does not turn up a complete blank. There is one film that stars a yard-long trilobite in the role of havoc-wreaking monster. This is the 2003 John Carl Buehler film *Deep Freeze*, synonymized across the Atlantic as *Ice Crawlers*. Aficionadi might note a pattern here, as it has been said that 'it wouldn't be a John Carl Buehler movie without a deadly rubber monster puppet'. As the name suggests, the trilobite in question has been entombed in Antarctic ice, but it is woken from its slumbers not by an atomic bomb, but by oil drilling, to conform to a more up-to-date source of existential angst. Peckish after its long nap, it makes inroads first into the oil crew, and then, one by one, into the research team that arrives to investigate the mysterious goings-on.

In plotline the film is somewhat akin to those of the *Alien* dynasty (which do not feature on the Wikipedia list, despite featuring monsters that are as spectacularly dinosaurish as anyone would wish for⁴). It did not, though, alas, garner the same critical acclaim as those films. That august chronicle of spine-chilling movies, *Dread Central*, confronted with *Deep Freeze*, laid into it with vim and vigour, metaphorical knuckledusters pressed into service throughout. The behavioural ecology of the lone homicidal trilobite was central to the forensic dissection. Dubbed 'Trilly the

³ For the sake of completeness, we have to note *Godzilla vs Mechagodzilla* (1974); *Godzilla vs Mechagodzilla II* (1993) and *Godzilla Against Mechagodzilla* (2002).

⁴ Clearly there is some prejudice, amidst those who study the ways of Hollywood, against extraterrestrial dinosaurs. No wonder the poor creatures were so bad-tempered.



magic trilobite' by the reviewer, this extraordinary arthropod could unfailingly pick the exact moment for its next victim to become alone, so that it could then briskly eviscerate him or her. Not only that, it was a dab hand at teleportation, to be able to scuttle at warp speed from one sealed room into another in order to fulfill its eviscerative responsibilities. The trilobite is not seen very often in the film – and a jolly good thing, too, to the reviewer, as he rolled up his sleeves and compared it unfavourably to the mutated sea slugs from *Godzilla 1985*. The worst thing of all, though, to that overworked *Dread* correspondent, was that at the end of the film, when the last surviving pair of humans have finally despatched Trilly amid massed explosions and collapsing buildings, and have just begun to relax amid the scenes of devastation ... just what happened to appear on the last frame? Why, another trilobite tentacle is seen to emerge from the ice. Aghast, our critic now lives in fear of a sequel.

One is struck, amidst all of the derring-do, of how modestly proportioned is the be-carapace'd protagonist in the film. Three feet long equals about 90 cm, which is within range of the size of the largest recorded trilobites, which include *Isotelus rex* from Manitoba (70 cm) and the comparably-sized *Ogyginus forteyi* from Arouca, Portugal, both hailing from the Ordovician. This is very un-Hollywood like restraint, especially when one thinks that some fossil arthropods were distinctly larger than the trilobites.

An agent on the lookout for that threatened follow-up spine-chillerer might, for instance, consider signing up the Carboniferous rainforest denizen that was *Arthropleura*. This beast is genuinely impressive. Technically, it was a millipede, but it was not a millipede as we occasional gardeners know them. The fragments recovered suggest a beast of length of up to 2.5 metres and a width approaching half a metre, this kind of arthropodic hypertrophy being allowed in those days, it seems, by the high-oxygen conditions then prevalent. Its diet has been said to be vegetarian, but the evidence – spores in alleged faecal pellets – is a little indirect, and while most modern millipedes are inoffensive detritivores, a determined scriptwriter could cite the insects and earthworms eviscerated by the few millipedes of less gentle habits, and easily scale that up to, say, a menu of assorted scurrilous oil company workers and incautious academics⁵. If its footprints (going by the monicker *Diplichnites cuiithensis*, and more abundant than its corporeal remains) are anything to go by, *Arthropleura* was mobile enough to give dramatic chase to the steadily diminishing ranks of the scurrilous and incautious, though whether it was also telekinetic and psychic is a little harder to verify. Those qualities are so hard to constrain by the normal methodologies of taphonomic study.

One can, of course, combine both size and scariness more properly. Among monstrous invertebrates, the eurypterids have a strong case for taking the palm, probably in their case taking it by means of extortion, battery and intimidation. It is not just their appearance, with 'sea scorpion' as a most fitting alias, but their size that should count them amongst the most sinister of Hollywood's inhuman villains. Even a modest eurypterid – say, a few tens of centimetres long – would not be something to approach blithely. The largest of those beasts – so far, *Jaekelopterus*, estimated at 2.5 metres long from the evidence of a 46-centimetre claw discovered in Germany's Rhineland – would have combined charisma and menace in equal proportions, though its victims may never have had much time to ponder this ratio.

⁵ Or incautious oil company workers and scurrilous academics. In these enlightened times, one can take one's pick.



A shoo-in for Hollywood's monster of the year, in any year? One would have thought so. And, indeed, one monster movie does have a eurypterid at the heart of the action. Or is reputed to. Alas, the special effects team involved seem to have never been taught the virtues of clear morphological description, to allow the goose-fleshed audience to place the source of their terror into a precise taxonomic category, even as they clamber under the cinema seats. In *Deep Star Six*, the taxonomic precision has only gone as far as 'absurd muppet-like leviathan,' although this was in the context of the considerable distinction of a placing in the *Twelve Most Ridiculous Movie Monsters*, for which the competition must have been intense. *Deep Star Six*'s beast has, we are told, 'a big mouth and scales'. The former is a little generic and the latter is decidedly suspicious for any self-respecting eurypterid. But perhaps the phylogenetic tension was carefully crafted to add yet more tingle to the collective spine of the paying customers.

And so, currently, in terms of the relative proportions of movies with vertebrates and invertebrates, respectively, we are left with a score of one hundred and seventy-five (and rising) to two. To approach parity seems a distant dream, and yet those who hold the flame for petrified invertebrates must keep striving, against all odds, for equal representation. Just one breakthrough should do it. To touch all bases, my money would be on *Gertie vs Gripskull The Gargantuan Graptolite from the Grim Depths: The Final Showdown*. No, hold that title. It should of course be: *The Penultimate Showdown*. There's the sequel to think of, after all...

Jan Zalasiewicz

University of Leicester

Hills of Hame
Experience the TOTAL mountain environment

Dr Al McGowan: Principal and owner
 - Geologist
 - Natural historian
 - Hill and Moorland Leader
 - Wilderness medic

MOUNTAIN TRAINING ASSOCIATION

Email: hillofshame@gmail.com
 Phone: 0131 664 7702
 Mobile: 0744 3612983
<https://hillsofshame.wordpress.com>

- ❖ **Palaeontological and Geological Tours in Scotland for small parties**
- ❖ **Training for individuals and groups in navigation (NNAS Bronze and Silver Awards available) and expedition skills**
- ❖ **Available to act as an additional leader for university-level field courses in British Isles**
- ❖ **Fieldwork, statistical and data visualization tasks undertaken as contract research in CGeol capacity**



>>**Future** Meetings of Other Bodies



Linnean Society Palaeobotany and Palynology Specialist Group Meetings
Burlington House, London, UK 23 – 24 November 2016

The 2016 autumn meetings of the Linnean Society Palaeobotany and Palynology Specialist Groups are open to anyone interested in palaeobotany or palynology and related fields. Attendance is free and advance registration is not necessary. The meetings will be held at the Linnean Society, Burlington House, in Piccadilly on consecutive days. For further information on the palaeobotany or palynology meetings, please contact Dr Peta Hayes, (e-mail <p.hayes@nhm.ac.uk>) or Dr Barry Lomax (e-mail <barry.lomax@nottingham.ac.uk>).



25th International Workshop on Plant Taphonomy
Meeting Location University of Bonn, Germany 25 – 26 November 2016

This year's International Workshop on Plant Taphonomy will be held on the last weekend in November in Bonn. The date provides terrific opportunities for stimulating discussions over Glühwein at the Bonn Christmas Market, so please mark it on your calendar! The 2016 workshop will feature a keynote lecture from Bob Gastaldo (Colby College, Maine, USA) and a round-table discussion on the taphonomy of leaf cuticle led by Lutz Kunzmann (Senckenberg Research Institute, Dresden, Germany). Talks and posters on all aspects of plant taphonomy are welcome.

Despite the formal presentations, we hope the meeting will retain its informal, discussion-oriented, workshop flavour. Thus, students and new members wanting to check out plant taphonomy are especially welcome. The deadline for pre-registration and abstracts is 1st October. There will be more information in a second mailing at the end of summer. If you would like to receive this second circular or if you have any questions, please e-mail Carole Gee (<cgee@uni-bonn.de>).



The Rhynie Chert – our earliest terrestrial ecosystem revisited
The Royal Society, London, UK 6 – 7 March 2017

This scientific discussion meeting is organized by Prof. Dianne Edwards CBE FRS, Prof. Liam Dolan FRS and Dr Paul Kenrick. New discoveries in the fields of developmental and functional biology are shedding light on the origins of land plants; we explore how exceptional fossils from our earliest preserved terrestrial ecosystem – the 400-million-year-old Rhynie Chert – can be integrated into a neobiological understanding of the evolution of plants and their interactions with other organisms and their environment. The schedule of talks and organizer/speaker biographies are available online. Meeting papers will also be published in a future issue of *Philosophical Transactions B*. An evening poster and microscope session with drinks reception will be held following the close of the meeting.



This event is intended for researchers in relevant fields and is free to attend. Places are limited so registration is essential. Please see the website for more details:

<<https://royalsociety.org/science-events-and-lectures/2017/03/rhynie-chert/>>



Lyell Meeting 2017: Sticking Together

Burlington House, London, UK 7 March 2017

Sedimentology and geomorphology have traditionally been seen as fields in which physical, and sometimes chemical, processes dominate completely. Even in settings where biological processes have long been recognized, for example in marine carbonates, focus has been almost entirely on metazoans. This is curious, because microbial communities since the Pre-Cambrian have suffused all sedimentary environments on Earth, and at least half of global biomass is prokaryotic. Are all these microbes simply bystanders? Recent research has hinted that they are key agents in controlling an impressive range of processes and products in sedimentology, bringing the fields of microbe palaeontology and bio-sedimentology into intimate alignment. The implications are fundamental, and pose the question “are large-scale sedimentological features actually microbial trace fossils?”.

This meeting will put the majority of life on Earth back into its proper place within the sedimentary geosciences. It will shed new light on the important roles that microbial life plays in controlling how sediments erode, transport, precipitate, deposit and cement. We will explore whether microbial processes can leave signatures in sedimentary deposits that prove life was there, despite the fact that the majority of global biomass has a negligible preservation potential. Ultimately, we will lift the lid on the exciting field of sedimentary geobiology as we collectively work towards a new paradigm of microbial sedimentology.

For further information about the conference please contact Naomi Newbold (e-mail <naomi.newbold@geolsoc.org.uk>) or see the website: <<https://www.geolsoc.org.uk/lyell17>>.



European Geosciences Union (EGU) General Assembly 2017

Vienna, Austria 23 – 28 April 2017

The EGU General Assembly 2017 will bring together geoscientists from all over the world to one meeting covering all disciplines of the Earth, planetary and space sciences, including palaeontology. The EGU aims to provide a forum where scientists, especially early career researchers, can present their work and discuss their ideas with experts in all fields of geoscience. The PalAss will continue to give its support to sessions under the Division on Stratigraphy, Sedimentology and Palaeontology. Due to other events occurring concurrently in Vienna the organizers encourage booking accommodation well in advance.

Please see the website for more details: <<http://www.egu2017.eu/>>.



14th International Ichnofabric Workshop

Taipei, Taiwan 29 April – 7 May 2017

The International Ichnofabric Workshop will take place in Taipei under the auspices of the Department of Geosciences, National Taiwan University and the National Taiwan Museum. We cordially invite oral and poster presentations dealing with all aspects of ichnofabric, ichnology, and sediment–organism interaction. The workshop will include an intra-workshop field trip to the northeast coast of Taiwan, where uplifted Cenozoic sandstones offer exquisite exposure of the trace fossils and their sedimentary context. The workshop will be followed by a ‘round-the-island’ geological excursion of Taiwan, from an ichnological perspective, including a visit to the core repository of CPC in Miaoli.

For more information please see the website: <<http://homepage.ntu.edu.tw/~ludvig/styled-12/>>.



International Symposium on the Ediacaran–Cambrian Transition (ISECT NL2017)

St. John’s, Newfoundland, Canada 20 – 22 June 2017

The ISECT 2017 meeting will bring together researchers on all aspects of the palaeontology, geochemistry and stratigraphy of the Ediacaran and Cambrian intervals. The meeting will consist of a two-day symposium exploring various topics including the placement of the Ediacaran–Cambrian boundary. It will also provide delegates with the opportunity to visit some of Newfoundland’s spectacular geological and palaeontological sites, including excursions to the Ediacaran–Cambrian boundary at Fortune Head; the Cambrian–Ordovician boundary in western Newfoundland; the trilobite localities at Manuel’s River; and the Mistaken Point Ecological Reserve UNESCO World Heritage Site, home to some of the world’s best assemblages of Ediacaran macrofossils.

Registration and abstract submission are now open. Please see the website for more details: <<http://www.isect2017.org/>>.



DINO11: 11th International Conference on Modern and Fossil Dinoflagellates

EPOC Laboratory, Bordeaux University, France 17 – 21 July 2017

The scientific programme will be devoted to the latest developments in studies of living and fossil dinoflagellates, which are one of the most important groups of planktonic and benthic marine microalgae, and, as such, of interest in both biology and geology. In keeping with the tradition of this conference series, the programme of this meeting (held only every 3–5 years) will consist of oral presentations based on talks and posters supplemented by a small number of invited and keynote talks.

Abstract submission will be open from 1st December 2016. Please see the website for more details: <<http://www.laplf.org/dino11/calquedino11.htm>>.



**65th Annual Symposium of Vertebrate Palaeontology and Comparative Anatomy
& 26th Symposium of Palaeontological Preparation and Conservation with the
Geological Curators' Group (SVPCA and SPPC/GCG)**
University of Birmingham, UK 12 – 15 September 2017 (*provisional*)

SVPCA is a meeting for current research in vertebrate palaeontology and comparative vertebrate anatomy, and has been held annually in the UK, Ireland or France since 1953. The meeting is held in conjunction with SPPC, a forum for discussion of fossil preparation, conservation, and related topics co-organised with the Geological Curators' Group. The 2017 SVPCA and SPPC meetings will be held at the University of Birmingham, in collaboration with the Lapworth Museum of Geology. The provisional dates for the combined meetings are Tuesday 12th to Thursday 14th September, with a field trip on Friday 15th. This will be the first time in its 65-year history that SVPCA has come to Birmingham, and we are looking forward to welcoming all of you.

Please see the website for details: <<https://svpca2017.com/>>.



5th International Palaeontological Congress
Paris, France 9 – 13 July 2018

The fifth International Palaeontological Congress, IPC5, will be held in Paris. More details to follow.

Please help us to help you! Send announcements of forthcoming meetings to
<newsletter@palass.org>.



Meeting REPORTS



XIV EAVP Annual Meeting

Haarlem, The Netherlands 6 – 10 July 2016

In recent years, the EAVP annual meeting has increased considerably in size, and EAVP Haarlem received over 200 abstract submissions and up to 200 attendees representing a diverse community of palaeontologists, students and preparators, among others. The meeting had a very international attendance, including Germany, Spain, UK, Netherlands, Poland, Argentina, Brazil and South Africa. We were proud to see the largest turnout of UK workers thus far at an EAVP meeting. We were also delighted to see **Jo Hellawell** represent PalAss, and help facilitate interflow between different palaeontological organizations.

For three days we had a full schedule of parallel sessions in the Great and Small Halls of Teylers Museum, Haarlem. Teylers Museum is the oldest museum in The Netherlands, dating to the 17th century. It is a beautiful historic building and its central location allowed EAVP attendees to taste a bit of Dutch culture in the historic centre of Haarlem (which has all the charm, but none of the tourists, of Amsterdam). The only downside was that the building was packed to maximum capacity, and some attendees had to stand at the back of the small hall or wait for the next session. Luckily the splendid catering service offered fresh coffee and biscuits for everyone at all times, and in the evenings, very impressive traditional Dutch shots served in test-tubes on dry-ice.



Symposium in the Great Hall of Teylers Museum



Happy attendees at the EAVP Annual Meeting in Haarlem!

The meeting was opened by the curator of the Teylers Museum, **Trienke van der Spek**, after which EAVP president **Dino Frey** welcomed us all to a programme packed with symposia. The first of these was Fossillegal, hosted by **Jeff Liston** (see article on page 27 of this *Newsletter* for a special report on this symposium), and featured various talks about fossil legislation. Thankfully there were no standoffs and the conclusion of this session was that everybody more or less agreed with one another! Certainly good hope for the future of legislation in fossil trade.

Meanwhile, the Small Hall was packed and occupied all day by an in-depth symposium on the biogeography of vertebrates in the Pleistocene of Europe, organized by **Dimitris Kostopoulos** and **George Konidaris**. That evening the AGM was held, where the EAVP Open Access house journal *PalaeoVertebrata* was promoted, and the Annual Auction raised over €900 for the student support fund for next year's EAVP meeting.



Over the next couple of days, the meeting featured symposia on Island Evolution, the Anisian Winterswijk Muschelkalk and the Pleistocene North Sea Basin. Further highlights were a symposium on early tetrapods, organized by **Sebastien Steyer** and **Josep Fortuny** with speakers **Jenny Clack**, **Tim Smithson** and **Tom Challands**, and a symposium on hominids (another first for EAVP), organized by **Hanneke Meijer** and including UK palaeoanthropologist **Marc Sier**.

The Annual Dinner consisted of a delicious Italian buffet, beer and wine. The next morning two excursions were on offer to the die-hards: the Pleistocene Maasvlakte sands, where mammoths and other Pleistocene mammal fossils can be found, and the Maastrichtian ENCI quarry where Late Cretaceous (in)vertebrates are preserved.



EAVP President and Secretary Dino Frey and Soledad de Esteban Trivigno in auction-action

This year's EAVP was a successful and fun meeting and we can't wait until EAVP 2017 in Munich, Germany; but first on our list is PalAss Lyon, so we'll see you there!

Femke Holwerda

EAVP Haarlem main organizer



64th Symposium for Vertebrate Palaeontology and Comparative Anatomy (SVPCA)
Liverpool, UK 22–26 August 2016

This year's annual Symposium for Vertebrate Palaeontology and Comparative Anatomy was held in Liverpool, a thriving metropolitan port city that is home to not one, but two excellent universities – University of Liverpool and Liverpool John Moores University – which jointly organised and hosted the meeting. The opening reception was held in the Liverpool World Museum, a grand old Victorian building where delegates were free to wander the natural history galleries. Next morning, at the University of Liverpool, **Peter Falkingham** opened the first sessions.

The sessions opened with talks on the beginning of vertebrate evolution. **Valeria Vaskaninova** began with some beautiful placoderm fossils from the Prague Basin, followed by **Benedict King's**



phylogeny of basal gnathostomes based on a novel Bayesian morphological clock, shaking up the established tree and reviving the issue of placoderm monophyly. **Mike Coates** shared new fossil evidence for the evolution of the hyoid arch – a key structure in fish feeding and breathing – at the base of ray-finned fishes. **Jenny Clack** brought us out of the water on to land, sharing the findings of the “Tetrapod World” project and the diverse fossils now filling in Romer’s Gap, and **Neil Brocklehurst** (no relation) showed us how both herbivores and carnivores increased in size during the Carboniferous.



The Liverpool World Museum, which hosted the opening reception. Image courtesy of Wikimedia Commons.

Rob Asher began the afternoon’s sessions with an interesting talk on the history of classification, explaining how our understanding of taxonomic relationships improved with advances in biological theory (e.g. Darwinian evolution). **Richard Butler** told us about the importance of accounting for modern influences on biodiversity – in this case, species area effects – when estimating palaeodiversity in the fossil record, and **Jon Tenant** discussed the drivers of tetrapod diversity across the Jurassic–Cretaceous boundary.

The origin of teeth is a hot topic in vertebrate biology, and **Zerina Johanson** presented new developmental evidence from modern chondrichthyans that teeth didn’t evolve from skin denticles. The incomparable **Jeff Liston** gave a fascinating and hilarious talk on the work his team has done excavating and exhibiting the gigantic fossil fish *Leedsichthys*. To end the first day, **David Unwin** chaired an open forum on the impact of the REF (Research Excellence Framework) on palaeontology in the UK. The topic certainly generated a great deal of discussion, and as an early career researcher I found this an especially helpful chance to learn more about the system and how it impacts the research climate of the UK.



The following day started off with mammals. **Elis Newham** took us through the diversification of mammals prior to the K-Pg extinction, and the possible role of the evolution of angiosperms in the rise of mammals. We then had a whirlwind of Scottish synapsids from **Elsa Panciroli**, who showed us size isn't everything for defining species, and **Robin Beck** solved a long-standing marsupial mystery with his phylogeny of the tongue-twisting polydolopimorphians.

After coffee, we took to the air for a session devoted to pterosaurs. **Nick Longrich's** new fossil finds from Morocco support high pterosaur diversity before the K-Pg extinction, showing they didn't suffer a slow decline. Another new fossil was presented by **Mark Witton**, a tiny pterosaur from the Late Cretaceous roughly the size of a cat, accompanied with some adorable Palaeoart. **David Unwin** rounded off, revealing that pterosaurs grew at similar slow speeds to modern reptiles, rather than those of flying birds or bats.

New to SVPCA this year were the Lightning Talks. These immediately preceded the poster session, and were given by the poster presenters, as a chance to give everyone a taste of their research and an incentive to find them in the poster session. The posters themselves were presented in a smaller room downstairs; some of my personal favourites were **Melisa Morales-Garcia's** exploration of ungulate morphospace and ecology in past North American and modern-day African savannahs, and **Alessandro Chianrenza's** use of niche-modelling to understand environmental dynamics and biodiversity in the Late Cretaceous. A special mention should also go to the poster of 14-year-old **Bobby Clark**, a keen budding palaeontologist wanting to get the most out of his fossils.

The auction that night was a great event with Jeff Liston in his element as master of ceremonies. The evening culminated in a tense bidding war between Peter Falkingham and next year's host Richard Butler for the final lot, and in total raised almost £1,000 to support attendees to future SVPCA meetings.

The final day of the meeting began with a session devoted to dinosaurs. **Mike Taylor** presented newly described material of the famous sauropod *Barosaurus* and asked just how big did it get? Later **Susie Maidment** showed off a new *Stegosaurus* fossil, and new evidence for differences in size and habitat preference between different contemporaneous *Stegosaurus* species. **Jakob Vinther** and **Bob Nicholls** rounded off the session with a blend of science and art: fossilized scale and pigment patterns reconstructed into the camouflaging colour patterns of a *Psittacosaurus*, accompanied by a life-sized, real-life sculpture.

The *Psittacosaurus* was beautiful, but would it float? That was the question **Don Henderson** asked of *Spinosaurus*, and a variety of other theropods, using his own virtual sculptures to address the issue of aquatic lifestyles among dinosaurs. Keeping with the theme, **Sophie Macaulay** showed how feathers, often thought of as quintessentially light, can have significant impacts on the position of centre-of-mass in birds and likely in dinosaurs. **Edina Prondvai** was the last dinosaur talk before lunch, using the histology of bones in "dinobirds" to assess the evolution of precocial and altricial growth strategies seen in modern avians.

After lunch, Mesozoic marine reptiles and extant animals were the flavour of the afternoon, with **Ben Moon** exploring the evolutionary dynamics of ichthyosaurs following the end-Triassic extinction. **Dean Lomax** then guided us through the twisted history of two species of *Ichthyosaurus* which may indeed be one and the same. **Ariel Camp's** presentation on the muscle power behind



fish suction feeding was accompanied by some fabulous animations, illustrating powerful new methods in musculoskeletal biology. The final talk of the conference was Liverpool's very own **Karl Bates**, showing off the great work of his PhD student Juliet McClymont on the surprising variation in how humans walk, and its reflection in foot pressure data.

The field trip the following day to Chester Zoo allowed us to marvel at an incredible menagerie of living critters. The sun was shining and everyone explored at their own pace, though personally I was frantically trying to see as much as possible – from elephants to orangutans, lions, tigers and bears. There was even time to take in a special summer treat: life-sized animatronic dinosaurs!



One of Chester Zoo's Sumatran tigers taking a nap in the sunshine. Image courtesy of Dr Peter Falkingham



A life-sized animatronic Utahraptor at Chester Zoo. It even had feathers! Image courtesy of Dr Peter Falkingham



To see more about what was said at SVPCA 2016 in Liverpool, go to the meeting's twitter presence: #SVPCA. Next year, SVPCA 2017 will be held in Birmingham, hosted jointly by the University of Birmingham, the Lapworth Museum of Geology and the Birmingham Museums Trust. For all the latest information, be sure to check <<https://svpca2017.com/>>.

Robert Brocklehurst

University of Manchester



Yorkshire Fossil Festival

Scarborough 16 – 18 September 2016



The Yorkshire Fossil Festival in full swing at the Rotunda Museum, Scarborough. Photo: James Witts.

For the last three years, the sunny seaside town of Scarborough and its Rotunda Museum have hosted the Yorkshire Fossil Festival for a few days in September, and it continues to go from strength to strength. From humble beginnings, the event has grown from a handful of universities and societies to an impressive celebration of all things geology and palaeontology, with more fossil-rich goodness than you can shake a trilobite at. A few familiar faces from previous years were seen in the exhibition tents, including those of the Geological Society, the Natural History Museum, the University of Leeds, the University of Hull, the Palaeontological Association and many others, as well as new appearances from institutions such as the University of Leicester. The fantastic 'Iguanodon Restaurant' gave a humerus (pun intended) account of early dinosaur discoveries in the UK and the characters responsible (seeing Richard Owen portrayed as a pantomime villain was a particular highlight!). Other activities on offer included meeting a baby *T. rex* in the town centre, fossil-hunting trips on the beach, and exciting talks, including one on how to become a palaeontologist by **Liam Herringshaw, Jack Oyston and Katie Strang.**



'When am I?' The Palaeontological Association's contribution takes visitors on a thrilling journey through deep time! Photo: James Witts.

As in previous years, the first day of the Festival was 'schools day', where local school children, sixth formers and students of the Open University were given the chance to explore the wide range of fossil-based activities on offer. These included digging for sharks' teeth with the University of Leicester, matching coprolites to the animals that made them with the University of Leeds, and learning all about brachiopods with the Natural History Museum. There was so much learning and fun to be had that not even the typical Yorkshire weather could dampen the spirits of these budding palaeontologists and fossil enthusiasts! On Saturday and Sunday the Festival opened its doors to all visitors, and a weekend of unseasonably warm sunshine encouraged the public to attend in their masses.

PalAss once again delighted and intrigued with its 'When am I?' activity, which challenged children and grown-ups alike to work out what time period is represented by various fossils and images. The display takes the public on a journey from a tropical Silurian sea filled with sea scorpions and orthoconic nautiloids, through to a steamy Carboniferous swamp buzzing with huge dragonflies and enormous millipedes, then into an ancient Jurassic sea stalked by monstrous ichthyosaurs and plesiosaurs, and finally to a frozen Pleistocene tundra featuring herds of woolly mammoths. As ever, the activity was hugely popular, and visitors could then visit palaeoartist **James McKay** to have their new favourite prehistoric creature immortalised in watercolour. This fantastic event would not have been possible without the contributions of PalAss, as well as the countless dedicated organizers and volunteers who gathered from all over the country to make the third Yorkshire Fossil Festival a roaring success!

Jake Morton

University of Bristol



Palaeontology in the Mile High City: The Annual Meeting of the Geological Society of America

Denver, Colorado 25 – 28 September 2016

This year's Geological Society of America (GSA) Annual Meeting and Exposition was held in Denver, Colorado. The GSA meeting is an annual event and its location rotates among various North American cities, returning to Denver every three years. As usual, the meeting covered a wide range of geological themes, reaching out even to the philosophical and extra-terrestrial (Pluto and Ceres were popular this year). The technical sessions are accompanied by the possibility to stock up on books and knick-knacks at the exposition booths (generally detrimental to luggage weight restrictions) as well as the obligatory exchange of daily single beer coupons for locally brewed IPA (this entails waiting in long lines) before hitting the long aisles of posters which are changed daily.

What makes a visit to the GSA Meeting truly worthwhile are the pre-meeting workshops and the many (up to four) parallel sessions on palaeontological topics during the duration of the whole meeting. This allows a thorough immersion into diverse current topics and research questions, but despite vaulting between sessions, inevitably means missing some interesting talks.

A pre-meeting workshop on virtual palaeontology organized by **Leif Tapanila** and **Imran Rahman** highlighted the ongoing developments in this burgeoning field. The presentations were replete with luscious figures, models and animations of skeletal structures, soft tissues, fluid flows, and dinosaur tracks generated using a range of non-destructive methods. Such impressive examples support the claim that virtual palaeontology represents a revolution in the observation and interpretation of morphological features in palaeontological research. Many talks also expounded upon the possibilities of employing such eye-catching research outputs for public outreach.

The main meeting saw up to twenty sessions of talks and posters that covered a wide variety of subjects including my personal interests, palaeoecology, predation and taphonomy. There was clear evidence that the “omics” are gaining ground with an innovative session on genomics in palaeontology that introduced gene regulatory networks in a palaeontological context. There were various micropalaeontological sessions focusing on foraminifera and conodonts and their use in environmental reconstructions, as well as a number of highly-attended sessions on evolution, diversity, mass extinctions and palaeogeography. A number of sessions also concentrated on specific time slices, including the early Paleozoic world, the Permian–Triassic crises and the Late Paleocene–Early Eocene. As expected, there were relatively few talks concerning vertebrate palaeontology as the Society for Vertebrate Paleontology have long held their own dedicated meeting at another place and time. Sessions related to public outreach and collection-based database management and visualizations attest to the increasing importance of these aspects of palaeontology. All the session organizers, contributing authors and abstracts of this and previous GSA meetings can be researched online, thus providing a fascinating archive for tracking fields of interest in the palaeontological community over the last few decades.

The Paleontological Society Annual Business Meeting and Awards Reception was chaired by the president of the Paleontological Society, **Steven Holland**. A Special Council Citation for a non-palaeontologist who has had a significant impact on the field was awarded to **Martin S. Bell** for thwarting illegal smuggling and sale of fossils. This year's Strimple Award went to



Samuel J. Ciarca Jr. for 50 years of collecting and researching eurypterid faunas and generously sharing both his knowledge and collections with others. The Pojeta Service Award was given to **Judy Scothmore** for a long career in science education and public outreach. **Alycia L. Stigall** received the 2016 Schuchert Award to a person under 40 whose work reflects excellence and promise in the science of palaeontology. Finally, this year's Paleontological Society Medal was awarded to **Richard Fortey** for his extensive contribution to palaeontology in his research and popular science writing, helping to make our field more accessible to the general public. All these awards and accolades were gratefully washed down by a promptly served meal and unlimited beer.

Denver presented itself with agreeable weather, although the ubiquitous air conditioning in the conference centre led to increasing coughs and incipient colds as the meeting progressed. The Cushman Foundation once again successfully kept the time and place of their dinner secret, presumably to prevent interlopers like me from attending. Next year's meeting is in Seattle on the West Coast. A visit will be well justified, despite adding yet another hour of jet lag woes for European visitors.



“The Good, the Bad and the Ugly” (see upper left) at the Ice Breaking Party at this year’s GSA meeting in Denver, with a new friend for vertebrate palaeontologists. Note also a gaggle of echinoderm workers in the upper right background and the specially brewed conference IPA beer.

James H. Nebelsick

Eberhard Karls Universität Tübingen, Germany



Royal Society – Russian Academy of Sciences roundtable on
“The main biotic events in the Phanerozoic history of the earth”
Moscow, Russia 10 – 11 October 2016

The Royal Society (RS) and the Russian Academy of Sciences (RAS) agreed to hold two meetings in 2016 and 2017 to discuss future collaborative research directions in areas of mutual scientific interest. The first theme selected was palaeontology and thus a Royal Society delegation of six leading palaeontologists travelled to Russia in early October to explore possible collaborations with their Russian counterparts. Co-chaired by Professor Mike Benton FRS (University of Bristol) and Professor Sergei Rozhnov (Director of the Borissiak Paleontological Institute, Russian Academy of Sciences, Moscow (PIN)), this meeting featured diverse presentations encompassing a vast range of geological time, from the Precambrian to the emergence of *Homo sapiens*.

Professor **Derek Briggs** FRS (Yale University) described some extraordinary Ediacarian fossil localities in the White Sea region to the north of Russia. Global chemical and seafloor conditions favoured soft-tissue preservation during this time. Professor **Sergei Rozhnov** (PIN) discussed how understanding morphogenetic transformations can aid reconstructions of the phylogeny of echinoderms. His talk focused on material from the early Palaeozoic. His colleague **Pavel Parkhaev** (PIN) outlined two competing theories for the origin of molluscs, with the possibility of origin from either flatworms or annelids. Professor **Jenny Clack** FRS (University of Cambridge) spoke about tetrapod localities in Russia. Key discoveries in Russia include Devonian fish-like tetrapods and tetrapod-like fish, which provide invaluable information on the evolution of animal life on land. Russia also has valuable exposures of Permian rocks from the Eastern European basin, which is another valuable source of tetrapod-bearing fossil localities. Dr **Andrey Sennikov** (PIN) summarised the sequence of faunas preserved in the Permo–Triassic red beds of Russia. These document faunal change before, during and after formation of the Siberian Traps.

Professor **Mike Benton** outlined the latest research on the timing and impact of the Permo–Triassic extinction. Perturbed conditions continued for 6 million years after the extinction crisis, leading to fossil gaps in the coal, chert and coral records. As a result of evolutionary bottlenecks, species diversity (the number of species) eventually recovered but disparity (the range of morphologies) was somewhat reduced. Professor **Alexander Ponomarenko** (PIN) highlighted a number of changes to beetle assemblages during the Permian and Triassic, emphasizing how this group appear to lack an obvious extinction signal, which contrasts with the death and destruction occurring among most other taxa. Dr **Nikita Zelenkov** (PIN) spoke about the origin and early evolution of birds, from their apparent beginnings in the Jurassic period to their radiation in the early Cretaceous, drawing on evidence from China, Mongolia and Russia. An account of earth's first ‘green revolution’ – the diversification of vascular plants in the lower Devonian – was provided by Professor **Dianne Edwards** FRS (Cardiff University). The struggles of these early plants to obtain, retain, disperse and transport water led to the development of some of the most crucial features of land plants, including cuticles, stomata, rhizomes and roots. Dr **Anatoly Broushkin** (PIN) continued the focus on palaeobotany by describing his and Dr **Natalia Gordenko's** (PIN) work on spongiophiles. The biology of this group remains poorly understood, although Drs Broushkin and Gordenko have succeeded in obtaining anatomical structures from challenging material.



Professor **Chris Stringer** FRS (Natural History Museum, London) demonstrated that Britain was colonised 11 separate times by different species of humans (including *Homo sapiens*, *heidelbergensis* and *neanderthalensis*), of which 10 were ultimately unsuccessful.



Photo: Luke Clarke.

Prof. Chris Stringer of the Natural History Museum London describing the human colonization of the United Kingdom.

Dr **A.K. Agadzhagyan** (PIN) highlighted the latest findings from the Denisova cave in the Altai Mountains. Fossils from this site recently revolutionised our understanding of human evolution with the discovery of the Denisovan people, whose skeletons are preserved along with 32 species of large mammals.

Dr **Samuel Turvey** (Institute of Zoology, London) brought the discussion to the present day. His research uses insights gained from data from past human-caused extinctions to inform modern conservation efforts. He described the potential for major biases in analyses of extinction rates if only modern extinctions are taken into account.

Following the meeting, delegates visited the impressive Orlov Paleontological Museum, which includes a particularly strong collection of dinosaurs from Mongolia, synapsids from the Perm region and Precambrian fossils from Siberia.

All attendees were enthusiastic and keen to explore further cooperation. Many of the early-career Russian scientists expressed interest in receiving training in analysis of functional palaeobiology, phylogeny and macroevolution. Existing schemes offered by the Royal Society and the British Council to support scientific cooperation with Russia were also discussed. Further developments can be expected in the next months and years.

Luke Clarke
Royal Society

Professor Michael Benton FRS
University of Bristol



Photo: Luke Clarke.

At the Orlov Palaeontological Museum.



—OBITUARY—

William Gilbert Chaloner FRS

1928 – 2016

Bill Chaloner was one of the world's foremost palaeobotanists and palynologists, and had the distinction of serving as President of the Palaeontological Association from 1976 to 1978 and receiving the Association's Lapworth Medal in 2005. Bill's early research concerned *in situ* spores from Carboniferous lycophytes and linking the macrofossil plant record with the palynological record. He developed an interest in the early history of plant life on land working on megaspores, miospores and macrofossil plants.

Bill had a lifelong interest not only in biology, particularly botany, but also in geology. He quickly broadened his studies to aspects of not only the stratigraphic use of plants but also to plant evolution and ecology, and his expertise was widely sought by the British Geological Survey and industry. Bill was an innovator and a pioneer in the use of scanning electron microscopy in the study of fossil plants and spores; he also forged research on the chemistry of fossil plants, especially spores, and elucidated important aspects of the chemistry and diagenesis of sporopollenin.

In the latter part of his career Bill worked on developing methods to use fossil plants not only as palaeoclimatic indicators, but also for palaeoatmospheric reconstructions. In this vein he pioneered the use of stomatal indices in reconstructions of ancient carbon dioxide levels. Bill also had an interest in the potential of charcoal as an indicator of both ancient wildfires and oxygen levels. He continued to research for all of his 22 years post-retirement and he even helped to organize a symposium for the Royal Society on 'Fire and Mankind' in 2015, in addition to editing the accompanying volume published in the *Philosophical Transactions of the Royal Society* earlier this year.

Bill was an inspirational teacher and lecturer and always had time for young researchers; he helped many people during their careers. He was kind, thoughtful, witty, had a rare insight into complex problems, and always offered wise advice when asked.

After his degrees at the University of Reading, a post-doctoral period in America and his National Service, he was appointed lecturer at University College London. He was given the Chair of Botany in Birkbeck College in London in 1972. He was made a Fellow of the Royal Society in 1976. He was appointed to the Hildred Carlyle Chair of Botany at Bedford College, London in 1979. He moved to Royal Holloway in 1985 as part of the merger and became the Head of the School of Biological Sciences. He retired in 1994, becoming Emeritus Professor of Geology. He was made a Fellow of Royal Holloway.

He is survived by his wife (of over 60 years), three children and six grandchildren.

William Gilbert Chaloner born 22 November 1928, died 13 October 2016.

Andrew C. Scott

Royal Holloway, University of London



Photo courtesy of the Palaeontological Association



Sylvester-Bradley REPORT

Fossil polychaetes from the Palaeozoic of North America

Luke A. Parry

School of Earth Sciences, University of Bristol

Introduction

Annelids are an ancient animal phylum with a fossil record that extends approximately 520 million years to the early Cambrian. During this time, annelids have evolved a multitude of body plans, feeding modes, ecologies and life histories. They occur in diverse ecosystems ranging from the deep sea to terrestrial soils, and fill niches from vagile predators to sessile filter feeders. Annelid body fossils are known from numerous Palaeozoic Lagerstätten and are preserved in various ways, including as carbonaceous compressions, pyritized remains and in iron carbonate concretions. Such fossils can preserve exquisite detail, including guts and muscles, and offer rare but important insights into annelid origins.

The oldest annelids are fossil polychaetes preserved as carbonaceous compressions from the early Cambrian Sirius Passet (Vinther *et al.* 2011) and Guanshan (Liu *et al.* 2015) biotas, and are not readily comparable with any extant groups. The oldest unequivocal crown group annelids are scolecodonts (Hints and Eriksson 2007), the jaws of eunicidan polychaetes, which are organic in composition and recoverable from sedimentary rocks by acid maceration. Despite their potential evolutionary significance, prior to this project there were no robust and taxonomically inclusive phylogenetic hypotheses for Palaeozoic fossil annelids, with analyses restricted to either few characters or single fossil taxa.

This research project sought to identify new fossil polychaetes from collections housed at the Royal Ontario Museum (ROM), including material from the Cambrian, Devonian and Carboniferous. During this research I identified new characters from known taxa from the Burgess Shale and Mazon Creek and from one new taxon from each of the Devonian of Ontario and Mazon Creek. Morphological observations derived from known taxa were incorporated into a novel character matrix for all annelids which was recently published in the *Proceedings of the Royal Society B* (Parry *et al.* 2016).

New annelid taxa

Exceptionally large scolecodonts from the Lower Eifelian (Lower-Middle Devonian) Kwataboahagan Formation, Rabbit (Askaskawayau) Ridge, Ontario, Canada were studied at the ROM. Unlike typical scolecodonts, these specimens are preserved on bedding planes and are readily visible to the naked eye, typically >10 mm long (Figure 1a). These specimens are comparable in size to the jaws of *Eunice aphroditois* (the 'bobbit worm'), whose whole body can be >2 m long. Consequently, these are the largest fossil polychaete jaws known. Descriptions of the Eifelian specimens are currently in preparation in collaboration with Prof. Mats Eriksson (Lund University) and David Rudkin (ROM).

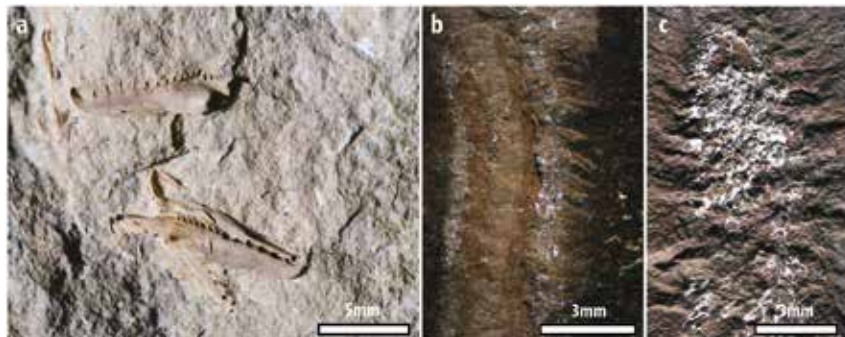


Figure 1. New fossil polychaetes from the Palaeozoic. a, scolecodont clusters from the Middle Devonian of Ontario. b, c, possible chrysopetalid polychaete specimens from the Carboniferous Mazon Creek showing distinctive notochaetae (b), and paired anterior jaws (c).

The ROM houses a substantial collection of concretions from Mazon Creek, the annelid portion of which has never been extensively studied. Currently, numerous polychaete taxa that span the diversity of the annelid crown group are described from this biota (Jones and Thompson 1977; Thompson and Johnson 1977; Thompson 1979; Hay 2002). One new taxon was identified as a possible member of the Chrysopetalidae, the earliest (and only) fossil record for this family. It possesses a dorsal covering of chaetae (Figure 1b) and a pair of anterior jaws (Figure 1c).

Annelid Phylogeny

Historical morphological and molecular phylogenies conflict over the identity of the earliest diverging annelid groups and the composition of the annelid crown group. Morphological trees place the unsegmented Echiura (spoon worms) and Sipuncula (peanut worms) outside of Annelida, and recover polychaetes with simple body plans ('Scolecida') as an early diverging clade or grade within annelids (Rouse and Fauchald 1997). Crucially, polychaetes are recovered as monophyletic with respect to the clitellates (earthworms, leeches and their close relatives). In contrast, molecular phylogenies place the unsegmented echiurans, sipunculans and clitellates within a paraphyletic grade of polychaetes (Struck *et al.* 2011). Incorporation of data from fossil annelids (particularly those from the Cambrian, *e.g.* Parry *et al.* 2015) repolarizes morphological characters, placing echiurans and clitellates (but not sipunculans) within polychaetes, rendering them paraphyletic (Figure 2). This result is stable across optimality criteria and their implementations (*e.g.* maximum parsimony, maximum likelihood, Bayesian inference) (Parry, *et al.* 2016).

Acknowledgements

I thank the Palaeontological Association for Sylvester-Bradley Award PA-SB201404 that funded this research.

REFERENCES

- HAY, A.A. 2002. Flabelligerida from the Francis Creek shale of Illinois. *Journal of Paleontology*, 76, 764–766.
- HINTS, O. and ERIKSSON, M. 2007. Diversification and biogeography of scolecodont-bearing polychaetes in the Ordovician. *Palaeogeography Palaeoclimatology Palaeoecology*, 245, 95–114.

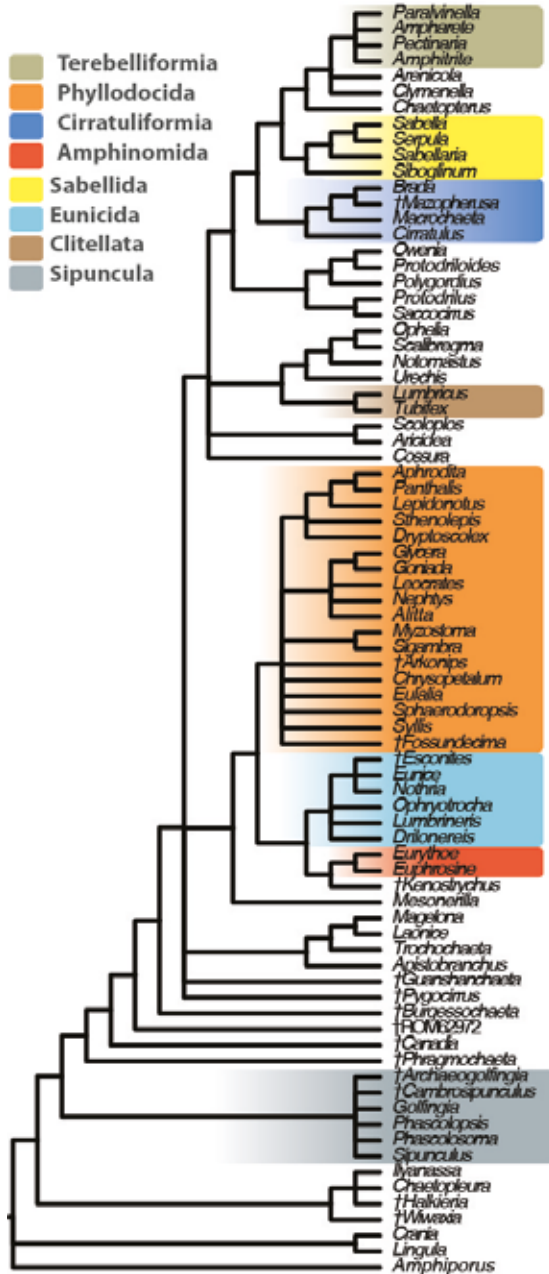


Figure 2. Phylogeny of living and fossil polychaetes based on morphological data. From Parry et al. 2016.



- JONES, D. and THOMPSON, I. 1977. Echiura from the Pennsylvanian Essex fauna of northern Illinois. *Lethaia*, **10**, 317–325.
- LIU, J., OU, Q., HAN, J., LI, J., WU, Y., JIAO, G. and HE, T. 2015. Lower Cambrian polychaete from China sheds light on early annelid evolution. *The Science of Nature*, **102**, 1–7.
- PARRY, L., VINTHER, J. and EDGECOMBE, G.D. 2015. Cambrian stem-group annelids and a metameric origin of the annelid head. *Biology Letters*, **11**, 20150763.
- PARRY, L.A., EDGECOMBE, G.D., EIBYE-JACOBSEN, D. and VINTHER, J. 2016. The impact of fossil data on annelid phylogeny inferred from discrete morphological characters. 20161378. *Proceedings of the Royal Society B*, **283**, 20161378.
- ROUSE, G.W. and FAUCHALD, K. 1997. Cladistics and polychaetes. *Zoologica Scripta*, **26**, 139–204.
- STRUCK, T., PAUL, C., HILL, N., HARTMANN, S., HOSEL, C., KUBE, M., LIEB, B., MEYER, A., TIEDEMANN, R., PURSCHKE, G. and BLEIDORN, C. 2011. Phylogenomic analyses unravel annelid evolution. *Nature*, **471**, 95–113.
- THOMPSON, I. 1979. Errant polychaetes (Annelida) from the Pennsylvanian Essex fauna of northern Illinois. *Palaeontographica Abteilung A*, **163**, 169–199.
- THOMPSON, I. and JOHNSON, R.G. 1977. *New fossil polychaete from Essex, Illinois*. Field Museum of Natural History, Chicago. 34 pp.
- VINTHER, J., EIBYE-JACOBSEN, D. and HARPER, D.A. 2011. An Early Cambrian stem polychaete with pygidial cirri. *Biology Letters*, **7**, 929–932.



Callomon REPORT

The evolution of modern reef ecosystems

William J. Foster

Jackson School of Geosciences, University of Texas at Austin

Many of the animal groups that comprise modern reef ecosystems first appeared or radiated during the Mesozoic in the wake of the late Permian mass extinction. This event caused the extinction of up to 74% of benthic invertebrates, including major Palaeozoic reef building animals (e.g., rugose and tabulate corals). In the aftermath of the extinction, i.e., during the Induan substage, reefs were relatively impoverished and were constructed by microbialites (Figure 1). Although metazoan-constructed reefs reappear in the fossil record during the Early Triassic (e.g. Brayard *et al.* 2011), they were not common until the Illyrian substage, i.e., 11 million years after the extinction. Reefs, therefore, took longer than other marine ecosystems to recover (e.g. Foster and Twitchett 2014).

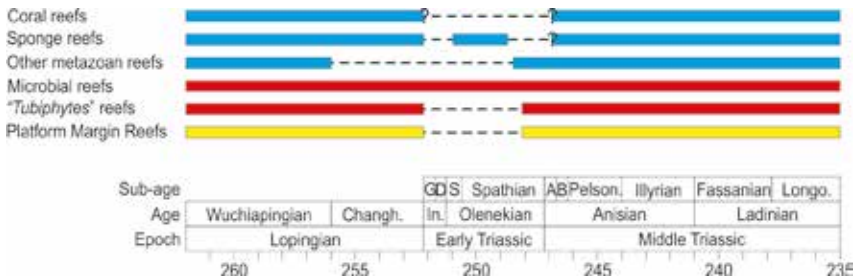


Figure 1. Range chart of reef ecosystems across the Permian/Triassic boundary. Changh. = Changhsingian, In. = Induan, G = Griesbachian, D = Dienerian, S = Smithian, A = Aegean, B = Bithynian, Pelson. = Pelsonian, Longo. = Longobardian.

Quantitative palaeoecological analyses of the recovery of benthic invertebrates following the late Permian mass extinction are currently limited to the Early Triassic and to those groups that recovered within this interval, e.g. various molluscan taxa. The recovery of reefs has been assessed only qualitatively, whereby recovery is considered to have occurred in three stages: microbial reefs appeared in the Early Triassic, Wetterstein reefs (dominated by calcisponges) in the Middle Triassic, and Dachstein reefs (dominated by corals) in the late Triassic (Flügel 2002). Previous studies of the Wetterstein reefs and related strata in the southern Alps have presented very little palaeoecological community data. How the taxonomic and functional composition of reef ecosystem communities evolved in the wake of the late Permian extinction event is therefore still poorly understood. To investigate the recovery and evolution of reef communities I focused on the Wetterstein Formation in Aggtelek, Hungary, which represents the oldest Mesozoic platform margin metazoan reef in Europe. The Aggtelek reef has received little attention since its initial description by Balogh (1948); recent biostratigraphic studies indicate an Illyrian age (Velledits *et al.* 2011).



In this study the entire Anisian–Ladinian Wetterstein reef succession was investigated, including exposures of the older part of the reef at the Baradla Cave, Kecő Valley and Aggtelek-Jósvafő road-cut sections, and exposures of the younger part of the reef at the Nagy-Jenei Hill, Tót Valley and Pitics Hill. The exposure at these sections is often poor and discontinuous, which hinders detailed mapping and logging. Further, fossils are often not visible to the naked eye, but are visible in petrographic thin sections. Samples were therefore systematically collected along transects for later sectioning.

The Aggtelek Reef is extremely diverse with 77 species identified, including sponges, foraminifera, cyanophyceae, brachiopods, crinoids, dasycladaceans, echinoids, rhodophyta, bryozoans, annelids and microproblematica. The median taxonomic richness of samples from the reef facies is 4 (ranges: 1–14 species). The species composition is highly variable among samples, possibly reflecting original taxonomic heterogeneity across the reef. Despite their taxonomic diversity, most species present are sessile suspension feeders; the only motile taxa associated with the Aggtelek reef are conodonts and echinoids (see Mihaly 1981; Velledits *et al.* 2011).

Eighty-three samples were collected and analysed from the Steinalm, Jenei and Wetterstein Formations which represent lagoon, basin, and reef facies, respectively. The taxonomic composition of the samples shows a clear habitat differentiation (Figure 2). Samples from lagoon and back reef facies are dominated by foraminifera and dasycladaceans, samples from the reef facies are more heterogeneous but dominated by sponges, foraminifera, cyanophyceans and microproblematica, and samples from the slope and basin are dominated by foraminifera, microproblematica and occasionally dasycladaceans. There is also evidence that reef composition changed through time: no foraminifera or red algae were observed in the younger part of the reef exposed in the Aggtelek-Jósvafő road-cut and Pitics Hill section. The back reef facies shows abundant microbialite fabrics.

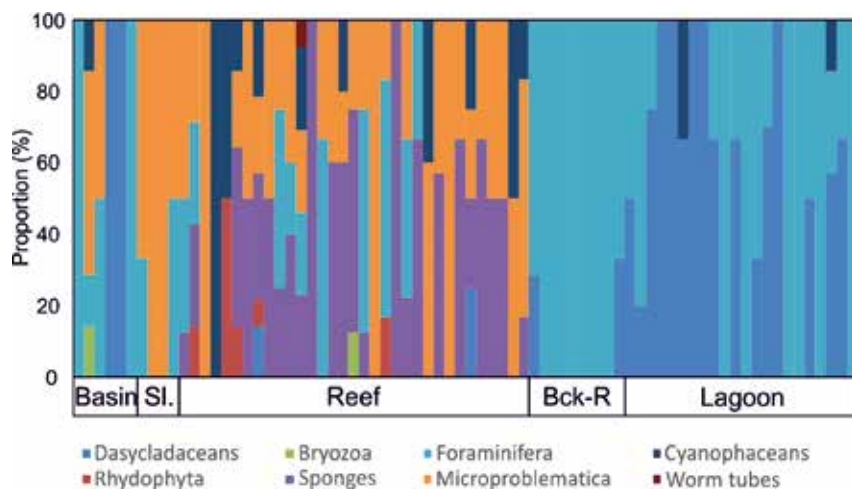


Figure 2. Species composition of samples from the Middle Triassic (Anisian stage) of the Aggtelek Karst, grouped according to depositional environment. Sl. = slope, Bck-R = back-reef, lagoon.

This study quantitatively shows the first evidence for a taxonomically diverse reef ecosystem in the Western Palaeotethys soon after the late Permian mass extinction. The reef was dominated by sponges and microproblematica and showed clear habitat differentiation from the platform



interior to basin by the upper Anisian. This codominance of sponges and microproblematica contrasts with early Triassic platform margin reefs in other regions (which are dominated by the microproblematicum *Tubiphytes* (e.g. China, Payne *et al.* 2006; Romania, Popa *et al.* 2014)), and with Early Triassic microbialite, sponge, and *Placunopsis*-reefs.

Acknowledgments

I am grateful for the Palaeontological Association for Callomon Award PA-CA201401 that funded this project. I would like to thank Dr Kinga Hips (Eötvös Loránd University), Dr Csaba Péro (Eötvös Loránd University) and Dr Felicitász Velledits (Miskolc University) for both their hospitality and advice on exposures and sample collection; Dr Szabolcs Leél-Össy (Eötvös Loránd University) for helping me sample, navigate, and fully experience the Baradla Cave; Prof. Richard Twitchett for hosting me at the NHM, London, at the beginning of the project; finally, Dr Louise Foster for her assistance in the field.

REFERENCES

- BALOGH, K. 1948. Adatok a Gömör–Tornai karszt geológiájához (Beiträge zur geologie des Gömör–Tornaer karstes). *A Magyar Állami Földtani Intézet Beszámoló a Vitaülésekről*, **10**, 107–129. (Hungarian with German abstract)
- BRAYARD, A., VENNIN, E., OLIVIER, N., BYLUND, K., JENKS, J., STEPHEN, D.A., BUCHER, H., HOFMANN, R., GOUDEMAM, N. and ESCARGUEL, G. 2011. Transient metazoan reefs in the aftermath of the end-Permian mass extinction. *Nature Geoscience*, **4**, 693–697.
- FLÜGEL, E. 2002. Triassic reef patterns. In KIESSLING, W., FLUGEL, E. and GOLONKA, J. Phanerozoic reef patterns. *SEPM Special Publication*, **72**, 391–463.
- FOSTER, W.J. and TWITCHETT, R.J. 2014. Functional diversity of marine ecosystems after the late Permian mass extinction event. *Nature Geoscience*, **7**, 233–238.
- MIHALY, S. 1981. Az Aggteleki-karszt középső-triasz Echinoideai (Mitteltriadische Echinoideen des Aggteleker Karstes – Nordungarn). *A Magyar Állami Földtani Intézet Évkönyve 1979*, 297–331.
- PAYNE, J., LEHRMANN, D.J., CHRISTENSEN, S., WEI, J. and KNOLL, A. 2006. Environmental and biological controls on the initiation and growth of a Middle Triassic (Anisian) reef complex on the Great Bank of Guizhou, Guizhou Province, China. *Palaos*, **21**, 325–343.
- POPA, L., PANAIOTU, C. and GRADINARU, E. 2014. An early Middle Anisian (Middle Triassic) *Tubiphytes* and cement crusts-dominated reef from North Dobrogea (Romania): facies, depositional environment and diagenesis. *Acta Geologica Polonica*, **64**, 189–206.
- VELLEDDITS, F., PER, C., BLAU, J., SENOWBARI-DARYAN, B., KOVACS, S., PIROS, O., POCSAI, T., SZUGI-SIMON, H., DUMITRICA, P. and PALFY, J. 2011. The oldest Triassic platform margin reef from the Alpine-Carpathian region (Aggtelek, NE Hungary): platform evolution, reefal biota and biostratigraphic framework. *Revista Italiana di Paleontologia e Stratigrafia*, **117**, 221–268.



Undergraduate Bursary **REPORTS**

New sauropod dinosaur remains from the Late Cretaceous of North Africa

Cecily Nicholl

Department of Earth Science and Engineering, Imperial College London

Introduction

Sauropods were an exceptionally successful clade of gigantic herbivorous dinosaurs that dominated many Mesozoic ecosystems (Upchurch *et al.* 2011). First appearing in the Late Triassic (Yates & Kitching 2003), sauropods became globally widespread by the Upper Jurassic, before disappearing during the Cretaceous–Palaeogene extinction event. Although generally well-represented in the fossil record, there are certain time intervals and localities where sauropod remains are scarce, and hence it follows that any new discoveries become important data points that can contribute to our understanding of a complex evolutionary history within the group, especially in many of the most basal forms where relationships remain particularly poorly resolved.

Recently, two sauropod cervical vertebrae were discovered in Early to Middle Jurassic sediments from a new locality in the Middle-High Atlas of central Morocco. This particular period in Africa preserves relatively few sauropod remains, with *Tazoudasaurus naimi* (Allain *et al.* 2004) from the Early Jurassic, and *Chebsaurus algeriensis* (Mahammed *et al.* 2005) and *Atlasaurus imelakai* (Monbaron *et al.* 1999) from the Middle Jurassic, forming the only valid genera currently to be described from the northern region of the continent during this time. *Jobaria tiguidensis* (Serenó *et al.* 1999) and *Spinophorosaurus nigerensis* (Remes *et al.* 2009) from the Middle Jurassic beds of Niger also prove useful in comparisons with the newly discovered vertebrae.

Anatomy

The specimen, NHMUK PVR36834 (Figure 1), comprises two well-preserved cervical vertebrae discovered in articulation, both consisting of a centrum fused to the neural arch and neural spine, with no ribs present in either. Although fusion has occurred between the centra and neural arches, the presence of visible neurocentral sutures indicates that this individual had not reached complete ontogenetic growth, and was therefore in a juvenile to subadult stage. We can postulate that the vertebrae would have sat between the fifth and tenth position in the cervical series, which is supported by the prezygapophyses extending beyond the most anterior point of the centrum, and a high length to height ratio.

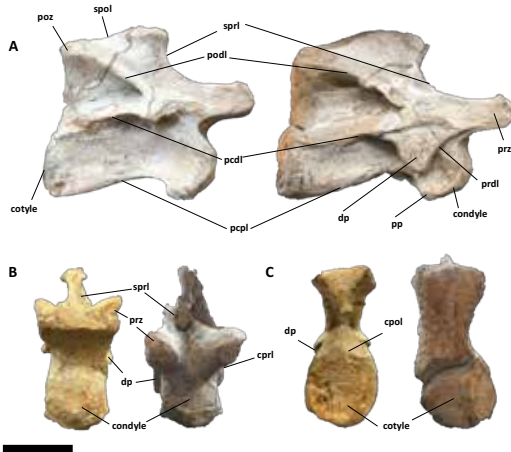


Figure 1. NHMUK PVR36834 seen in right lateral view A, anterior view B, and posterior view C. Abbreviations: pp, parapophyses; dp, diapophyses; prz, prezygapophyse; poz, postzygapophyse; pcpl, posterior centroparapophyseal lamina; pcdl, posterior centrodiapophyseal lamina; prdl, prezygadiapophyseal lamina; podl, postzygapophyseal lamina; cppl, centroprezygapophyseal lamina; cpol, centropostzygapophyseal lamina; sprl, spinoprezygapophyseal lamina; spol, spinopostzygapophyseal lamina. Terminology for laminae from Wilson (1999). Scale bar is 10 cm.

The centra of the vertebrae are opisthocoelous, with an anterior convex condyle and concave posterior cotyle, a feature true of all sauropods. The lateral surfaces have smooth, extensive depressions with no dividing laminae, and are excavated mildly, lacking true pleurocoels. The simplicity of the centra is a plesiomorphic character in sauropods, and can be seen in other contemporaneous North African genera, such as *Tazoudasaurus*. However, this condition does reappear in some of the most derived sauropods, such as the titanosaurs *Saltasaurus loricatus* (Bonaparte and Powell 1980) and *Alamosaurus sanjuanensis* (Gilmore 1922). Parapophyses are present on the anterodorsal corner of the lateral surface and project ventrolaterally with a mild posterior inclination. As we would expect in a more basal taxon, the dorsal surfaces are unexcavated, with excavations in this position evolving later, in the neosauropods.

On the ventral surface of the centra, a well-developed keel is present. It extends along the midline, becoming more prominent in the anterior region before fading out posteriorly, and completely disappearing three-quarters of the way along the centra. In most derived forms, this keel becomes reduced or absent. Transversely, the anterior third of the surface is slightly concave, but remains essentially flat in the posterior two-thirds, as is the case in many basal genera.

The neural spines are simple and unbifurcated, unlike in Diplodocidae, and are essentially formed by the spinoprezygapophyseal and spinopostzygapophyseal laminae, which are separated by excavated fossae. Interestingly, the anterior margin of the spine has a ventral-most section that is slanted anteriorly, a character that is shared by only a few other sauropods in their middle vertebrae, but that is also present in *Jobaria* (Figure 2).

Another distinguishing character is the presence of tubercles on the dorsomedial surface of the prezygapophyses. They create small, fairly flat protrusions on the processes that are distinct from



pre-epiphyses, and are present in other early genera such as *Pulanesaura eocollum* (McPhee *et al.* 2015) and *Jobaria*.

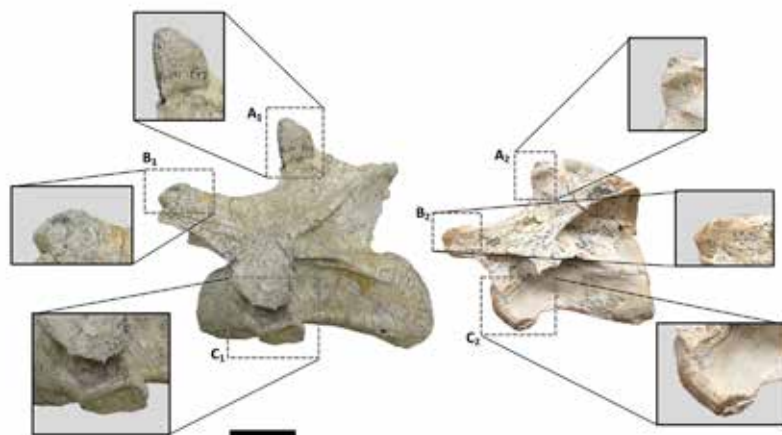


Figure 2. Key anatomical similarities and differences between *Jobaria tiguidensis* Cv9 (left) and NHMUK PVR36834 (right). Anterior slant in most ventral region of the neural spine (A1 and A2); tubercles on the dorsomedial surfaces of the prezygapophyses (B1 and B2); excavated (C1), and unexcavated (C2) dorsal surface of the parapophyses. Scale bar is 10 cm.

Finally, an accessory lamina is visible as a slight protrusion between the anteroventral region of the diapophysis, extending anteroventrally towards the apex of the anterior articulation surface. It is orientated diagonally at around 40° to the horizontal, so is a continuation to the trend of the postzygodiapophyseal lamina. It is short in length, extending for only 30 mm, and projects ventrolaterally. It is difficult to determine whether this feature occurs in other genera, or even whether it varies with ontogeny, as the diapophyses frequently obscure this area in other specimens.

Phylogenetic Analysis

Despite the limited amount of material, we placed the vertebrae into two existing phylogenetic data matrices that we felt to be most relevant – Carballido *et al.* (2015), and MCPhee *et al.* (2015). As expected, the addition of NHMUK PVR36834 to each matrix produced a series of poorly-resolved nodes within the phylogenetic tree, and positioned NHMUK PVR36834 in a polytomy with several basal sauropods. Nevertheless, the results allow us, with some confidence, to determine that the vertebrae belonged to a non-neosauropod sauropod, although it is currently unclear as to whether it belongs within or outside of Eusauropoda.

Regardless of comparisons between genera being difficult due to variations throughout the cervical series and ontogenetic growth, NHMUK PVR36834 very closely resembles the middle vertebrae of *Jobaria* in its general morphology, specifically with regard to the length-to-height ratio, anteriorly sloping spine, and presence of tubercles on the prezygapophyses. Although *Jobaria* displays parapophyses with an excavated dorsal surface and deeper divided depressions in the centrum, these excavations can develop throughout ontogeny, as seen in *Europasaurus* (Carballido and Sander 2012), suggesting that these vertebrae could have been from a juvenile *Jobaria* or a closely related genus.



Currently, we are modifying the matrix by Carballido *et al.* (2015) to include new characters that relate specifically to the presence of an anteriorly sloping neural spine, tubercles on the prezygapophyses, and the length to average height/width of the centrum. We hope that these introductions may produce a better resolved tree, and provide us with a more accurate positioning of NHMUK PVR36834.

Acknowledgements

I would like to thank Dr Phil Mannion for all of his help in supervising this project, and Prof. Paul Barrett and Sandra Chapman of the Natural History Museum, who allowed me access to the specimens. I would also like to thank the Palaeontological Association for Undergraduate Research Bursary PA-UB201601 that financially enabled this project.

REFERENCES

- ALLAIN, R., AQUESBI, N., DEJAX, J., MEYER, C., MONBARON, M., MONTENAT, C., RICHIR, P., ROCHDY, M., RUSSELL, D. and TAQUET P. 2004. A basal sauropod dinosaur from the Early Jurassic of Morocco. *Comptes Rendus Palevol*, 3, 199–208.
- BONAPARTE, J.F. and POWELL, J.E. 1980. A continental assemblage of tetrapods from the Upper Cretaceous beds of El Brete, northwestern Argentina (Sauropoda-Coelurosauria-Carnosauria-Aves). *Mémoires de la Société Géologique de France*, 139, 19–28.
- CARBALLIDO, J.L. and SANDER, P.M. 2012. Postcranial axial skeleton of *Europasaurus holgeri* (Dinosauria, Sauropoda) from the Upper Jurassic of Germany: implications for sauropod ontogeny and phylogenetic relationships of basal Macronaria. *Journal of Systematic Palaeontology*, 12, 335–387.
- CARBALLIDO, J.L., POL, D., PARRA RUGE, M.L., PADILLA BERNAL, S., PÁRAMO-FONSECA, M.E. and ETAYO-SERNA, F. 2015. A new Early Cretaceous brachiosaurid (Dinosauria, Neosauropoda) from northwestern Gondwana (Villa de Leiva, Colombia). *Journal of Vertebrate Paleontology*, 35, e980505.
- GILMORE, C.W. 1922. A new sauropod dinosaur from the Ojo Alamo Formation of New Mexico. *Smithsonian Miscellaneous Collections*, 72, 1–9.
- McPHEE, B.W., BONNAN, M.F., YATES, A.M., NEVELING, J. and CHOINIERE, J.N. 2015. A new basal sauropod from the pre-Toarcian Jurassic of South Africa: evidence of niche-partitioning at the sauropodomorph–sauropod boundary? *Scientific Reports*, 5, 13224.
- MAHAMMED, F., LÄNG, E., MAMI, L., MEKAHLI, L., BENHAMOU, M., BOUTERFA, B., KACEMI, A., CHÉRIEF, S., CHAOUATI, H. and TAQUET, P. 2005. The ‘Giant of Ksour’, a Middle Jurassic sauropod dinosaur from Algeria. *Comptes Rendus Palevol*, 4, 707–714.
- MONBARON, D., RUSSELL, D. and TAQUET, P. 1999. *Atlasaurus imelakei* n.g., n.sp., a brachiosaurid-like sauropod from the Middle Jurassic of Morocco. *Comptes Rendus de l’Académie des Sciences. Science de la terre and des planets*, 329, 519–526.
- REMES, K. and ORTEGA, F. 2009. A new basal sauropod dinosaur from the Middle Jurassic of Niger and the early evolution of Sauropoda. *PLoS One*, 4, 1–13.
- SERENO, P.C., BECK, A.L., DUTHEIL, D.B., LARSSON, H.C.E., LYON, G.B., MOUSSA, B., SADLEIR, R.W., SIDOR, C.A., VARRICCHIO, D.J., WILSON, G.P. and WILSON, J.A. 1999. Cretaceous sauropods from the Sahara and the uneven rate of skeletal evolution among dinosaurs. *Science*, 286, 1342–1347.



- UPCHURCH, P., BARRETT, P.M., and DODSON, P. 2004. Sauropoda. In WEISHAMPEL, D.B., DODSON, P. and OSMÓLSKA, H. (Eds.) *The Dinosauria*. University of California Press, Berkeley. pp. 259–322.
- WILSON, J.A. 1999. A nomenclature for vertebral laminae in sauropods and other saurischian dinosaurs. *Journal of Vertebrate Paleontology*, **19**, 639–653.
- YATES, A.M. and KITCHING, J.W. 2003. The earliest known sauropod dinosaur and the first steps towards sauropod locomotion. *Proceedings of the Royal Society B*, **270**, 1753–1758.

A new phylogeny of Stegosauria (Dinosauria: Ornithischia)

Tom Raven

Department of Earth Science and Engineering, Imperial College London

Introduction

The Stegosauria were a group of armoured ornithischian dinosaurs that lived from the Middle Jurassic to the Lower Cretaceous and are easily recognizable due to two rows of plates and spikes extending from the neck to the end of the tail. Their skeletal remains are known from nearly all continents but are relatively rare, so there is much that is yet to be understood about the palaeobiology of the group. In order to better understand the evolution of the stegosaurs, a stable hypothesis of evolutionary relationships is required. The first phylogeny of Stegosauria was by Galton and Upchurch (2004), and was followed by Maidment *et al.* (2008) and subsequent iterations of the same matrix in Mateus *et al.* (2009) and Maidment (2010). Since the last phylogeny was published, new material of *Stegosaurus* (Maidment *et al.* 2015; Maidment *et al.* in review) has been described, and *Miragaia longicollum* has been synonymised with *Dacentrurus armatus* (Cobos *et al.* 2010). Additionally, a new genus, *Alcovasaurus longispinus*, has been described (Galton and Carpenter 2016).

In light of these new data, I undertook a re-analysis of the phylogenetic relationships of the Stegosauria. This research used recent technological advances in phylogenetic analysis, *e.g.*, the New Technology searches in TNT (Goloboff *et al.* 2008), which allow a more thorough search of tree space and direct analysis of continuous characters without the need to arbitrarily discretize character states (Goloboff *et al.* 2006).

Methods

All taxonomically valid basal thyreophoran and stegosaurian taxa were included, along with three ankylosaur taxa. The most basal ornithischian *Pisanosaurus mertii* (Butler *et al.* 2008) was used as the outgroup taxon. *Lesothosaurus diagnosticus* and *Laquintasaura venezuelae*, taxa that are thought to be basal thyreophorans (Butler *et al.*, 2008; Baron *et al.*, 2016), were also included.

All stegosaurs found to be valid by Maidment *et al.* (2008) and used in subsequent iterations (*e.g.* Maidment 2010) were used here. *Stegosaurus armatus* was replaced as the type species of *Stegosaurus* by the better-known species *Stegosaurus stenops* (Galton 2010); this convention was followed here. *Dacentrurus longicollum* was retained as a separate taxon as there are significant differences between it and *Dacentrurus armatus*.



The character list of Maidment (2010) was updated as follows. Four characters were re-worded and six were removed as new data indicate that the latter character states vary with ontogeny or intraspecifically. Thirty-one new characters were identified from recent publications (Baron *et al.* 2016; Maidment *et al.* 2015; Maidment and Pereda-Suberbiola, accepted; Maidment *et al.* in review) and added to the character list. The final character list used contained 114 characters, of which 24 are continuous.

A character-taxon matrix, of 114 characters and 23 taxa, was built in Mesquite (Maddison and Maddison 2016). Due to the constraints of Mesquite and the inclusion of continuous data, two matrices were built, one for continuous data and one for discrete data, and subsequently concatenated for use in TNT. To test for the effects of continuous data, the analysis was also re-run with the 24 continuous characters pruned.

Results and discussion

The New Technology search in TNT with the full dataset produced one most parsimonious tree (MPT) (Figure 1). This represents fewer MPTs and a vastly improved resolution at the base of Stegosauria than previous phylogenetic analyses.

The sister-taxon relationships between *Tuojiangosaurus* and *Paranthodon*, and *Chungkingosaurus* and *Huayangosaurus*, found here were also found in the strict reduced consensus tree of Maidment (2010), suggesting robust support for these groupings, especially that of *Chungkingosaurus* and *Huayangosaurus*, which was also found by Mateus *et al.* (2009). Additionally, the sister-taxon relationship at the base of Thyreophora of *Laquintasaurua* and *Scutellosaurus* is also found by Baron *et al.* (2016). These two analyses used entirely different sets of characters, which suggests a robust grouping.

Interestingly, the synonymisation of *Miragaia longicollum* as the genus *Dacentrurus* by Cobos *et al.* (2010) is not supported here; *Miragaia* is found to be in the clade *Stegosaurus*. *Stegosaurus mjosi* was originally considered a separate genus, *Hesperosaurus*, but was synonymised by Maidment *et al.* (2008). The results of this analysis do not support that synonymy, and indicate *Hesperosaurus* should be considered a separate genus; there are only two synapomorphies that support the synonymisation of *Miragaia* and *Stegosaurus*, whereas there are a number of characters that indicate differences between *Stegosaurus mjosi* and the other two taxa within *Stegosaurus*.

Another surprising result is the placement of *Alcovasaurus* as basal to Stegosauria and Ankylosauria. *Alcovasaurus* was originally described as *Stegosaurus* until new archival photographs were found (Galton and Carpenter, 2016). However, the use of constraint trees in TNT indicated that it took only 3.81 steps to move *Alcovasaurus* to be sister-taxon to *Stegosaurus stenops*, as opposed to 14.21 steps when the same was done with *Kentrosaurus*. The labile placement of *Alcovasaurus* is likely not to be robust; 98.86% of data is missing for the taxon.

When the dataset was analysed with continuous characters excluded, 6 MPTs were found, and a strict consensus calculated (Figure 2). The tree had a similar topology for Ankylosauria and at the base of Stegosauria, but the relationships of basal thyreophorans and derived stegosaurs were not resolved. This indicates that continuous data can contain phylogenetic information, and exclusion is unjustified.

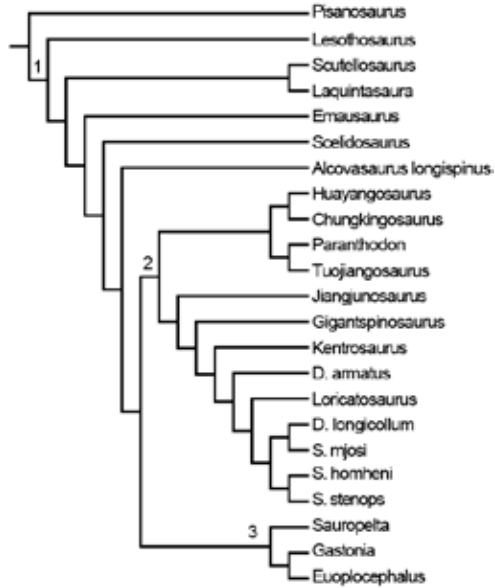


Figure 1. 1 MPT produced by New Technology Search. 1 = Thyreophora. 2 = Stegosauria. 3 = Ankylosauria.

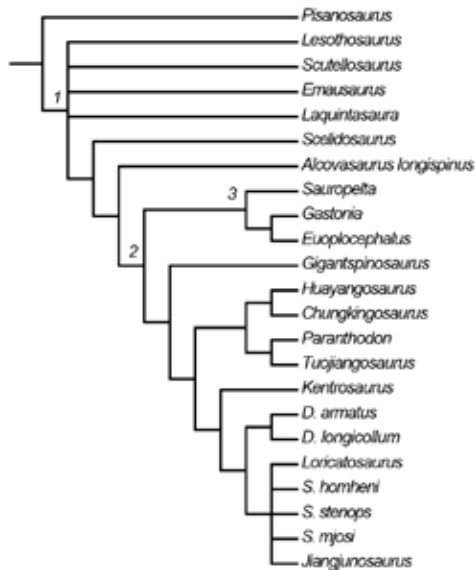


Figure 2. The strict consensus of 6 MPTs produced when continuous data were excluded from the analysis. 1 = Thyreophora. 2 = Stegosauria. 3 = Ankylosauria.



Conclusions

Using newly described taxa, more characters and improved technology, the phylogeny of Stegosauria has been vastly improved in this project, with more resolution across the tree. *Stegosaurus mjosi* has been found to lie outside of *Stegosaurus*, so this indicates *Hesperosaurus* should be considered a separate genus. Additionally, the coding of continuous data as such improves resolution of this phylogeny and so indicates that continuous data can indeed contain important phylogenetic information.

Acknowledgements

Thanks to Dr Susannah Maidment for supervision, and to members of the Imperial College Palaeobiology Research Group for useful discussions. Acknowledgements also to Palaeontological Association Undergraduate Bursary PA-UB201604, the funding for this research, and to Sandra Chapman (Natural History Museum, London), who provided access to specimens in her care.

REFERENCES

- BARON, M.G., NORMAN, D.B. and BARRETT, P.M. 2016. Postcranial anatomy of *Lesothosaurus diagnosticus* (Dinosauria: Ornithischia) from the Lower Jurassic of southern Africa: implications for basal ornithischian taxonomy and systematics. *Zoological Journal of the Linnean Society*. doi: <10.1111/zoj.12434>.
- BUTLER, R.J., UPCHURCH, P. and NORMAN, D.B. 2008. The phylogeny of the ornithischian dinosaurs. *Journal of Systematic Palaeontology*, 6, 1–40.
- COBOS, A., ROYO-TORRES, R., LUQUE, L., ALCALÁ, L. and MAMPEL, L. 2010. An Iberian stegosaurus paradise: The Villar del Arzobispo Formation (Tithonian-Berriasian) in Teruel (Spain). *Palaeogeography, Palaeoclimatology, Palaeoecology*, 293, 223–236.
- GALTON, P.M. 2010. Species of plated dinosaur *Stegosaurus* (Morrison Formation, Late Jurassic) of western USA: a new type species designation needed. *Swiss Journal of Geosciences*, 103, 187–198.
- GALTON, P.M. and CARPENTER, K. 2016. The plated dinosaur *Stegosaurus longispinus* Gilmore, 1914 (Dinosauria: Ornithischia; Upper Jurassic, western USA), type species of *Alcovasaurus* n. gen. *Neues Jahrbuch für Geologie und Paläontologie*, 279, 185–208.
- GALTON, P.M. and UPCHURCH, P. 2004. Stegosauria. In WEISHAMPEL, D.B., DODSON, P. and OSMOLSKA, H. (Eds.) *The Dinosauria*. University of California Press, Berkeley. pp. 343–362.
- GOLOBOFF, P.A., MATTONI, C.I. and QUINTEROS, A.S. 2006. Continuous characters analysed as such. *Cladistics*, 22, 589–601.
- GOLOBOFF, P.A., FARRIS, J.S. and NIXON, K.C. 2008. TNT, a free program for phylogenetic analysis. *Cladistics*, 24, 774–786.
- MADDISON, W.P. and MADDISON, D.R. 2016. Mesquite: a modular system for evolutionary analysis. Version 3.10 <<http://mesquiteproject.org>>.
- MAIDMENT, S.C.R., NORMAN, D.B., BARRETT, P.M. and UPCHURCH, P. 2008. Systematics and phylogeny of Stegosauria (Dinosauria: Ornithischia). *Journal of Systematic Palaeontology*, 6, 367–407.
- MAIDMENT, S.C.R. 2010. Stegosauria: a historical review of the body fossil record and phylogenetic relationships. *Swiss Journal of Geosciences*, 103, 199–210.



- MAIDMENT, S.C.R., BRASSEY, C. and BARRETT, P.M. 2015. The Postcranial Skeleton of an Exceptionally Complete Individual of the Plated Dinosaur *Stegosaurus stenops* (Dinosauria: Thyreophora) from the Upper Jurassic Morrison Formation of Wyoming, USA. *PLoS One*, **10**, e0138352.
- MAIDMENT, S.C.R. and PEREDA-SUBERBIOLA, X. Accepted. Basal Thyreophora and Stegosauria. In WEISHAMPPEL, D.B. *et al.* (Eds.) *The Dinosauria*, 3rd edition. Cambridge University Press, Cambridge.
- MAIDMENT, S.C.R., WOODRUFF, D.C. and HORNER, J.R. In review. Latitudinal partitioning and differential growth in species of the thyreophoran dinosaur *Stegosaurus* in the Upper Jurassic Morrison Formation, U.S.A. *Journal of Vertebrate Paleontology*.
- MATEUS, O., MAIDMENT, S.C.R. and CHRISTIANSEN, N.A. 2009. A new long-necked 'sauropod-mimic' stegosaur and the evolution of the plated dinosaurs. *Proceedings of the Royal Society B: Biological Sciences*, **276**, 1815–1821.
- SERENO, P.C. 1991. *Lesothosaurus*, “Fabrosaurids,” and the early evolution of Ornithischia. *Journal of Vertebrate Palaeontology*, **11**, 168–197.

Sharks with question marks: impacts of a new fossil on interrelationships of early bullhead sharks

Tiffany S. Slater

Institute of Science and the Environment, University of Worcester

Introduction

Bullhead sharks (Heterodontiformes) represent a monophyletic group that occupies a basal position within modern sharks, rays, and skates (Neoselachii) (Carvalho 1996). Remains of Heterodontiformes are among the oldest in the fossil record for Neoselachii (Kriwet 2008). Three genera are known from the Jurassic as a result of their rapid diversification: *Proheterodontus* and *Paracestracion*, which disappear from the fossil record before the Cretaceous, and the extant *Heterodontus*, which underwent further radiation in the Cretaceous.

A newly discovered complete heterodontid specimen from the Kimmeridgian of Eichstätt, Germany, hereafter referred to as *P. danieli* sp. nov., was the subject of an analysis of meristic characters in order to inform on the past biodiversity of this group. This sub-adult specimen was compared to the holotype of *Paracestracion falcifer* (AS-VI-505) and to extant heterodontid species.

Dentition

The change in tooth morphology during the ontogeny of extant heterodontids is gradual, resulting in pronounced ontogenetic heterodonties. Heterodontid teeth reduce from multiple cusps in juveniles to a single cusp in adults; for example, symphyseal teeth of *H. japonicus* reduce from seven cusps at a body length of 225 mm to a single cusp at a body length of 750 mm (Figure 1). The *P. falcifer* holotype exhibits anterior teeth with one cusp at a body length of 400mm; this difference is substantial if it possessed seven cusps at a body length of 225 mm as it does in *P. danieli* sp. nov. Thus the difference in number of cusps in anterior teeth relative to the total body length suggests that the fossils represent different species.



The number of tooth families in heterodontids increases throughout ontogeny and has a species-specific pattern due to differential growth of jaws (Reif 1976). In extant heterodontids with a similar body length of 225 mm, the Meckel's cartilage contains 13–17 tooth families, while the palatoquadrate contains 17–21 (Reif 1976). A higher number of tooth families in *P. danieli* sp. nov. (21 and 23 families, respectively) indicates elongation of the jaws earlier in ontogeny than in extant heterodontids, potentially reflecting different feeding ecologies (Table 1). Additionally, extant heterodontids show an increase of one to two tooth families on the palatoquadrate from a body length of 225 mm to 400 mm (Reif 1976). Therefore, the difference in number of tooth families on the palatoquadrate between *P. danieli* sp. nov. (23) and the *P. falcifer* holotype (29) is more than expected if they were of the same species (Table 1).

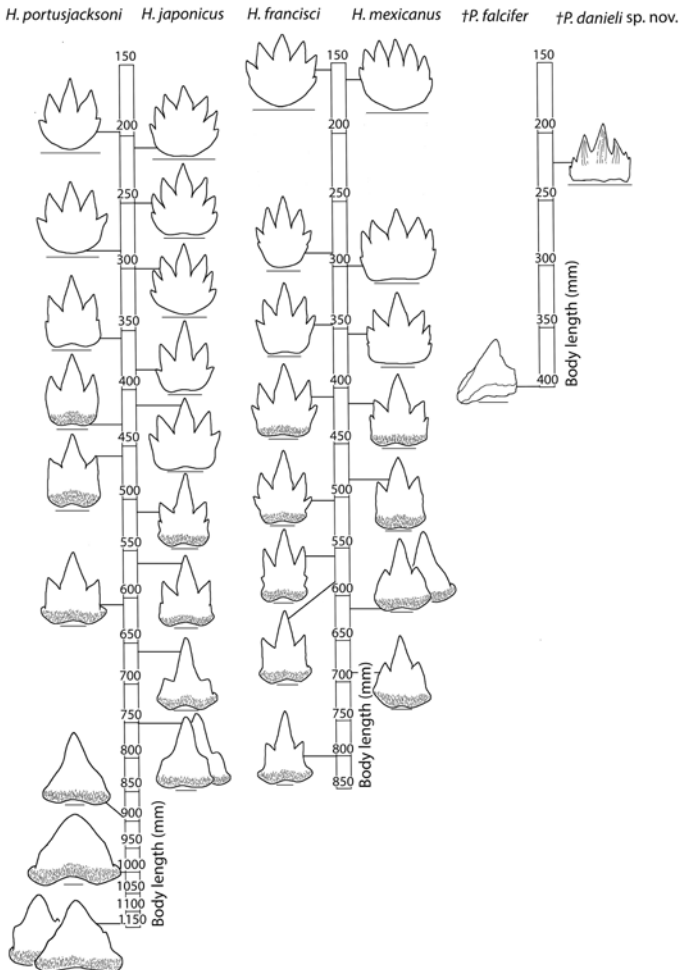


Figure 1. Tooth morphology of symphyseal teeth throughout ontogeny for †extinct and extant heterodontids. Adapted from Reif 1976. All scale bars 1 mm.



Axial body

The genus *Paracestracion* possesses one dorsal fin spine anterior to each of the two dorsal fins, the first associated with the pelvic fins. Spines are supported by basal cartilages, which also support fin radials (Maisey 1979). Positioning of the median and paired fins is under genetic control, and the close association of fin spines with the dorsal and pelvic fins suggests they are also involved in dorsal fin modularity (Mabee *et al.* 2002).

The anterior fin spine position shows no ontogenetic change in extant heterodontids, making it a reliable character in taxonomy. Sexual dimorphism is a probable explanation for the difference between *P. viohli* and *P. falcifer*; *P. danieli* sp. nov., however, differs from all *P. falcifer* specimens in the position of the anterior fin spine, which is positioned at the 9th vertebra (Table 1) (Daniel 1914). In *Etmopterus spinax*, the posterior fin spine position is conserved, likely due to its association with the pelvic girdle (Tave 1984). Similarly, the conserved position of the anterior fin spine in *Paracestracion* is potentially due to modularity with the pelvic girdle. Migration of the pelvic fins in *Heterodontus* might have been a result of de-coupling in this module from a common ancestor in the Lower Jurassic. The posterior fin spine position shows no consistency other than in *Heterodontus*, which could have resulted from genetic alterations to fin positioning.

Table 1. Data table for meristic characters of †extinct and extant heterodontids. Characters of axial body are as positioned along vertebral column. Pectoral and pelvic girdle correspond to placement of the coracoid and puboischiadic bar, respectively. Abbreviations: Total body length (TBL), Dorsal fin spine (DFS). Asterisk marks the holotype for the genus *Paracestracion*.

Species name	TBL (mm)	No. tooth families		Axial body			
		Meckel's cartilage	Palatoquadrate	1st DFS	2nd DFS	Pectoral girdle	Pelvic girdle
† <i>Paracestracion danieli</i> sp. nov.	225	21	23	32, 33	62, 63	12	32
*† <i>Paracestracion falcifer</i>	400	?	29	23, 24, 25	43, 44	10	24
† <i>Paracestracion falcifer</i>	?	?	?	24, 25	52, 53	?	24
† <i>Paracestracion falcifer</i>	?	?	?	24, 25	~50?	10	24
† <i>Paracestracion viohli</i>	?	?	?	22, 23	?	?	?
<i>Heterodontus francisci</i>	300	15	20	15, 16	46, 47	8	28, 29
<i>Heterodontus japonicus</i>	280	17	19	15, 16	46, 47	8	28, 29

Despite this conservation in the position of pectoral fins, the position of the coracoid and puboischiadic bar differs between the new specimen, other *Paracestracion* species, and extant *Heterodontus* (Table 1) (Mabee 2002).



Distance measurements

Seven distance measurements were taken from *P. danieli* sp. nov., the holotype of *Paracestracion falcifer*, extant juveniles of *H. japonicus*, *H. zebra*, *H. philippi*, and two adult *H. japonicus* to identify differences in body shape throughout ontogeny and between species. The Past3 software package was used to convert measurements into a ratio of length and to perform a Principal Components Analysis (PCA).

The PCA results indicate a strong divergence between *P. danieli* sp. nov., *P. falcifer*, and *Heterodontus*, with the highest level of variation being the distance between the pectoral and pelvic fins, and the second being the distance between the posterior dorsal and caudal fin (PC1=78.9%; PC2=15.9%) (Figure 2). The difference between *P. danieli* sp. nov. and *P. falcifer* is greater than that seen between juvenile and adult *H. japonicus*, supporting the hypothesis that *P. danieli* sp. nov. and *P. falcifer* are different species.

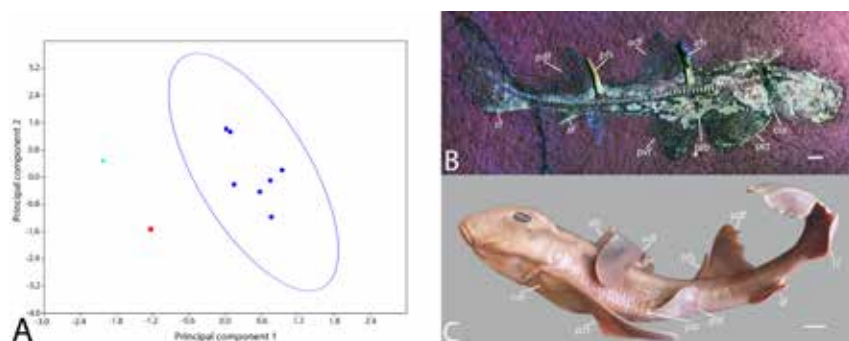


Figure 2. PCA of distance measurements taken from extinct and extant heterodontids. Measurements included were total body length, length of coracoid and puboischiadic bar, and the distance between: first and second dorsal fin, second dorsal fin and caudal fin, pectoral and pelvic fins, and pelvic fins and anal fin. A, Morphospace of PC1 and PC2 with 95% ellipses. Green diamond, *P. danieli* sp. nov.; red square, *P. falcifer* holotype; blue circles, extant *Heterodontus* species; B, UV photograph of *P. danieli* sp. nov.; C, Photograph of extant *H. japonicus* (ZMB 20239). Abbreviations: adf, anterior dorsal fin; af, anal fin; afs, anterior dorsal fin spine; cf, caudal fin; cor, coracoid; pct, pectoral fins; pdf, posterior dorsal fin; pfs, posterior dorsal fin spine; pib, puboischiadic bar; pvf, pelvic fins. All scale bars are 1 cm.

Concluding remarks

A comparison of meristic characters suggests that *P. danieli* sp. nov. is a separate species to that of *P. falcifer* and thus that extinct heterodontids were more diverse than previously thought. Future research will use cladistics approaches to investigate inter-relationships of Heterodontiformes.

Acknowledgements

I am grateful for the Palaeontological Association Undergraduate Research Bursary PA-UB201606 that financially supported this project. I would like to thank my supervisors, K. Ashbrook and J. Kriwet for their support and expertise, and P. Bartsch and J. Klapp at the Museum für Naturkunde Berlin for access and assistance with their collection.



REFERENCES

- CARVALHO, M.R. 1996. Higher-level elasmobranch phylogeny, basal squalians, and paraphyly. In STIASNY, M.L.J., PARENTI, L.R. and JOHNSON, G.D. (Eds.) *Interrelationships of fishes*. Academic Press, Cambridge. pp. 35–62.
- DANIEL, J.F. 1914. The anatomy of *Heterodontus francisci*. *University of California Publications in Zoology*, 13, 147–166.
- KRIWET, J. 2008. A new species of extinct bullhead sharks, *Paracestracion viohli* sp. nov. (Neoselachii, Heterodontiformes), from the Upper Jurassic of South Germany. *Acta Geologica Polonica*, 58, 235–241.
- MABEE, P.M., CROTWELL, P.L., BIRD, N.C. and BURKE, A.C. 2002. Evolution of median fin modules in the axial skeleton of fishes. *Journal of Experimental Zoology Part B: Molecular and Developmental Evolution*, 294, 77–90.
- MAISEY, J.G. 1979. Finspine morphogenesis in squalid and heterodontid sharks. *Zoological Journal of the Linnean Society*, 66, 161–183.
- MAISEY, J.G. 2012. What is an ‘elasmobranch’? The impact of palaeontology in understanding elasmobranch phylogeny and evolution. *Journal of Fish Biology*, 80, 918–951.
- REIF, W.-E. 1976. Morphogenesis, Pattern Formation and Function of the Dentition of *Heterodontus* (Selachii). *Zoomorphologie*, 83, 1–47.
- TAVE, D. 1984. Quantitative genetics of vertebrae number and position of dorsal fin spines in the velvet belly shark, *Etmopterus spinax*. *Copeia*, 3, 794–797.



Book Reviews

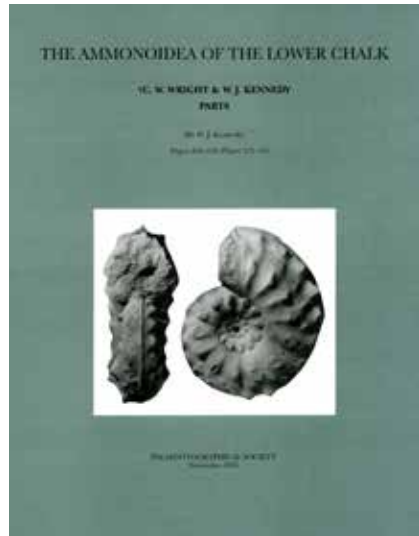
The Ammonoidea of the Lower Chalk: Part 6

W. J. Kennedy, 2015. Monograph of the Palaeontographical Society, Publication 645 (part of Vol. 169), 404–459, Pls 125–145, text-figures 157–180. London. ISSN 0269-3445 (paperback) £100.

The first part of the monograph, “The Ammonoidea of the Lower Chalk” by C.W. Wright and W.J. Kennedy, appeared some thirty years ago. Parts 1 to 5 were published between 1984 and 1996 (Wright & Kennedy 1984, 1987, 1990, 1995, 1996), and now Part 6 has appeared in print. Rome wasn’t built in a day. This monograph by two of the most prolific Cretaceous ammonite workers is an extremely important work and a must-have for anyone working on or studying Cenomanian (Cretaceous) ammonites, biostratigraphy, biogeography or related subjects.

As stated on the cover and title page, the author of the present Part 6 is W.J. Kennedy. The senior author of the monograph series, C.W. Wright, an undisputed doyen of Cretaceous ammonitology, died in 2010. For an extensive obituary, see Kennedy (2006). Despite the fact that Kennedy is the sole author of the present part, the authorship in the recommended reference stated on the reverse title page is “Wright & Kennedy (2015)”. This is bound to cause bibliographic confusion, *i.e.*, the volume will be cited as Wright & Kennedy (2015) by some, as Kennedy (2015) by others, and perhaps even as Kennedy in Wright & Kennedy (2015) by a few. The correct authorship in citing Part 6 should be Kennedy (2015), despite the recommendation given by the publisher.

This monograph series provides detailed descriptions and revisions of the lower Cenomanian to lower upper Cenomanian “Lower Chalk” ammonoids of southern England. In contrast to most other authors (Hopson 2005, figs 2–3), Wright & Kennedy exclude the upper Cenomanian Plenus Marls from their “Lower Chalk”. The ammonoids of the Plenus Marls were treated together with the “Middle Chalk” faunas (uppermost Cenomanian to middle Turonian) in a previous monograph (Wright & Kennedy 1981). It should be noted that the designations “Lower Chalk” and “Middle Chalk” are today obsolete and should be used only in an informal sense. Formally, the “Lower Chalk” corresponds to the Grey Chalk Subgroup and the Plenus Marls Member of the overlying Holywell Nodular Chalk Formation. The Grey Chalk Subgroup in southern England is subdivided into the West Melbury Marly Chalk and the Zig Zag Chalk formations (*e.g.*, Rawson *et al.* 2001).





Background information on stratigraphy, localities, techniques and conventions, as well as an exhaustive reference list, was published in Part 1 of the monograph series (Wright *et al.* 1984). Additional references are listed in each part.

Historically, ammonites have been – and arguably still are – the most important fossil group for the biostratigraphy and chronostratigraphy of the Cretaceous. Bio- and chronostratigraphic accuracy depends primarily upon the quality of the underlying taxonomy and systematics. It is therefore difficult to reconcile this with the fact that these research fields are somewhat frowned upon and regarded almost as a kind of “stamp collecting”. Consequently, these fields are severely underfunded, which has led to a blatant shortage of skilled taxonomists. Wright and Kennedy are to be commended for their long-lasting and highly productive work on Cretaceous ammonites, which has contributed substantially to high-quality bio- and chronostratigraphy, and in turn to improved reconstructions and interpretations of Cretaceous Earth history.

In Part 6 of the monograph series, as in parts 2 to 5, only true ammonites (Suborder Ammonitina) are described. Representatives of the ammonoid suborders Phylloceratina and Lytoceratina were described in Part 1, with some additional remarks in Part 5. In the present part, one species of *Graysonites* and *Cunningtoniceras*, respectively, and three species of *Schloenbachia* are described, the latter occupying a full 50 out of the 54 pages of descriptions. Thus, this volume is essentially a detailed revision of *Schloenbachia*, a genus that more than most other Cretaceous ammonite genera has suffered from taxonomic oversplitting throughout the years, as a result of unusually high intraspecific variation. The numerous species, subspecies and varieties in the literature are here reduced to a mere three successive species, viz. *S. varians*, *S. coupei* and *S. lymensis*, each in turn subdivided into five “formae”. The impressive amount of work behind this effort is reflected in the extensive synonymy lists, which for *S. varians* occupies three full pages.

As we have come to expect from Jim Kennedy’s pen (keyboard?), the systematic descriptions are detailed and carefully elaborated. Only the diagnoses are in my opinion not optimal, being worded more like short descriptions rather than differential diagnoses. The abundant photographic illustrations of the specimens are of the highest quality. As in the previous parts of the monograph series, illustrations are divided between plates and text-figures. In the present Part 6, specimens are figured in 21 plates and 22 text-figures, with most of the latter occupying full pages like plates. The reason for this rather user-unfriendly arrangement is not clear to me.

So, who should buy this book? Labelled “Part 6”, it is obviously not a stand-alone volume; it simply picks up where Part 5 ended, *i.e.*, on p. 403. If you do not have access to the previous parts, you may not benefit much from Part 6, unless you happen to have a special interest in the exclusively Boreal Cenomanian genus *Schloenbachia*. For Cretaceous ammonite workers already familiar with this monograph series, Part 6 is a welcome complement. The cover price of £100 for a mere 56 pages of text and 21 plates may seem a bit hefty, but for members of the Palaeontographical Society the current volume (generally comprising two monographs) is included in the annual fee of £35 for individual members and £17.50 for student members. Furthermore, on all publications of the Society, members receive at least a 50% discount (for student members, the discount is currently 75%). Further good news is that parts 1–5 of the monograph series have been greatly reduced in price and can now be had for a total of £70 (before any discounts!). But hurry up – stocks of the older parts are limited!



A final part of the monograph series, containing stratigraphic conclusions and an index, has been submitted and is awaiting publication (W.J. Kennedy, pers. comm., 2016). Once the series is complete, it will form a truly important work that all dedicated Cretaceous ammonite workers should have close to hand.

Peter Bengtson

Heidelberg University

REFERENCES

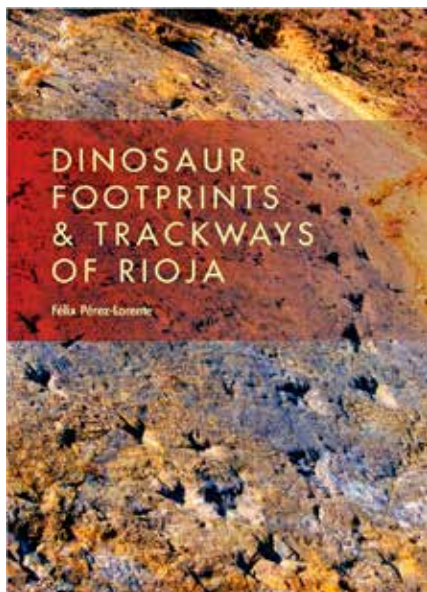
- HOPSON, P.M. 2005. A stratigraphical framework for the Upper Cretaceous Chalk of England and Scotland, with statements on the Chalk of Northern Ireland and the UK Offshore Sector. *British Geological Survey Research Report*, RR/05/01, 1–102.
- KENNEDY, W.J. 2006. C. W. Wright: a most professional amateur. *Proceedings of the Geologists' Association*, 117(1), 9–40.
- RAWSON, P. F., ALLEN, P. and GALE, A. S. 2001. The Chalk Group – a revised lithostratigraphy. *Geoscientist*, 11(1), 21.
- WRIGHT, C. W. and KENNEDY, W. J. 1981. The Ammonoidea of the Plenus Marls and the Middle Chalk. *Monograph of the Palaeontographical Society*, Issue 560 (part of Vol. 134) [for 1980], 1–148, Pls 1–32.
- WRIGHT, C. W. and KENNEDY, W. J. 1984. The Ammonoidea of the Lower Chalk: Part 1. *Monograph of the Palaeontographical Society*, Issue 567 (part of Vol. 137) [for 1983], 1–126, Pls 1–40.
- WRIGHT, C. W. and KENNEDY, W. J. 1987. The Ammonoidea of the Lower Chalk: Part 2. *Monograph of the Palaeontographical Society*, Issue 573 (part of Vol. 139) [for 1985], 127–218, Pls 41–55.
- WRIGHT, C. W. and KENNEDY, W. J. 1990. The Ammonoidea of the Lower Chalk: Part 3. *Monograph of the Palaeontographical Society*, Issue 585 (part of Vol. 144), 219–294 + 1 p., Pls 56–86.
- WRIGHT, C. W. and KENNEDY, W. J. 1995. The Ammonoidea of the Lower Chalk: Part 4. *Monograph of the Palaeontographical Society*, Issue 599 (part of Vol. 149), 295–319 + 1 p., Pls 87–94.
- WRIGHT, C. W. and KENNEDY, W. J. 1996. The Ammonoidea of the Lower Chalk: Part 5. *Monograph of the Palaeontographical Society*, Issue 601 (part of Vol. 150) [for 1996], 320–403, Pls 95–124.
- WRIGHT, C. W., KENNEDY, W. J. and HANCOCK, J. M. 1984. Introduction. *In* Wright, C. W. and Kennedy, W. J. The Ammonoidea of the Lower Chalk: Part 1. *Monograph of the Palaeontographical Society*, Issue 567 (part of Vol. 137) [for 1983], 1–37.



Dinosaur Footprints and Trackways of La Rioja

F. Pérez-Lorente 2015. 376 pp. Indiana University Press. Hardcover.
Price £63.00. ISBN: 978-0-253-01515-0.

The dinosaur track sites of La Rioja in Spain are undoubtedly among the best and most important in the world. When I was a Masters student working on dinosaur tracks, I remembered that several colleagues asked me if I had been there and seen them. However as a poor student without a travel budget, I opted for the second best thing, to read about them instead, but was quickly deterred when it turned out that almost all the literature was in Spanish and in journals not easily obtainable from the Danish science libraries. Now the science of the site is finally accessible to me as several years later I sit with this beautiful book in my hand. The book is published with the high quality one has come to expect from the Life of the Past series from Indiana University Press: hardcover and of a satisfying size, so it not only looks great on your shelf, but is also comfortable to read.



The book is divided into five chapters, whereby the first is a short introduction to the history of discovery and research on the La Rioja track sites. Chapter 2 provides valuable background on vertebrate ichnology and interpretations of fossils tracks, to familiarize the reader with the main subject area prior to Chapter 3, which focuses on the track sites themselves and comprises the majority of the book. This is followed by a short chapter on the conservation of the area. The book is concluded with a concise summary.

Chapter 1 provides a short historical introduction to the dinosaur tracks in the La Rioja region, where we learn that since their initial discovery in 1969 the numerous track sites in the area have yielded *circa* 8,000 separate tracks ranging in age from the Late Jurassic to Early Cretaceous. Furthermore, it is estimated that between 25,000–70,000 more track sites have the potential to be excavated in the area, a truly astonishing number.

Chapter 2 is a broad introduction to vertebrate ichnology and all the different sedimentological, taphonomical and behavioral aspects that can alter the shape and appearance of a track or trace. All of these variables *must* be taken into consideration when one is making interpretations of vertebrate tracks and trackways. The controversial reports of tracks made by swimming dinosaurs are treated in some depth here. All in all, this chapter acts like a step-by-step guide in making field interpretations of a new dinosaur track site. Jargon is kept to a minimum and as a result the text is easy to follow and is accompanied by maps, photos and diagrams.



Chapter 3 constitutes the main body of the text. Here the author describes all the most important track sites in the La Rioja region on a case-by-case basis, with detailed maps of each track site and interpretations of the track assemblages and track makers. While it could be tempting to erect many new ichnogenera on the vast amount of material from La Rioja, Perez-Lorente does not fall for that temptation and uses only ichnogeneric data where they have been published previously, assigning the tracks to important groups of dinosaurs *e.g.* sauropods, theropods and ornithopods.

As this is the most important chapter in the book, the reader would find the book more useful as a reference volume if the individual track sites appeared in the table of contents. This would have made it much easier to find information on specific sites given the multitude of localities in La Rioja.

The short penultimate chapter concerns the work that has been done to preserve all of the sites, and how the individual sites are classified according to their scientific importance. In particular, the author details the different legal aspects of site protection from which I am sure we can all learn; this information could be applied to management of equally important sites throughout the rest of the world. As such, this chapter serves as a good inspiration for people working with palaeontological site protection both locally and internationally.

The book concludes with a short summary of the La Rioja track sites as well as dinosaur tracks more broadly. James O. Farlow, the editor of the *Life of the Past* series, states that this book is “likely to become a landmark reference in dinosaur ichnology...”. It is natural for an editor to praise the books they publish, but in this case I find it fully justified. This book offers a wealth of information on dinosaur tracks and how to interpret them in the field. So if you are a student or professional in vertebrate ichnology, or in any way interested in fossil tracks and trackways, this book should certainly be on your shelf. While the list price of £63.00 can seem a bit exorbitant, it can be found for significantly less from certain well-known online retailers, which is all the more reason to buy it.

Jesper Milàn

Geomuseum Faxe, Denmark



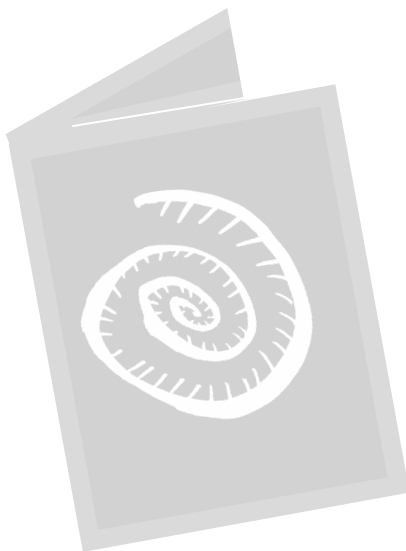
Books available to review

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.

- *Species and speciation in the fossil record*, by Warren D. Allmon & Margaret M. Yacobucci.
- *The White River Badlands: Geology and Paleontology*, by R. C. Benton, D. O. Terry Jr., E. Evanoff & H. G. McDonald.
- *British Polacanthid dinosaurs*, by William T. Blows.
- *Acrocanthosaurus inside and out*, by Kenneth Carpenter.
- *Dinosaur Tracks*, by Peter I. Falkingham, Daniel Marty & Annette Richter
- *The Tyrannosaur Chronicles*, by D. Hone.
- *Advances in Parasitology: Fossil Parasites*, by T. J. Littlewood & K. De Baets.
- *Mammoths and the Environment*, by V. V. Ukraintseva.
- *The worst of times*, by P. B. Wignall.

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





Careering off course!

Inspirational palaeontologists

Matt Dale of Mr Wood's Fossils

Matt Dale is the proprietor of Mr Wood's Fossils, Edinburgh's famous fossil shop. Mr Wood's Fossils was founded by Stan Wood in 1983. After a period of supplying museums with fossils for display and research, Stan opened a shop in the Grassmarket, a historic market place in Edinburgh's Old Town. Preferring to be out in the field, Stan hired a small team to manage the shop. Matt took over as the shop's manager in 1998, having previously studied undergraduate geology (Glasgow), postgraduate museum studies (Leicester) and having worked with fossils in Glasgow's Kelvingrove Museum. Matt bought the business from Stan in 2006. Mr Wood's Fossils sells a variety of products, including ammonites, trilobites, dinosaurs and fossil fish, minerals and jewellery.



Where did your passion for geology and palaeontology come from?

I have always had a broad interest in natural history and animals in particular. I happened into geology, however. After two years of civil engineering at university, I wanted to change courses and geology was the most appealing option by some distance.

What are the main responsibilities of your job?

I was lucky in my introduction to the job and I had help learning the commercial side of things. Stan Wood, the owner, had a very hands-off approach, leaving all the paperwork and running of the business to the manager. I had to learn basic book-keeping, stock control, VAT returns, how to deal with wages, PAYE and HMRC, and stock purchasing. This last one was key – buy the right stuff at the right prices and the business has a chance of survival. It's a global, albeit very small, industry, and

Mr Wood's Fossils has done very well to survive since its launch in 1987. Customers remember the shop and return. Word-of-mouth helped build a foundation and over time business has gradually become somewhat more predictable. I bought the business from Stan in 2006 and have continued to work Monday to Friday since.

What is the best thing about your job?

It's simply a nice place to work. It's not a supermarket where people see shopping as a necessity. Nobody really *needs* to buy a dinosaur tooth or a meteorite, so when they come in, it's generally because they want to. I like it when customers ask questions. The fossils and minerals are collected from all around the world, in many different ways, and I know the story behind a lot of them. I also enjoy the trade fairs I attend to find stock. Twice a year I go to shows in Arizona and France, where people come from all over to buy and sell. I have a big group of international



friends I see once or twice a year and the shows are very much social occasions as well as vital for the business.

... and, what is the most challenging part of your job?

As I said, buying is very important. The first time I went to Arizona to spend thousands of pounds of someone else's money on stock (which would be crucial to the shop's success in the coming year) was very daunting. It gradually became easier as I began to get a better grasp on fair pricing, became better at assessing quality, and identified important and first stage suppliers. After 18 years, attending the shows has become almost routine, although the first few days of a show, when I need to get the best of the big sellers before they are sold out, are still stressful. Other than that, I'm not a big fan of paperwork, so from time to time that can be frustrating.

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

Shops in general face a huge challenge now, with out-of-town retail parks and online buying leaving many high streets struggling to fill premises. Mr Wood's Fossils is in central Edinburgh, which sees a lot of footfall from tourism and locals working nearby, so I feel we are cushioned slightly against what is a national and international trend. The traditional high street is on its last legs and I would not recommend that anyone open a shop now, unless they have already built a customer base first, through a market stall or online.

Mr Wood's Fossils,
5 Cowgatehead,
Grassmarket,
Edinburgh EH1 1JY

and online at <<http://www.mrwoodsossils.co.uk/>>

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

An eye for quality and a good sense of market value. You have to know if something will sell at a sufficiently high price to justify purchasing decisions. You can't be too expensive but you need to have enough of a margin to keep the business going.

What are the most interesting fossils that you have sold in recent years?

Last year I had an enormous *Titanites* ammonite from Portland in Dorset that I had intended to buy for myself and take home. I rarely bring the car into town so the ammonite had been sitting by the door of the shop for a few months, waiting. While I was away on a buying trip a customer was determined to purchase it. My assistant called me in France and we agreed to sell it. I haven't found another like it yet.

Does your work involve collaborations and/or business with institutions, such as universities and museums?

I have provided fossils for universities to use in their exams once or twice – they need to have a large number of very similar fossils, with clear characteristics to allow identification and so on. I deal with museums fairly frequently. Sometimes I provide a particular fossil or mineral for an exhibition, more often handling materials for education departments or events. I've been out collecting with the National Museums of Scotland a few times over the last year, and I hope to do more of that.

Tom Stubbs
University of Bristol



Palaeontology

VOLUME 59 • PART 5

CONTENTS

Symposium

- Uncovering the holes and cracks: from anecdote to testable hypotheses in predation studies 597
 ELIZABETH M. HARPER
 <<http://dx.doi.org/10.1111/pala.12255>>

Original Articles

- The oldest Gondwanan cephalopod mandibles (Hangenberg Black Shale, Late Devonian) 611
 and the mid-Palaeozoic rise of jaws
 CHRISTIAN KLUG, LINDA FREY, DIETER KORN, ROMAIN JATTIOT *and* MARTIN RÜCKLIN
 <<http://dx.doi.org/10.1111/pala.12248>>
- New material of *Palaeoamasia kansui* (Embrithopoda, Mammalia) from the Eocene of 631
 Turkey and a phylogenetic analysis of Embrithopoda at the species level
 OZAN ERDAL, PIERRE-OLIVIER ANTOINE *and* SEVKET SEN
 <<http://dx.doi.org/10.1111/pala.12247>>
- Ontogeny of the Furongian (late Cambrian) trilobite *Proceratopyge* cf. *P. lata* Whitehouse 657
 from northern Victoria Land, Antarctica, and the evolution of metamorphosis in trilobites
 TAE-YOON S. PARK, JI-HOON KIHM, JUSUN WOO, YOUNG-HWAN G. KIM *and* JONG-IK LEE
 <<http://dx.doi.org/10.1111/pala.12251>>
- Gauging scale effects and biogeographical signals in similarity distance decay analyses: 671
 an Early Jurassic ammonite case study
 AXELLE ZACÁI, ARNAUD BRAYARD, JEAN-LOUIS DOMMERGUES, CHRISTIAN MEISTER,
 GILLES ESCARGUEL, RÉMI LAFFONT, BRUNO VRIELYNCK *and* EMMANUEL FARA
 <<http://dx.doi.org/10.1111/pala.12250>>
- Fish and tetrapod communities across a marine to brackish salinity gradient in the 689
 Pennsylvanian (early Moscovian) Minto Formation of New Brunswick, Canada, and their
 palaeoecological and palaeogeographical implications
 AODHÁN Ó GOGÁIN, HOWARD J. FALCON-LANG, DAVID K. CARPENTER, RANDALL F. MILLER,
 MICHAEL J. BENTON, PEIR K. PUF AHL, MARCELLO RUTA, THOMAS G. DAVIES, STEVEN J. HINDS
and MATTHEW R. STIMSON
 <<http://dx.doi.org/10.1111/pala.12249>>
- Allometry in Anisian (Middle Triassic) segminiplanate conodonts and its implications for 725
 conodont taxonomy
 YANLONG CHEN, THOMAS A. NEUBAUER, LEOPOLD KRYSZTYN *and* SYLVAIN RICHOSZ
 <<http://dx.doi.org/10.1111/pala.12253>>
- Ancient animal migration: a case study of eyeless, dimorphic Devonian trilobites 743
 from Poland
 BŁAŻEJ BŁAŻEJOWSKI, CARLTON E. BRETT, ADRIAN KIN, ANDRZEJ RADWAŃSKI *and*
 MICHAŁ GRUSZCZYŃSKI
 <<http://dx.doi.org/10.1111/pala.12252>>



Palaeontology

VOLUME 59 • PART 6

CONTENTS

Symposium

- How far did feedback between biodiversity and early diagenesis affect the nature of Early Palaeozoic sea floors? 753
V. PAUL WRIGHT *and* LESLEY CHERNS
<<http://dx.doi.org/10.1111/pala.12258>>

Rapid Communication

- Proteroctopus ribeti* in coleoid evolution 767
ISABELLE KRUTA, ISABELE ROUGET, SYLVAIN CHARBONNIER, JÉRÉMIE BARDIN,
VINCENT FERNANDEZ, DAMIEN GERMAIN, ARNAUD BRAYARD *and* NEIL LANDMAN
<<http://dx.doi.org/10.1111/pala.12265>>

Original Articles

- Key innovations in Mesozoic ammonoids: the multicuspidate radula and the calcified aptychus 775
HELMUT KEUPP, RENÉ HOFFMANN, KEVIN STEVENS *and* RAIMUND ALBERSDÖRFER
<<http://dx.doi.org/10.1111/pala.12254>>
- Structure and homology of *Psittacosaurus* tail bristles 793
GERALD MAYR, MICHAEL PITTMAN, EVAN SAITTA, THOMAS G. KAYE *and* JAKOB VINTHER
<<http://dx.doi.org/10.1111/pala.12257>>
- Environmental preferences of brachiopods and bivalves across major climatic changes during the Late Palaeozoic ice age (Pennsylvanian, western Argentina) 803
DIEGO BALSEIRO *and* KAREN HALPERN
<<http://dx.doi.org/10.1111/pala.12259>>
- Systematic and palaeoecological significance of the first record of Pygocephalomorpha females bearing oöstegites (Malacostraca, Peracarida) from the lower Permian of southern Brazil 817
PAULA GIOVANA PAZINATO, MARINA BENTO SOARES *and* KAREN ADAMI-RODRIGUES
<<http://dx.doi.org/10.1111/pala.12260>>
- New discoveries of tetrapods (ichthyostegid-like and whatcheeriid-like) in the Famennian (Late Devonian) localities of Strud and Becco (Belgium) 827
SÉBASTIEN OLIVE, PER E. AHLBERG, VINCENT N. PERNÈGRE, ÉDOUARD POTY,
ÉTIENNE STEURBAUT *and* GAËL CLÉMENT
<<http://dx.doi.org/10.1111/pala.12261>>
- The mouth apparatus of the Cambrian gilled lobopodian *Pambdelurion whittingtoni* 841
JAKOB VINTHER, LUIS PORRAS, FLETCHER J. YOUNG, GRAHAM E. BUDD *and*
GREGORY D. EDGEcombe
<<http://dx.doi.org/10.1111/pala.12256>>
- Postcanine microstructure in *Cricodon megabolus*, a Middle Triassic gomphodont cynodont from south-eastern Africa 851
CHRISTOPHE HENDRICKX, FERNANDO ABDALA *and* JONAH CHOINIÈRE
<<http://dx.doi.org/10.1111/pala.12263>>



- The oldest durophagous teleosauroid (*Crocodylomorpha*, *Thalattosuchia*) from the lower Bathonian of central High Atlas, Morocco 863
STÉPHANE JOUVE, BASTIEN MENNECART, JULIEN DOUTEAU *and* NOUR-EDDINE JALIL
<<http://dx.doi.org/10.1111/pala.12262>>
- Principal component analysis as an alternative treatment for morphometric characters: phylogeny of caseids as a case study 877
NEIL BROCKLEHURST, MARCO ROMANO *and* JÖRG FRÖBISCH
<<http://dx.doi.org/10.1111/pala.12264>>
- Comparative cranial myology and biomechanics of *Plateosaurus* and *Camarasaurus* and evolution of the sauropod feeding apparatus 887
DAVID J. BUTTON, PAUL M. BARRETT *and* EMILY J. RAYFIELD
<<http://dx.doi.org/10.1111/pala.12266>>



Papers in Palaeontology

VOLUME 2 | PART 2

CONTENTS

- Early Campanian (Late Cretaceous) Pleromidae and Isoraphiniidae (lithistid Demospongiae) 189
from the Łódź-Miechów Synclinorium (central and southern Poland): new data and
taxonomic revision
EWA ŚWIERCZEWSKA-GLADYSZ
<<http://dx.doi.org/10.1002/spp2.1037>>
- A review of the evolution, biostratigraphy, provincialism and diversity of Middle and 235
early Late Triassic conodonts
YANLONG CHEN, LEOPOLD KRYSZTYN, MICHAEL J. ORCHARD, XU-LONG LAI *and*
SYLVAIN RICHOUZ
<<http://dx.doi.org/10.1002/spp2.1038>>
- New Unionida (Bivalvia) from the Kimmeridgian (Late Jurassic) of Asturias, Spain, and 265
their palaeobiogeographical implications
GRACIELA DELVENE, MARTIN C. MUNT, LAURA PIÑUELA *and* JOSÉ C. GARCÍA-RAMOS
<<http://dx.doi.org/10.1002/spp2.1039>>
- New record of *Egertonia* (Elopiformes, Phylloodontidae) from the Late Cretaceous of 287
South India
THOMAS J. D. HALLIDAY, ANDREW R. CUFF, GUNTUPALLI V. R. PRASAD,
MECHEK S. THANGLEMMOI *and* ANJALI GOSWAMI
<<http://dx.doi.org/10.1002/spp2.1040>>
- Middle Devonian jawed polychaete fauna from the type Eifel area, western Germany, 295
and its biogeographical and evolutionary affinities
PETRA TONAROVÁ, OLLE HINTS, PETER KÖNIGSHOF, THOMAS J. SUTTNER, ERIKA KIDO,
ANNE-CHRISTINE DA SILVA *and* DAMIEN PAS
<<http://dx.doi.org/10.1002/spp2.1041>>
- A new western European Cretaceous bryozoan genus from the early Cenomanian 311
radiation of neocheilostomes
SILVIU O. MARTHA *and* PAUL D. TAYLOR
<<http://dx.doi.org/10.1002/spp2.1042>>



Papers in Palaeontology

VOLUME 2 | PART 3

CONTENTS

- Himalayan Cambrian hyoliths 323
PETER D. KRUSE *and* NIGEL C. HUGHES
<<http://dx.doi.org/10.1002/spp2.1043>>
- Fungal spores from the Palaeogene El Foyel Group of Ñirihuau Basin, Argentina 343
MARCELO A. MARTÍNEZ, M. VIRGINIA BIANCHINOTTI, RAMESH K. SAXENA,
M. ELINA CORNOU *and* MIRTA E. QUATTROCCHIO
<<http://dx.doi.org/10.1002/spp2.1044>>
- New occurrences of tetrapod ichnotaxa from the Permian Orobic Basin (Northern Italy) and critical discussion of the age of the ichnoassociation 363
LORENZO MARCHETTI
<<http://dx.doi.org/10.1002/spp2.1045>>
- A new taxon of cynodont from the *Tropidostoma* Assemblage Zone (upper Permian) of South Africa, and the early evolution of Cynodontia 387
CHRISTIAN F. KAMMERER
<<http://dx.doi.org/10.1002/spp2.1046>>
- Gastropods from the Carboniferous (Namurian) of Congleton Edge, Cheshire, UK 399
JOHN S. PEEL
<<http://dx.doi.org/10.1002/spp2.1047>>
- Xianella*: a new mat-forming calcified cyanobacterium from the Middle–Late Ordovician of North China 439
JEONG-HYUN LEE *and* ROBERT RIDING
<<http://dx.doi.org/10.1002/spp2.1049>>
- Discussion**
- Comments on: A review of the evolution, biostratigraphy, provincialism and diversity of Middle and early Late Triassic conodonts 451
PABLO PLASENCIA, ANA MÁRQUEZ-ALIAGA, JUAN ALBERTO PÉREZ-VALERA, AYMON BAUD,
MILAN SUDAR, ALI-MURAT KILIÇ *and* FRANCIS HIRSCH
<<http://dx.doi.org/10.1002/spp2.1053>>
- Reply to comments on: A review of the evolution, biostratigraphy, provincialism and diversity of Middle and early Late Triassic conodonts 457
YANLONG CHEN, LEOPOLD KRYSTYN, MICHAEL J. ORCHARD, XULONG LAI *and*
SYLVAIN RICHOZ
<<http://dx.doi.org/10.1002/spp2.1052>>



Papers in Palaeontology

VOLUME 2 | PART 4

CONTENTS

- Early Cambrian sponges of the Sirius Passet Biota, North Greenland 463
JOSEPH P. BOTTING *and* JOHN S. PEEL
<<http://dx.doi.org/10.1002/spp2.1048>>
- Roveacrinida (Crinoidea, Articulata) from the Santonian–Maastrichtian (Upper Cretaceous) of England, the US Gulf Coast (Texas, Mississippi) and southern Sweden 489
ANDREW SCOTT GALE
<<http://dx.doi.org/10.1002/spp2.1050>>
- A new basal chaeomysticete (Mammalia: Cetacea) from the Late Oligocene Pysht Formation of Washington, USA 533
CARLOS MAURICIO PEREDO *and* MARK D. UHEN
<<http://dx.doi.org/10.1002/spp2.1051>>
- The Cambrian palaeoscolecoid *Wronoscolex* from the Shipai fauna (Cambrian Series 2, Stage 4) of the Three Gorges area, South China 555
YUNING YANG *and* XINGLIANG ZHANG
<<http://dx.doi.org/10.1002/spp2.1054>>
- A new taxon of cistecephalid dicynodont from the upper Permian Kundaram Formation of India 569
CHRISTIAN F. KAMMERER, SASWATI BANDYOPADHYAY *and* SANGHAMITRA RAY
<<http://dx.doi.org/10.1002/spp2.1055>>
- Revision of the early crocodylomorph *Trialestes romeri* (Archosauria, Suchia) from the lower Upper Triassic Ischigualasto Formation of Argentina: one of the oldest-known crocodylomorphs 585
AGUSTINA LECUONA, MARTÍN D. EZCURRA *and* RANDALL B. IRMIS
<<http://dx.doi.org/10.1002/spp2.1047>>



Overseas Representatives

- Argentina: DR M. O. MANCENÍDO, Division Paleozoología invertebrados, Facultad de Ciencias Naturales y Museo, Paseo del Bosque, 1900 La Plata, Argentina.
- Australia: DR RUDY LEROSEY-AUBRIL, School of Environmental & Rural Science, University of New England, Armidale NSW 2351, Australia.
- 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.

TAXONOMIC/NOMENCLATURAL DISCLAIMER

This publication is not deemed to be valid for taxonomic/nomenclatural purposes [see Article 8.2 of the International Code of Zoological Nomenclature (4th Edition, 1999)].

Newsletter copy

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

Deadline for copy for Issue No. 94 is 8th February 2017.

Palaeontological Association on the Internet

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

Advertising in the Newsletter

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

£75 for half a page

£130 for a full page

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

Rates for distribution of separate fliers with the Newsletter:

1,100 copies for worldwide distribution	£250
850 copies for worldwide distribution exclusive of North America	£200
600 copies for U.K. circulation only	£150

THE PALAEOLOGICAL ASSOCIATION: Council 2016

President:	D. A. T. HARPER, Palaeoecosystems Gp, Department of Earth Sciences, Durham University, Durham DH1 3LE
Vice-Presidents:	E. RAYFIELD, Life Sciences Building, University of Bristol, 24 Tyndall Avenue, Bristol BS8 1TQ D. S. WARD, 81 Crofton Lane, Orpington, Kent BR5 1HB
Secretary:	R. J. TWITCHETT, Natural History Museum, Cromwell Road, London SW7 5BD
Treasurer:	P. WINROW, Dept of Earth Science and Engineering, South Kensington Campus, Imperial College London SW7 2AZ
Newsletter Editor:	M. McNAMARA, School of Biological, Earth and Environmental Sciences, University College Cork, Ireland
Publicity Officer:	L. HERRINGSHAW, Geography, Environment & Earth Sciences, University of Hull, Cohen Building, Hull HU6 7RX
Book Review Ed.:	T. CHALLANDS, Geosciences, University of Edinburgh, Grant Institute, James Hutton Road, Edinburgh EH9 3FE
Internet Officer:	A. R. T. SPENCER, Earth Science and Engineering, South Kensington Campus, Imperial College London SW7 2AZ
Outreach Officer:	F. GILL, School of Earth and Environment, University of Leeds, Leeds LS2 9JT
Education Officer:	C. BUTTLER, Department of Geology, National Museum of Wales, Cathays Park, Cardiff CF10 3NP
Meetings Coord.:	T. R. A. VANDENBROUCKE, Geology & Soil Sciences (WE13), Ghent University, Krijgslaan 281/S8, 9000 Ghent, Belgium

Editor Trustees:

M. RUTA, School of Life Sciences, University of Lincoln, Riseholme Park, Lincoln LN2 2LG
C. H. WELLMAN, Department of Animal and Plant Sciences, University of Sheffield S10 2TN

Ordinary Members of Council:

R. J. BUTLER, Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham B15 2TT
C. T. S. LITTLE, School of Earth and Environment, University of Leeds, Leeds LS2 9JT
M. MUNT, Dinosaur Isle Museum, Culver Parade, Sandown, Isle of Wight PO36 8QA
I. RAMAN, Oxford University Museum of Natural History, South Parks Road, Oxford OX1 3PW

Co-opted:

G. BENEVENTO, Dept of Earth Sciences, Oxford University, South Parks Road, Oxford OX1 3AN

Executive Officer:

J. HELLAWELL, Durham

Editor-in-Chief:

A. B. SMITH, Natural History Museum, Cromwell Road, London SW7 5BD

Publications Officer:

S. THOMAS, 32 Royston Road, Whittlesford, Cambridgeshire CB22 4NW