The Palaeontology Newsletter

74

Contents

Reminder: The deadline for copy for Issue no 75 is 4th October 2010.

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

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Editorial

As I type this short piece the northern hemisphere Summer Solstice has passed, the days are barely but perceptibly drawing in, and thoughts inevitably turn towards the cold, dark days of mid-Winter and that singular beacon of light and festivity that is the Association Annual Meeting. This year, as I'm sure you are aware, the meeting is to be held in Ghent. The latest meeting information is, as usual, included in the pages of this Newsletter and is available 24/7 on the Association website.

Mention of the website brings me to a couple of items. Firstly, some of you may have spotted that there is a 'Palaeontology in the News' section on the homepage of the Association that provides a number of links to palaeo-related news items on the webpages of the BBC, Guardian, National Geographic and such like. We hope that this new service is of use and interest, and any comments would be welcome.

Secondly, there has been some discussion about perhaps moving some of the Newsletter content to the web and removing it from the printed version. Currently, for example, information on future meetings of other bodies is available on both the Association website and in the printed Newsletter. In order to take some of this discussion forward it would be very useful to hear from all members with strong views on this issue. It is, after all, your Newsletter. If you have any views on which parts of the Newsletter, if any, would be better in electronic-only form, and/or which parts should remain in the paper version, I would be very interested in hearing them.

Many thanks to all the regular contributors to the Newsletter, and to those who have provided content such as meeting reports, book reviews and other individual items, for making the Newsletter such a pleasure to read (and edit!). The 'future meetings' section is looking a bit thin at present, so if there are any meetings coming up that you would like to see advertised, please drop me a line.

Richard Twitchett
Newsletter Editor
<newsletter@palass.org>

Association Business

Annual Meeting 2010

Notification of the 2010 Annual Meeting, Annual General Meeting and Annual Address

The 2010 Annual Meeting of the Palaeontological Association will be held at Ghent University in Belgium on 17–20 December, organised by members of the Department of Geology of Ghent University in collaboration with the Department Géosystèmes of the University of Lille 1 (France), the Royal Belgian Institute of Natural Sciences (KBIN – Brussels, Belgium) and Kunsthal St-Pietersabdij (Ghent, Belgium).

The 2010 Annual General Meeting and Annual Address will be held at the University of Ghent on 18th December 2010, following the scientific sessions.

AGENDA

Apologies for absence

Minutes of the 52nd AGM, University of Birmingham

Trustees Annual Report for 2009

Accounts and Balance Sheet for 2009

Election of Council and vote of thanks to retiring members

Palaeontological Association Awards

Annual address

H. A. Armstrong
Secretary

DRAFT AGM MINUTES 2009

Minutes of the Annual General Meeting held on Monday 14th December 2009 at the University of Birmingham.

Apologies for absence: Prof. N. MacLeod

1. **Trustees Annual Report for 2009.** Agreed, proposed by Prof. J. Callomon and seconded Prof. E.N.K. Clarkson.

2. **Accounts and Balance Sheet for 2009**. Proposed by Prof. G. Sevastopoulo and seconded by Prof. M. Hart, the accounts were agreed by unanimous vote of the meeting.

3. **Election of Council and vote of thanks to retiring members**. Prof. R. J. Aldridge extended a vote of thanks to Prof. MacLeod and Dr A. McGowan, the retiring members of Council.

Dr E. Harper and Dr Modesto were retiring as scientific editors. The following members of Council were elected to serve on Council:

President:	Prof. R. J. Aldridge
Vice Presidents:	Dr Thomas Servais Dr P. Orr
Treasurer:	Prof. J.C.W. Cope
Secretary:	Dr H. A. Armstrong
Chair of Publications Board:	Prof. M. P. Smith
Editor Trustee:	Dr Dr P. C. J. Donoghue
Book Review Editor:	Dr C. Jeffrey-Abt
Publicity:	Dr M. A. Purnell
Newsletter Reporter:	Dr L. Herringshaw
Newsletter Editor:	Dr R. J. Twitchett
Web Officer:	Dr M. Sutton
Ordinary Members:	Mr W. Fone Prof. S. Donovan Dr J. A. Rasmussen Dr C. Underhill Dr E. Rayfield Dr C. Buttler Dr D. Schmidt

Prof. J. Francis was co-opted as "President elect" and Mr P. Winrow was co-opted to stand as Treasurer at the AGM 2010. Dr Harrington and Dr Vandenbroucke remain on Council as Annual Meeting organisers.

4. **Association Awards.** The following awards were made:

- Lapworth Medal to Prof. B. Runnegar (Director of the UCLA Astrobiology Center, and of the NASA Astrobiology Institute)
- President's Medal to Dr K. Peterson (Dartmouth College)
- Hodson Award to Dr E.J. Rayfield (University of Bristol)
- Mary Anning award to Mr Magne Hoyberget

Honorary Life membership was awarded to Prof. R. Fortey, Prof. C. Paul, Prof. E.N.K. Clarkson and Mr S. Baldwin. Sylvester-Bradley Awards were made to Sallan, Brewer, Butler, Hopley, Nunn, Peralta-Medina and Lecuona. The President's Award was made to R. Garwood, and Council Awards to N. Crumpton and L. Darras.

The Annual Address entitled "Digital dinosaurs: Unlocking the riddles of the past using advanced 3D imaging" was given by Prof. L. Witmer (Ohio University College of Osteopathic Medicine).

Trustees Annual Report 2009

Nature of the Association. The Palaeontological Association is a Charity registered in England and Wales, Charity Number 276369. Its Governing Instrument is the Constitution adopted on 27th February 1957, amended on subsequent occasions as recorded in the Council Minutes. The aim of the Association is to promote research in Palaeontology and its allied sciences by (a) holding public meetings for the reading of original papers and the delivery of lectures, (b) demonstration and publication, and (c) by such other means as the Council may determine. Trustees (Council Members) are elected by vote of the Membership at the Annual General Meeting. The contact address of the Association is c/o The Executive Officer, Dr T. J. Palmer, Institute of Geography and Earth Sciences, University of Aberystwyth, Aberystwyth SY23 3DB, Wales, UK.

Trustees. The following members were elected to serve as trustees at the AGM on 20th December 2008: *President*: Prof. R. J. Aldridge; *Vice Presidents*: Prof. N. MacLeod and Dr T. Servais; *Treasurer*: Prof. J.C.W. Cope; *Secretary*: Dr H. A. Armstrong; *Chair of Publications Board*: Prof. M. P. Smith; *Editor Trustee*: Dr P. Orr and Dr P. C. J. Donoghue; *Book Review Editor*: Dr C. Jeffrey-Abt; *Publicity*: Dr M. A. Purnell; *Newsletter* Reporter: Dr A. McGowan; *Newsletter Editor*: Dr R. J. Twitchett; *Web Officer*: Dr M. Sutton; *Ordinary Members*: Mr W. Fone; Prof. S. K. Donovan; Dr J. A. Rasmussen, Dr C. Underwood, Dr E. Rayfield, Dr C. Buttler and Dr D. Schmidt. Dr Schmidt took up the new Council post of Meetings Co-ordinator. Dr Harrington and Dr Vandenbroucke remained on Council as Annual Meeting organisers. *The Executive Officer*: Dr T. J. Palmer and *Editor-in-Chief*: Dr S. Stouge continued to serve Council but are not Trustees.

Membership. Individual membership totalled 1,184 on 31st December 2009, an overall decrease of 38 over the 2008 figure. There were 747 Ordinary Members, an increase of 5; 164 Retired and Honorary Members, a decrease of 5; and 273 Student Members, a decrease of 40. There were 95 Institutional Members in 2009, and 98 institutional subscribers to *Special Papers in Palaeontology*.

Professional Services. The Association's Bankers are NatWest Bank, 42 High Street, Sheffield. The Association's Independent Examiner is G. R. Powell BSc FCA, Nether House, Great Bowden, Market Harborough, Leicestershire LE16 7HF. The Association's investment portfolio was managed by Quilter (formerly Citi Quilter), St Helen's, The Undershaft, London EC3A 8BB.

Reserves. The Association holds reserves of £667,511 in General Funds. These reserves enable the Association to generate additional revenue through investments, and thus to keep subscriptions to individuals at a low level, whilst still permitting a full programme of meetings to be held, publications produced and the award of research grants and grants-in-aid. They also act as a buffer to enable the normal programme to be followed in years in which expenditure exceeds income, and new initiatives to be pursued. The Association holds £42,128 in Designated Funds which contribute interest towards the funding of grants-in-aid, the Sylvester-Bradley, Hodson Fund and Jones Fenleigh awards. Funds carried forward to 2010 totalled £709,639.

Finance. Total charitable expenditure for 2009 was £221,220. Total resources expended were £251,378. The Association continues its membership of the International Palaeontological Association and remains a Tier 1 sponsor of *Palaeontologia Electronica,* and the *Treatise on Invertebrate Paleontology*. During the year funding was withdrawn from the PaleoDatabase summer school due to the relocation of Dr Alroy to Australia.

Risk. The recent changes in capital values have not adversely affected the ability of the Association to continue with its current and future charitable activities. Succession planning for executive officers remains a concern that will be reviewed in 2010.

Charitable Activities. The Association continues to increase its range and investment in charitable activities. We have continued to provide funds to support student and speaker attendance at our own and international meetings.

Grants.

Palaeontological Association Research Grant. Six applications were received for the Palaeontological Association Research Grant and funds were awarded to "Squamate diversity and the K/T boundary: new evidence from East Asia" (Evans and Barrett) and "Anoxia and the demise of Devonian reefs" (Bond, University of Leeds).

Grants–in-aid. Funds were agreed to support the attendance of young scientists at a meeting of IGCP 503 on Early Palaeozoic Biogeography and Palaeogeography at the Natural History of Denmark (Geological Museum). A number of applications had been made for financial support by organisers of symposia at the Third International Palaeontological Congress (IPC3). It was agreed that these proposals should be funded through IPC3 funds and money would be used to offer £500 honoraria for authors who provided review papers for *Palaeontology*.

Sylvester Bradley Fund. Fifteen proposals had been received. Seven were recommended for funding and included proposals from Brewer, Butler, Hopley, Lecuona, Nunn, Peralta-Medina and Sallon.

Online activities. The online activities of the Association continue to expand. Electronic versions of *Special Papers in Palaeontology* were produced and abstracts from *Palaeontology* were scanned to allow online searching of back issues. The Association continues to host mirror sites for the PaleoDbase, *Palaeontologica Electronica*, the EDNA fossil insect database, the Palaeontographical Society website and a database of fossils from Kent produced by the Kent RIGS Group. The Association continues to support the "Ask a Biologist" website and now has a Facebook page with an increasing number of friends.

Public meetings. Three public meetings were held in 2009, and the Association extends its thanks to the organisers and host institutions of these meetings.

53rd Annual General Meeting. This was held on 13–15 December at University of Birmingham. Dr Harrington with much local support organised the meeting which included a symposium on "Macroecology" and comprised a programme of internationally recognised speakers. There were 250 attendees. The Annual Address entitled "Digital dinosaurs: Unlocking the riddles of the past using advanced 3D imaging" was given by Prof. L. Witmer (Ohio University College of Osteopathic Medicine) and was attended by 200 people. The President's Award for best oral presentation from a member under 35 was made to Russell Garwood (Imperial College, London). The Council Poster Prize was presented to N. Crumpton (University of Bristol) and Laurent Darras (University of Leicester). The post-conference field trip was to the Cotswolds.

British Science Festival, Palaeontological Association Symposium. This is the annual forum for presentations to the public and general scientists. The Symposium "Innovations in evolution – how life created the Earth as we know it," was organised by Dr Purnell (University of Leicester) and funds were provided for four internationally renowned speakers. The Association nominee, Dr McNamara, won the Charles Lyell Award and presented a plenary lecture.

Progressive Palaeontology. The annual open meeting for presentations by research students was organised by Karl Bateson and was held at the University of Manchester.

In addition to hosting public meetings the Association manages the Stuart Baldwin Lecture Series. This enables amateur societies to fund visiting lecturers.

Publications. Publication of *Palaeontology* and *Special Papers in Palaeontology* is managed by Wiley Blackwell, who also make sales and manage distribution on behalf of the Association. Volume 52 of *Palaeontology* was published, comprising six issues. *Special Papers in Palaeontology 81*, "Patterns and Processes in Early Vertebrate Evolution," edited by Marcello Ruta, Jennifer A Clack and Angela C. Milner, and *Special Papers in Palaeontology 82*, "Ichnology of an Early Permian tidal flat: the Robledo Mountains Formation of southern New Mexico, USA" by Nicholas J. Minter and Simon J. Braddy were also published during the year. No Field Guide was published. The Association has agreed to publish a new series in partnership with Wiley Blackwell entitled "Topics in Palaeobiology."

The Association is grateful to the National Museum of Wales and the Lapworth Museum (University of Birmingham) for providing storage facilities for publication back-stock and archives. Council is indebted to Meg and Nick Stroud for assistance with the publication and distribution of *Palaeontology Newsletter*.

Publicity. The Association continues to promote palaeontology and its allied sciences through press releases to the national media, radio and television.

Awards. The Lapworth Medal, awarded to people who have made a significant contribution to the science by means of a substantial body of research, was presented to Prof. B. Runnegar (Director of the UCLA Astrobiology Center, and of the NASA Astrobiology Institute). The President's Medal for a palaeontologist in recognition of outstanding contributions in his/her earlier career, coupled with an expectation that they will continue to contribute significantly to the subject in their further work, was awarded to Dr K. Peterson (Dartmouth College). The Hodson Award, for a palaeontologist under the age of 35 who has made an outstanding achievement in contributing to the science through a portfolio of original published research, was awarded to Dr E. J. Rayfield (University of Bristol). The Mary Anning award, for an outstanding contribution by an amateur palaeontologist, was made to Mr Magne Hoyberget. Council also awards an undergraduate prize to each university department in which palaeontology is taught beyond Level 1. Honorary Life membership was awarded to Prof. R. A. Fortey, Prof. C. R. C. Paul, Prof. E. N. K. Clarkson and Mr S. A. Baldwin. The "Golden Trilobite Award" was made to <**www.elasmo.com**>, a high-quality, information-rich amateur website which provides a wealth of carefully collated information related to fossil and living sharks.

Governance. The Association continues to improve its administration with further improvements to the *Newsletter* and website. Trustees were members of the Joint Committee for Palaeontology; Prof. Aldridge (Chair) and Dr Servais represented the Association. Dr Armstrong acted as the Association representative on the International Palaeontological Association. During the year the Association responded to requests for information from the HEFCE consultation on the Research Excellence Framework and NERC consultation on graduate training for the future.

Forthcoming plans. In 2010 there will be a subscription increase. Ordinary membership will rise from £28 to £36, retired membership from £14 to £18 and student membership will remain unchanged. Council will continue to make substantial donations, from both General and Designated funds, to permit individuals to promote the charitable aims of the Association.

Resources will be made available from General Funds to support the Association Research Grant amd Grants-in-Aid, provided to carry out research into palaeontological subjects, to disseminate findings in print and at conferences, and to support the provision of palaeontological workshops. During 2010 the Association will host IPC3, a prestigious international meeting, with partners including Imperial College, the Natural History Museum, TMS and the Palaeontographical Society. The Association has provided a grant of £50,000 to support this meeting. This money has come out of our reserves and will have no effect on our ongoing activities. Trustees involved in organising this meeting are thanked on behalf of the Association. The Association will continue to recognise the contribution individuals have made to palaeontology and associated sciences through its awards. In 2010, a similar programme of public meetings and publications will be carried out. The 54th Annual meeting will be held at the University of Ghent. Progressive Palaeontology will be held at the University of Bristol. The Association will sponsor symposia at the British Science Festival and provide travel grants for the European Geosciences Union.

Funds will be made available to further develop the website aimed at encouraging outreach and improving the Governance of the Association. RSS news feeds will be added to the website. It is intended that two new *Field Guide to Fossils* will be published within the year. The Publications Board will continue to manage and develop our portfolio of publications.

Howard A. Armstrong
Secretary

Nominations For Council

At the AGM in December 2010, the following vacancies will occur on Council:

- Vice-President
- Publicity Officer
- Web Officer
- Four Ordinary members

Nominations are now invited for these posts. Please note that each candidate must be proposed by at least two members of the Association and that any individual may not propose more than two candidates. Nomination must be accompanied by the candidate's written agreement to stand for election and a single sentence describing their interests.

All potential Council Members are asked to consider that:

> "Each Council Member needs to be aware that, since the Palaeontological Association is a Registered Charity, in the eyes of the law he/she becomes a Trustee of that Charity. Under the terms of the Charities Act 1992, legal responsibility for the proper management of the Palaeontological Association lies with each Member of Council." Responsibilities of Trustees can be obtained by email from <**secretary@palass.org**>.

The closing date for nominations is **1st October 2010**. They should be sent to the Secretary: Dr Howard A. Armstrong, Department of Earth Sciences, Durham University, Durham DH1 3LE; email:<**h.a.armstrong@durham.ac.uk**> or via <**secretary@palass.org**>.

Council nominations are as follows:

Vice President: Prof. J.C.W. Cope

Publicity Officer: Dr E. Rayfield

Web Officer: Dr M. Sutton (has agreed to stand for a second term)

Ordinary Members: Dr C. Klug, Dr T. Vandenbroucke and Dr W. Renema

Grants, awards and prizes

Grants-in-Aid

The Palaeontological Association is happy to receive applications for loans or grants from the organizers of scientific meetings 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 the March and the October Council Meetings each year. Completed requests should be made at least six months in advance of the event in question and should be sent by 1st March or 1st October. Enquiries may be made to <**secretary@palass.org**>.

Grants-in-aid: Meeting support,workshops and short courses

The Palaeontological Association is happy to receive applications from the organizers of meetings and workshops for grants-in-aid. 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 literature. Application should be made by the scientific organizer(s) on the online form at <**www.palass.org**>. Such requests will be considered by Council at the March and the October Council Meetings each year. Completed requests should be made at least six months in advance of the event in question and should be sent by 1st March or 1st October. Enquiries may be made to <**secretary@palass.org**>.

Awards and Prizes

Nominations are now being sought for the Hodson Fund, Mary Anning Award and Sylvester-Bradley Award.

Hodson Fund

This award is conferred on a palaeontologist who is under the age of 35 and who has made a notable early contribution to the science. Candidates must be nominated by at least two members of the Association and the application must be supported by an appropriate academic case. The closing date for nominations is **1st September**. Nominations will be considered and a decision made at the October meeting of Council. The award will comprise a fund of £1,000, 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 recognised journals. Nominations should comprise a short statement (up to one page of A4) outlining the candidate's principal achievements. Members putting forward candidates should also be prepared, if requested, to write an illustrated profile in support of their nominee. The deadline for nominations is **1st September**. The award comprises a cash prize plus a framed scroll, and is usually presented at the Annual meeting.

Sylvester-Bradley Award

Awards are made to assist palaeontological research (travel, visits to museums, fieldwork *etc.*), with each award having a maximum value of £1,000. Preference is given to applications for a single purpose (rather than top-ups of other grant applications) and no definite age limit is applied, although some preference may be given to younger applicants or those at the start of their careers. The award is open to both amateur and professional palaeontologists, but preference will be given to members of the Association. The awards are announced at the AGM.

Council will also consider awards in excess of £1,000, particularly for pilot projects which are likely to facilitate a future application to a national research funding body.

Electronic submission of applications is through the website and will comprise a CV, an account of research aims and objectives (5,000 characters maximum), and a breakdown of the proposed expenditure. Each application should be accompanied by the names of a personal and scientific referee. Successful candidates must produce a report for *Palaeontology Newsletter* and are asked to consider the Association's meetings and publications as media for conveying the research results. The deadline for applications is **1st November**.

Nominations are sought for the "Golden Trilobite Award" for prestigious websites

This award is for the best institutional and amateur websites that promote the charitable and scientific aims of the Association. The award will take the form of a statement of recognition that can be posted on the winning sites. Nominations are sought from the membership and should be sent to the Secretary at <**secretary@palass.org**> by **1st September**. The websites will be judged by Council members.

Palaeontological Association Research Grants

Council has agreed that Association funds should be made available to support primary palaeontological research. Awards will be made to assist palaeontological research up to a maximum value of £15,000. Typically grants could support single research projects or 'proof of concept' proposals with an aim of supporting future applications to national research funding bodies. Online guidelines and application form are available for the deadline of **1st March**.

This year's awards:

Jonathan Antcliffe: Integrating the White Sea Ediacara into a global framework

To analyse the taphonomy and phylogenetic relationships of new material and otherwise extensive collections of the White Sea, Ediacara biota held in Novosibirsk, Russia at the Institute of Petroleum Geology and Geophysics.

Preliminary work has revealed that a significant proportion of the diversity of Ediacarans can be accounted for as taphomorphs of a more conservative suite of taxa. Work will focus on four key taxa that have established hypotheses of affinity that are crucial to hypotheses on the tempo of metazoan diversification or else the emergence of key metazoan anatomical character, their putative metazoan affinities and attributed evolutionary and developmental implications given in parentheses: *Charnia* (Octocorallia; the development of multiple tissue layers and heterotrophic behaviour), *Dickinsonia* (Annelida; through gut, bilateral symmetry, complex organ formation), *Spriggina* (Arthropoda; through gut, ecdysis, complex organ formation, active predation), *Kimberella* (Mollusca; through gut, complex organ formation, active scavenging).

All of these taxa are used as evidence for the early evolution of advanced metazoan developmental characteristics as well as complex metazoan behaviours, and are highly significant as fossil calibrations in molecular clocks, as well as understanding developmental evolution. This project aims to integrate the Ediacara Biota into a new formulation of the emergence of the most fundamental of metazoan bodyplans and their component anatomical innovations during this crucial stage of early evolution.

Barry Lomax: SporoMALDI – resolving terrestrial palaeoecosystem responses to perturbations in the global carbon cycle using isolated single sporomorphs

The fourth International Panel on Climate Change (IPCC) assessment states that evidence for global warming is unequivocal, and that this warming is very likely to have been caused by human activity accelerating the long-term carbon cycle via the combustion of fossil fuels.

Climate change and the associated perturbations of the carbon cycle are not solely an anthropogenic phenomenon, and throughout the majority of the Phanerozoic the Earth's stable climate state has been that of a greenhouse world which has undergone periodic and catastrophic changes in the carbon cycle. Consequently, the unlocking of this record is of immense and immediate importance.

Plants as sessile organisms must adapt to meet environmental challenges. Studies of plant adaptation to changes in atmospheric CO_2, for example, have led to greater understanding of how plants will respond to future climate change scenarios, and as a corollary of this, these data can be used in a mechanistic approach to interpret past climate. This proposal builds on these mechanistic principles by determining the carbon isotope signature of single pollen grains and spores. We focus on sporomorphs because (a) they are the most abundant plant organ preserved in the fossil record, (b) are found in a much wider variety of terrestrial and marine depositional environments than plant macrofossils, and (c) can be sampled at much higher stratigraphic resolution than most other plant organ.

Critically, sporomorphs have the potential to unlock carbon isotope analysis in terrestrial systems in an analogous way that foraminifera have opened up research on ocean systems. This project will test if Matrix-Assisted Laser Desorption/Ionisation Mass Spectrometry imaging (MALDI-MSi) can be used to deliver accurate and repeatable stable isotopic measurements of single spores and pollen grains.

James R. Wheeley: Nitrogen and organic carbon isotopes of Ordovician conodonts

As animals digest food they fractionate nitrogen and organic carbon by preferentially excreting the lighter isotopes. At successive trophic levels from primary consumer to predator to higher predator, body tissues thus become progressively enriched in the heavier isotope, and in the case of ^{15}N this is typically around +3.5‰ per trophic level.

Nitrogen and carbon isotope analyses are well established in modern terrestrial and marine ecosystems, being used widely as a non-invasive means of assessing food web relationships. They have also been applied to fossil ecosystems in the Neogene, Palaeogene, Cretaceous, and as far back as the Carboniferous, but as yet not to older ecosystems. Applying this approach to elucidate the trophic structure of Palaeozoic vertebrates has the potential to revolutionise the approaches taken to understanding these ecosystems.

The primary objective of the research is to test three hypotheses: 1) reliable and reproducible nitrogen and organic carbon isotope values can be obtained from conodonts; 2) trophic tiering is present within Ordovician conodonts; and 3) conodonts utilised an array of trophic resources and occupied a range of trophic levels in the benthic and pelagic realms.

Jan A. Zalasiewicz: Exploring potential new stratotypes for Silurian (Llandovery) stages in Wales

The current project aims at helping to resolve the stratigraphical problems that have arisen during the re-mapping of the Llandovery type area, and anticipates the decision of the International Subcommission on Silurian Stratigraphy to potentially move the GSSPs of the Aeronian and Telychian Stages away from the Trefawr track and/or Cefn Cerig sections.

This grant will provide funding for fieldwork, in order to produce a fully integrated stratigraphy of alternative potential stratotype section(s) within the Welsh Basin. We suggest the Rheidol Gorge

section near Pont-Erwyd in central Wales has potential to serve as an alternative stratotype section for the base of the Aeronian, and also perhaps for the base of the Telychian. We aim to construct a fully integrated (bio)stratigraphy for the levels pertinent to the base Aeronian and base Telychian levels in the Rheidol Gorge section.

The palaeontology and biostratigraphy will be published as papers, and when called for, a new formal stratotype proposal will be available by, and presented at the next quadrennial ISSS meeting in 2011 (likely to be held in the UK).

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No. 276369
STATEMENT OF FINANCIAL ACTIVITIES FOR THE YEAR ENDED 31st DECEMBER 2009

			General Funds	Designated Funds	TOTAL 2009	TOTAL 2008
Incoming Resources						
Incoming resources: generated funds						
Voluntary income	Subscriptions		68,202		68,202	66,376
	Donations		1,000		4,886	7,828
				69,202	3,886	73,088	74,204
Incoming resources: charitable activities						
Sales	Palaeontology		208,193			
	Special Papers		12,423			
	Offprints		799			
	Newsletters		210			
	Field Guides		4,871			
	Distribution		265			
				226,761		226,761	167,990
Investment income				14,945	285	15,230	21,299
TOTAL INCOMING RESOURCES				310,908	4,171	315,079	263,493
Resources expended							
Costs of generating funds							
for voluntary income	Administration		18,670				19,237
Investment management	Stockbroker fees		1,771				1,891
				20,441	0	20,441	21,128
Charitable activities							
Publications	Palaeontology		74,062				
	Special Papers		4,078				
	Offprints		288				
	Newsletters		14,343				
	Distribution		886				
	Marketing		2,708				
	Management		57,769				
	Total		154,134			154,134	133,916
Scientific Meetings & Costs			18,939			18,939	21,042
Grants and awards			6,723		8,154	14,877	19,390
Research Grants			6,637			6,637	15,000
Administration of charitable activities			23,337			23,337	24,046
				209,770		217,924	213,394
Governance costs	Examiner's fee		400				
	Trustee expenses		7,946				
	Administration		4,667				
				13,013	0	13,013	11,958
TOTAL RESOURCES EXPENDED				243,224	8,154	251,378	246,480
NET INCOMING RESOURCES				67,684	-3,983	63,701	17,013
INVESTMENT GAINS/LOSSES							
Realised gain			1,373				
Unrealised gain			43,465				
				44,838		44,838	-76,563
NET MOVEMENT IN FUNDS				112,522	-3,983	108,539	-59,550
FUNDS BROUGHT FORWARD				554,989	46,111	601,100	660,650
FUNDS CARRIED FORWARD				667,511	42,128	709,639	601,100

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No. 276369

BALANCE SHEET as at 31st DECEMBER 2009

2008					2009
£					£
	INVESTMENTS				
383,587	At market value				454,924
	CURRENT ASSETS				
216,682	Cash at Banks	171,134			
77,959	Sundry Debtors	147,424			
294,641	Total Current Assets		318,558		
	CURRENT LIABILITIES				
26,732	Subscriptions in Advance	24,244			
50,396	Sundry Creditors	39,599			
77,128	Total Current Liabilities		63,843		
217,513	NET CURRENT ASSETS				254,715
601,100	TOTAL ASSETS				709,639
	Represented by:				
554,989	GENERAL FUNDS				667,511
	DESIGNATED FUNDS				
8,526	Sylvester Bradley Fund		4,656		
22,175	Jones-Fenleigh Fund		23,064		
15,410	Hodson Fund		14,408		
46,111					42,128
601,100					709,639

Notes to the Financial Statements for the year ended 31st December 2009

1. Accounting Policies

The principal accounting policies adopted in the presentation of the financial statements are set out below and have remained unchanged from the previous year and also have been consistently applied within the same financial statements.

1.1 Basis of preparation of financial statements

The accounts have been prepared in accordance with the Statement of Recommended Practice issued by the Charity Commission in March 2005 and cover all the charity's operations, all of which are continuing. The effect of events relating to the year ended 31st December 2009 which occurred before the date of approval of the statements by Council have been included to the extent required to show a true and fair state of affairs at 31st December 2009 and the results of the year ended on that date.

1.2 Fund Accounting

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

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

Sylvester-Bradley Fund: Grants made to permit palaeontological research.

Jones Fenleigh Fund: Grants to permit one or more students annually to attend the meeting of the Society of Vertebrate Palaeontology and Comparative Anatomy (SVPCA).

Hodson Fund: Awards made in recognition of the palaeontological achievements of a worker under the age of 35.

1.3 Incoming Resources

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

1.4 Resources Expended

All expenditure is accounted for on an accruals basis and has been classified under the appropriate headings.

Charitable expenditure is that which is incurred in furtherance of the charity's objectives. Administrative costs have been allocated to the various cost headings based on estimates of the time and costs spent thereon.

1.5 Investments

Investments are stated at market value at the balance sheet date. The statement of financial activities includes net gains and losses arising on revaluations and disposals throughout the year.

2. Analysis of Financial Resources Expended

	Staff costs	Other costs	Total 2009	Total 2008
Generating Funds	14,710	5,731	20,441	21,128
Charitable activities	18,387	199,537	217,924	213,394
Governance	3,678	9,335	13,013	11,958
	36,775	214,603	251,378	246,480

3. Staff Costs

	Salary	National Insurance	Pension Contributions	Total 2009	Total 2008
Publications - 1 employee (2008 - 1)	28,518	0	4,277	32,795	26,446
Administration - 1 employee (2008 - 1)	29,380	3,017	4,378	36,775	34,649
	57,898	3,017	8,655	69,570	61,095

4. Trustees Remuneration and Expenses

Members of Council neither received nor waived any emoluments during the year (2008 – nil)

The total travelling expenses reimbursed to 12 Members of Council was £7,746 (2008 – £6,749)

5. Costs of Independent Examiner

	2009	2008
Examination of the accounts	400	400
Accountancy and payroll services	1,350	1,150
	1,750	1,550

6. Debtors

	2009	2008
Accrued income – receivable within one year	147,424	77,959

7. Creditors – falling due within one year

	2009	2008
Social Services costs	3,172	3,679
Accrued expenditure	36,427	46,717
	39,599	50,396

THE PALAEONTOLOGICAL ASSOCIATION Registered Charity No 276369

DESIGNATED FUNDS

STATEMENT OF FINANCIAL ACTIVITIES FOR THE YEAR ENDED 31st DECEMBER 2009

	Sylvester-Bradley	Jones-Fenleigh	Hodson	Total 2009	Total 2008
Donations	1,135	2,751	0	3,886	1,418
Interest Received	53	137	95	285	2,068
TOTAL INCOMING RESOURCES	1,188	2,888	95	4,171	3,486
Grants made	5,058	1,999	1,097	8,154	9,939
NET SURPLUS / (DEFICIT)	-3,870	889	-1,002	-3,983	-6,453
FUNDS BROUGHT FORWARD	8,526	22,175	15,410	46,111	52,564
FUNDS CARRIED FORWARD	4,656	23,064	14,408	42,128	46,111

Independent Examiner's Report on the Accounts of The Palaeontological Association for the year ended 31st December 2009

Respective responsibilities of trustees and examiner

The charity's trustees consider that an audit is not required for this year (under section 43(2) of the Charities Act 1993 (the Act), as amended by s.28 of the Charities Act 2006) and that an independent examination is needed.

It is my responsibility to:

- examine the accounts (under section 43 of the Act as amended)
- follow the procedures laid down in the General Directions given by the Charity Commissioners (under section 43(7) of the Act as amended), and
- state whether particular matters have come to my attention

Basis of independent examiner's statement

My examination was carried out in accordance with the General Directions given by the Charity Commissioners. An examination includes a review of the accounting records kept by the charity and a comparison of the accounts presented with those records. It also includes consideration of any unusual items or disclosures in the accounts and seeking explanations from the trustees concerning such matters. The procedures undertaken do not provide all the evidence that would be required in an audit and consequently I do not express an audit opinion on the accounts.

Independent examiner's statement

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

(1) which gives me reasonable cause to believe that in any material respect the trustees have not met the requirements to ensure that:

   - proper accounting records are kept (in accordance with section 41 of the Act) and
   - accounts are prepared which agree with the accounting records and comply with the accounting requirements of the Act

(2) to which, in my opinion, attention should be drawn in order to enable a proper understanding of the accounts to be reached.

Dated: 13 May 2010

G R Powell F.C.A.
Nether House, Great Bowden,
Market Harborough
Leicestershire LE16 7HF

Nominal	Holding	Cost (bought pre 2009)	Value end 2008
35,300	M & G Securities Ltd Corporate Bond I GBP Inc		
£25,000	UK 4.75% Stock 07/03/20 GBP 100	£25,202.60	£28,390.00
£20,000	UK 4.5% Gilt 07/03/19 GBP 0.01	£20,092.99	£22,381.00
£64,176.46	COIF Charities Fixed Interest Fund	£85,000.00	£84,058.33
804	Royal Dutch Shell B shares	£12,432.00	£13,877.00
600	BHP Billiton $0.5 shares	£4,341.48	£7,764.00
500	BG Group Ordinary 10p shares	£3,977.95	£4,785.00
925	HSBC Holdings Ordinary 0.5 US Dollar shares	£8,138.45	£6,124.00
1,825	HSBC Holdings Ordinary 0.5 US Dollar shares		
583	HSBC Holdings Ordinary 0.5 US Dollar shares		
6,800	Lloyds TSB Ordinary 25p shares	£10,169.91	£2,205.00
950	Barclays Ord 25p shares		
450	Natl Express Group Ord GBP 0.25	£4,073.57	£2,226.00
875	BAE Systems Ord 2.5 P shares		
1,000	3I Group Ordinary £0.738636 shares		
650	Glaxo Smithkline Ordinary 25p shares	£10,232.42	£8,348.96
405	Glaxo Smithkline Ordinary 25p shares	£6,375.58	£5,202.04
925	IMI Ord GBP 0.25	£4,053.31	£2,514.00
2,499	Bluecrest Allblue Ord Npv GBP shares	£3,020.28	£2,593.00
1,100	Wood Group (John) Ordinary 3.33p shares	£2,975.36	£2,071.00
7,000	Ing Global Real Estate Securities Ord NVP shares	£7,084.00	£2,223.00
2,150	BT Group Ordinary 5p shares	£7,787.53	£2,907.00
300	Unilever PLC Ord GBP 0.031111	£4,326.21	£4,737.00
150	Novo-Nordisk As DKK 1 Ser B		
460	Pearson Ordinary 25p shares	£8,069.00	£2,949.00
1,350	Prudential Ordinary 5P shares	£7,063.25	£5,603.00
650	RIT Capital Partners Ordinary £1 shares	£4,903.90	£5,746.00
20	Schroder Alt Solut Agriculture C GBP Dis Hdg	£2,987.22	£2,002.00
1,500	British Empire Sec & Gen Trust Ordinary 10p shares	£5,005.61	£4,973.00
425	Findlay Park Partners US Smaller Companies	£6,158.47	£8,540.00
1,750	Cazenove Inv Fd Mt European Fund X Acc Nav		
425	Fidelity EUR Value Ordinary 25P shares		
3,900	Edinburgh Dragon Trust Ordinary £0.20 shares	£4,478.10	£4,856.00
3,100	Capita Morant Wright Japan B Inc Nav	£5,170.11	£5,878.00
55	Fauchier Ptnrs Paragon Cap App Instl Stlg	£9,894.52	£8,860.00
1283.8	COIF Charities Investment Fund Acc Units	£75,000.00	£79,879.58
5,720	M & G Charifund Units	£4,073.00	£51,894.00
	Total	£352,086.82	£383,586.91

Proceeds (sold in 2009)	Cost (bought in 2009)	Gain realised during 2009	Value end 2009	Gain unrealised during 2009
	£10,061.14		£11,600.00	£1,538.86
			£26,692.00	-£1,698.00
			£21,028.00	-£1,353.00
			£81,048.45	-£3,009.88
			£14,564.00	£687.00
			£11,970.00	£4,206.00
			£5,610.00	£825.00
£5,110.64		-£1,013.36		
	£5,512.91		£12,936.00	£7,423.09
£4,005.53	£1,939.00	£2,066.53		
	£1,867.59		£3,447.00	-£625.59
	£3,528.34		£2,622.00	-£906.34
£2,098.51		-£127.49		
	£3,542.00		£3,146.00	-£396.00
	£3,058.76		£2,830.00	-£228.76
			£8,577.00	£228.04
£5,102.78		-£99.26		
£4,316.35		£1,802.35		
			£3,981.00	£1,388.00
			£3,397.00	£1,326.00
			£4,883.00	£2,660.00
			£2,903.00	-£4.00
			£5,982.00	£1,245.00
	£6,200.64		£5,944.00	-£256.64
			£4,099.00	£1,150.00
			£8,640.00	£3,037.00
			£6,793.00	£1,047.00
			£2,166.00	£164.00
			£6,249.00	£1,276.00
			£10,348.00	£1,808.00
	£6,107.82		£7,825.00	£1,717.18
	£4,059.07		£4,892.00	£832.93
			£7,547.00	£2,691.00
			£5,477.00	-£401.00
			£9,906.00	£1,046.00
			£91,316.44	£11,436.86
			£56,505.00	£4,611.00
£20,633.81	£45,877.27	£2,628.77	£454,923.89	£43,464.75

ASSOCIATION MEETINGS

54th Annual Meeting of the Palaeontological Association
Department of Geology, Ghent University, Belgium *17 – 20 December 2010*

The 54th Annual Meeting of the Palaeontological Association will be hosted by Ghent University in Belgium, organised by members of the Department of Geology and Soil Science, in collaboration with the Department Géosystèmes of the University of Lille 1 (France), the University of Namur (Belgium), the Royal Belgian Institute of Natural Sciences (KBIN – Brussels, Belgium) and Kunsthal St-Pietersabdij (Ghent, Belgium). As in previous years, this meeting will cover new and exciting developments in the fields of palaeontology and palaeobiology. Please check the Association's website <**www.palass.org**> for all details and updates.

Meeting Format
The meeting will begin with a symposium on Friday 17th December entitled "Biological proxies in climate modelling" (see below for details), followed by a drinks reception. Saturday 18th December will consist of a full day of talks and posters, the AGM of the Association and the Association Annual Address. In the evening there will be a drinks reception followed by the Annual Dinner. Sunday 19th will comprise another day of talks and will include a dedicated poster session. The meeting will conclude on Monday 20th December with a field excursion to the Mons Basin in South Belgium and a museum visit to the Royal Belgian Institute of Natural Sciences in Brussels (see below for details).

The time allocated to each talk will be 15 minutes including questions; if there are a large number of suitable high-quality abstract submissions, we may introduce shorter time slots for some part of the meeting. Please check the website for technical details on the preparation of oral and poster presentations.

The President's Prize will be awarded for the best talk at the Annual Meeting by someone under the age of 30 who is a member of the Association. This is a cash prize of £100. The Council Poster Prize will be awarded for the best poster at the Annual Meeting by someone under the age of 30 who is a member of the Association. This too is a cash prize of £100.

Symposium

Entitled "Biological proxies in climate modelling" (or, why palaeontologists and climate modellers should be thick as thieves), this symposium will document the major steps in the evolution of Phanerozoic climate, its links to biotic change, and the ways in which these climates can be tracked by fossil proxies and simulated by advanced numerical computer models. It will showcase the importance of using (mainly fossil but also other) proxy data to build and ground-truth these climate models. Sophisticated numerical climate models are nowadays at the forefront of climate change studies, but it remains essential to evaluate the robustness of output produced by such models through comparison with palaeoclimate proxies, such as synthesised (micro)fossil data (which are especially important for deep-time applications). With this symposium, we seek to promote further integration of geological and numerical approaches to facilitate the development of comprehensive reconstructions of Earth's past and future climate. We have approached climate modellers, palaeoclimatologists and palaeontologists to give synthesis papers on complementary endeavours or integrated projects. The main themes that will be considered are: (1) Data-model

comparisons, (2) Modelling Phanerozoic climates with General Circulation Models; (3) Climate events, extinction and recovery; (4) Large-scale Icehouse to Greenhouse transitions and their control mechanisms; (5) Deep-time warm periods and how they can aid our understanding of Cenozoic and recent climate change, and of the impact of future warming; (6) new proxies for deep-time climate.

Confirmed speakers are:

- Axel Munnecke (University of Erlangen, Germany)
- Yves Goddéris (CNRS-Observatoire Midi-Pyrénées, Toulouse, France)
- Daniel Lunt (Bristol University, UK)
- Ulrich Salzmann (Northumbria University, UK)
- Alan Haywood (University of Leeds, UK)
- Martin Head (Brock University, Canada)
- Dirk Verschuren (Ghent University, Belgium)

Field trip

The field excursion will leave Ghent centre early in the morning of Monday 20th December. During the morning and early afternoon we will visit two quarries in the Mons Basin of South Belgium: the Hautrage quarry (terrestrial clays and sands with fossil wood; coeval to the deposits that yielded the *Iguanodon* specimens of Bernissart); and the Malogne mine (Maastrichtian phosphatic chalks with *Hainosaurus*). Field guides will be Johan Yans (University of Namur) and Jacques Verniers (Ghent University). We will then drive to Brussels and visit the Royal Belgian Institute of Natural Sciences, where the famous *Iguanodon* specimens of Bernissart are on display – these specimens were collected from mines in the area we visited earlier (that now are no longer accessible). We will also see some of the spectacular vertebrate finds of the Messel site. The museum will open especially for the Association. The visit will end around 5.30–6pm. Participants can then choose to be dropped off at the railway station in Brussels (Brussels South Station, and from there take high speed trains – Eurostar, Thalys – home, or a local train to the airport), or can choose to stay on the bus that will return to Ghent.

Venue

The conference will take place at two of Ghent University's conference venues, right in the historical city centre of Ghent: the 'Aula' and 'het Pand'. The 'Aula' is the University's official hall, and will be the venue for the palaeoclimate symposium and reception on Friday. The second venue, 'Het Pand', is the University's official conference centre, housed in a converted medieval Dominican monastery, and will be the site for the scientific sessions on Saturday and Sunday.

Ghent is an enchanting and vibrant city, which is often referred to as one of the most beautiful historic cities in Europe. From St Michael's bridge, literally two minutes away from the main meeting venue, there is a breathtaking view of the skyline of Ghent with the three impressive towers of St. Nicholas' Church, the Belfry with its bell tower and St. Bavo's cathedral, which houses the world famous painting 'The Adoration of the Mystic Lamb' by Jan van Eyck (1426–1432). Traces of the Middle Ages run throughout the Hanseatic league city. The old port, with its guild halls on the Graslei and Korenlei, is merely one example of the beautiful sights this town has to offer. Not far from the Graslei arises the Castle of the Counts, once the medieval fortress of the Counts of Flanders. The Annual Dinner will be at St-Pieters Abbey (Saint Peter's), one of Ghent's finer and better preserved historical buildings.

Accommodation and Travel

For all details, we refer to the website. Unfortunately, it is impossible for us to use the on-campus student accommodation. Registration for the meeting will therefore not include accommodation, and conference participants are invited to make their own bookings. The city of Ghent offers a wide range of accommodation, for all budgets. We have block-booked a number of rooms in various hotels and a list of suggestions will be available from the website. We also suggest using <**www.visitgent.be**> to explore further possibilities. In the run-up to Christmas the city will be busy during weekends, so we suggest you arrange accommodation early.

Registration and call for abstracts

Registration (booking and payment by credit card) and abstract submission are now open, from online forms on the Asssociation's website. Abstract submission will close on Monday 6th September and we will not be able to consider abstracts submitted after this date. The main conference lecture hall has a capacity of 350; the Annual Dinner venue holds 220 persons and the number of registrants will be capped at these figures, even within the registration deadline if necessary. Registrations and bookings will be taken on a 'first come, first served' basis.

The cost for early registration is £90 (ordinary and retired members) and £70 for students; non-members pay £115. Increasing costs of organising the meeting, combined with an unfavourable position of the pound relative to the euro, have forced us to increase registration fees compared to earlier years. However, please note that this year's registration includes the sandwich lunches on Saturday and Sunday (as well as the reception on Friday, full registration package and coffee breaks). Early registration ends on Monday 6th September after which date all registration fees will increase by £25. The final deadline for registration is Friday 19th November. No refunds will be considered after that date. The field excursion costs £30 (this too includes lunch). The cost of the Annual Dinner is £50.

Travel grants are available to help student members (doctoral and earlier) to attend the meeting in order to present a talk or poster (see below).

Programme and summary of dates and deadlines

(Timetables and start times will be communicated shortly on the website)

Friday 17th December 2010

- Symposium "Biological proxies in climate modelling" (Aula, Ghent University)
- Reception (Aula, Ghent University)

Saturday 18th December 2010

- Scientific sessions: talks and posters (Pand, Ghent University)
- AGM and Annual Address (Pand, Ghent University)
- Reception and Annual Dinner (St. Pieters Abbey)

Sunday 19th December 2010

- Scientific sessions: talks and dedicated poster session (Pand, Ghent University)
- Presentations of awards (Pand, Ghent University)

Monday 20th December 2010

- Field excursion to the Mons Basin and KBIN Museum visit

Deadlines

- Monday 6th September (midnight): abstracts submission deadline and end of early registration at reduced rate
- Friday 19th November 2010: Final deadline for registration

Travel grants to student members

The Palaeontological Association runs a programme of travel grants to assist student members (doctoral and earlier) to attend the Annual Meeting in order to present a talk or poster. For the Ghent meeting, grants of up to £100 (or the € equivalent) will be available to student presenters who are travelling from outside Belgium. The actual amount that will be payable depends on the number of applicants and the distance travelled. Payment of these awards is given as a disbursement at the meeting, not as an advance payment. Students interested in applying for a PalAss travel grant should contact the Executive Officer, Dr Tim Palmer (<**palass@palass.org**>) once the organisers have confirmed that their presentation is accepted, and before 1st December 2010. Entitle the e-mail "Travel Grant Request". No awards can be made to those who have not followed this procedure.

Contact

To contact local organisers Thijs Vandenbroucke, Stephen Louwye or Jacques Verniers, please send an e-mail to <**annualmeeting@palass.org**>.

Organising committee:

Kurt Blom (Ghent University, Belgium), Marc Faure (Ghent University, Belgium), Pascal Godefroit (Royal Belgian Institute of Natural Sciences), Stephen Louwye (Ghent University, Belgium), Tim Palmer (Palaeontological Association), Thierry Smith (Royal Belgian Institute of Natural Sciences), Thijs Vandenbroucke (Université de Lille1, France), Jacques Verniers (Ghent University, Belgium) and Johan Yans (Facultés Universitaires Notre-Dame de la Paix, Namur, Belgium).

Scientific committee:

Richard Aldridge (University of Leicester, UK), Emanuelle Javaux (Université de Liège, Belgium), Stephen Louwye (Ghent University, Belgium), Patrick Orr (University College Dublin, Ireland), Thomas Servais (Université de Lille1, France), Robert Speijer (University of Leuven, Belgium), Etienne Steurbaut (Royal Belgian Institute of Natural Sciences), Thijs Vandenbroucke (Université de Lille1, France), Jacques Verniers (Ghent University, Belgium).

We look forward to seeing you in Ghent!

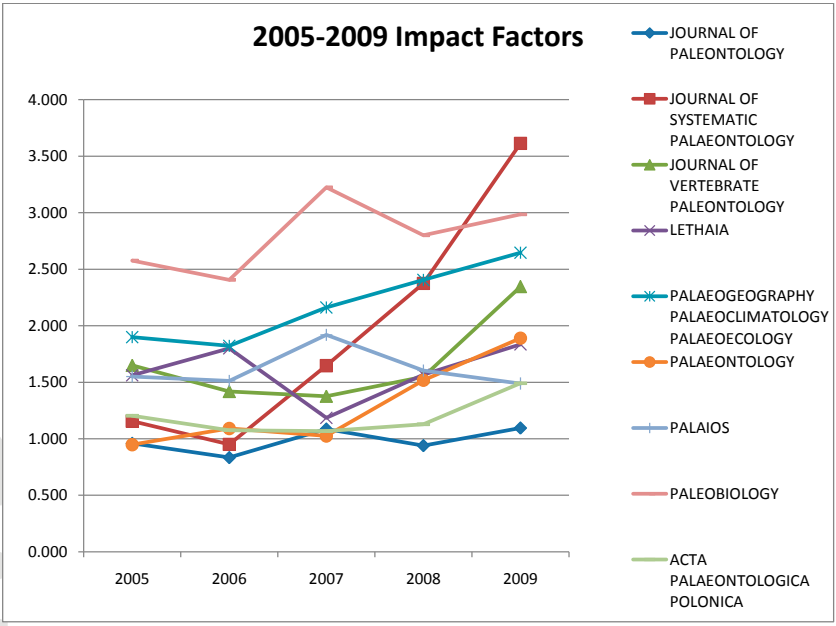
news

Impact factor of 3.6 for Special Papers in Palaeontology

The 2009 Impact Factor data were released by Thomson Reuters in June, and an impact factor is now available for Special Papers in Palaeontology. In 2009 the impact factor of Special Papers was 3.60, placing the journal at number three in the list of 40 journals within the 'Paleontology' subject category of ISI, behind Journal of Systematic Palaeontology (3.61) and Paleoceanography (3.64).

Palaeontology has in turn recorded a third successive yearly rise in impact factor to 1.89, from 1.51 in 2008. Overall, this places the journal tenth in the 'Paleontology' subject category, making the journal one of the highest ranked in the subject area to cover a broad range of groups and to carry taxonomic content.

Paul Smith
Chair, Publication Board



Title	2005	2006	2007	2008	2009
JOURNAL OF PALEONTOLOGY	0.960	0.834	1.087	0.940	1.096
JOURNAL OF SYSTEMATIC PALAEONTOLOGY	1.156	0.950	1.647	2.375	3.613
JOURNAL OF VERTEBRATE PALEONTOLOGY	1.649	1.418	1.376	1.548	2.346
LETHAIA	1.562	1.800	1.185	1.567	1.836
PALAEOGEOGRAPHY PALAEOCLIMATOLOGY PALAEOECOLOGY	1.899	1.822	2.162	2.405	2.646
PALAEONTOLOGY	0.948	1.091	1.025	1.517	1.89
PALAIOS	1.551	1.512	1.919	1.604	1.489
PALEOBIOLOGY	2.576	2.405	3.225	2.800	2.985
ACTA PALAEONTOLOGICA POLONICA	1.204	1.076	1.067	1.128	1.491

From our Correspondents

Desert Island disc

Better to travel than to arrive, they say. That destination may be long-sought, dreamed after, yearned for, in years of struggle and strife. Once reached, there's elation, of course. But then? Elation's not an emotion for the long haul. Those endorphins can't keep flooding through one's synapses. So … what then? That high mountain peak, once attained, becomes familiar, then ordinary, then – alas! – just a little tedious.

Remember those first portable computers? (if long enough in the tooth that you possibly still possess, perhaps you do). They were the size of a family suitcase, could squeeze only a handful of kilobytes into their capacious frame, and were portable only if you had practised Olympic weight-training and eaten raw steak for a month beforehand. No matter. This was the wave of the future, the bright entrance of a life liberated by the white heat of technology. And now… I type these words on a svelte laptop that can casually manipulate a million times more information than could its primeval ancestor of not quite three decades back – all the while emanating cool jazz from its interior. Promise fulfilled? – well, even that latest shiny model, with iridium cover and inbuilt ion probe and a zillion trillion gigabytes of RAM, often seems less a liberator and more a form of electronic manacle to bind us to our daily tasks.

Computers, nevertheless, today create the public face of our science, as the TV documentaries make megalosaurs, megalodons and megatheria leap and gambol ever more athletically into our living rooms. It's a circus, of course. We know that the real thrill lies in the chase for clues, and not in contemplating mortal combat amid the virtual animations. No matter whether our quarry is a dinosaur femur, a curious new brachiopod, or an unfamiliar marine alga. Animal, vegetable or bio-mineral, it's all the same. What matters is that it's present in a shape or size or association that humans have never previously seen, or in a type of rock stratum from which they had never been reported: that it's a mystery, a new puzzle, something beyond the frontier of knowledge, something to be hunted down through cliffs and crags and then through the eyepiece of a microscope and finally amid the endless rows of monographs; that it's something to tantalize, infuriate, engross, entrance – something to grip our waking hours and fill our fitful dreams until …

Until the mystery is solved. Until, that is, the allowable hypothesis is created that takes the mystery and … removes it. The object that had absorbed us, fascinated us, can now be soberly described and illustrated, laid out in words and in measurements in statistically significant combinations. The object itself is now neatly numbered, catalogued, laid out in a tray, pushed into the darkness of the museum cupboard. There, the magic fades, rather like one of those brightly iridescent reef fish that, untimely taken from the water, turns pale and dull.

So we have it: a bright advancing line of intellectual adventure, leaving in its wake countless, orderly ranks of curated specimens and printed manuscripts with, here and there, some rapidly fading press releases. In front of that shining line, of course, lies the unknown and unimagined wealth that still lies buried in the strata.

So, do fossils become extinct twice – once corporeally and the second time in the human imagination? Not necessarily, of course. Making a point is always a hair's breadth away from stretching that point well past *its* breaking point, from constructing a caricature. For each fossil, once laid to rest in the crowded mausolea we call museums, can come alive again – and again and again – in synonymy lists, in redescriptions and reinterpretations and shiny new cladograms, now and then changing its name or its biological affinity. In this sense, old fossils never die, for palaeontologists continually trawl through the collections of the past to make the new syntheses of the future.

And there's more to it than that, in a quite general sense. The more one looks at such things, the more one realises what it took human civilization many thousand years to comprehend, long after astronomy and mathematics became sophisticated and alchemy mutated into chemistry: that strata are sea floors, and that the curious petrifactions they contain are long-dead plants and animals. This realization – this *reality* – seems stranger to me now than it did in my youth. The shock of the old can trump the shock of the new (to be fair, it's had more practice).

Familiarity does not necessarily bring with it ennui. For instance, the people I have heard talk most passionately about any piece of music are the professional musicians who have played it thousands of times – who have deconstructed and reconstructed it, spent months memorizing it. There's no sense of the tiresome there, only of reaching farther into some small but quite unique part of infinity. Conversely, a lack of engagement can simply reflect ignorance. It took me a long time to appreciate Mozart's operas: about forty years. Well, say twenty, allowing for the musical sins of youth. But for those latter two decades I knew (from reliable sources) that there was greatness there. And I listened, from time to time, to try to find it – and heard nice melodies but nothing that seemed so extraordinary.

And then – something clicked, and I fell headlong into the music. It's a vivid memory still, of listening to *The Marriage of Figaro* while on the usual commute on the usual road (always a good, if carbon-hungry way to absorb music, with that kind of sideways concentration that one has while driving). The key that opened the box was *Susanna or via sortite*: that fizzing domestic spat between the suspicious (yet still philanderous) Count and his despairing wife, with running commentary by the sprightly servant girl indulging in subterfuge to rescue her unhappy mistress. Not that I realised any of that then – all I heard (as the musical penny finally dropped) were ascending cluster-bombs of melody and rhythm that mainlined high emotion deep into … well, into wherever these kind of things hit hardest. That feeling has stayed, and widened and deepened to include other arias and other operas by the sublime W.A. Not all yet, maybe. I'm still curiously resistant to *The Magic Flute*, other than to the magnificent if sinister charms of the Queen of the Night – but I'm as sure that's my failing rather than Mozart's as I am that (say) organic evolution is true.

In music, one of the unfailing, time-honoured representations of the ability of the familiar to continually fascinate is that age-old British Institution, *Desert Island Discs*. Such a simple idea – each week's invitee chooses the eight pieces of music they would rescue with them to a desert island, all the while being probed on their life via the gentle but insidious questioning of the

presenter. These days, it's Kirsty Young in the inquisitor's chair, with unfailing charm and an absolute mastery of the pregnant pause[1].

What I have rarely heard happen on this programme is experimentation – the choosing of a difficult and unfamiliar piece so that long exile can promote its deeper study. No, these are the pieces that people have carried with them all their life, as well-worn as that threadbare gardening jacket that somehow never finds its way into the charity shop.

For a palaeontologist, of course, years of field practice and the honing of low cunning means that, even as one is washed up on that distant beach after that fateful tropical storm, one would make sure that – by hook or by crook – there would be a well-stocked, solar-powered iPod somewhere about one's person (I'm sorry, Kirsty, but some things are just too important to be sacrificed to the programme rules). However, there would be an appropriate alternative. Bobbing in the waves, and the first thing to be dragged ashore, would be a specimen chest – containing, by that million-to-one coincidence that almost always happens in these situations, one's eight favourite fossils.

Just the things, they would be, to lay out in pride of place in that hurriedly improvised hut, and to come back to after a hard day foraging for shellfish or harvesting coconuts: the things to remind one of a past life and maybe to provide inspiration in the present one (to begin that long monograph on the local shellfish, say). But which fossils? It would of course be fun to think of the world's most spectacular examples to grace one's makeshift mantelpiece. Say: a complete *T. rex*; a fully feathered *Archaeopteryx*; a fine *Hallucigenia*; that first-ever Precambrian fossil *Charnia* as discovered in a Leicestershire wood; the section through the huge fossil tree-trunk that graced the Natural History Museum; an entire deep-frozen mammoth; perhaps Ida too, that lovely million-dollar lemur, neither missing nor link; and to round things off in this fashion, the Piltdown skull.

For that collection, of course, one would need to have been, just pre-shipwreck, a palaeontological master criminal on the run[2], which might be unlikely[3]. And, of course, Desert Island Discs isn't all, or even mostly, about revered masterpieces. It's personal, and a good deal of its charm is that one can discover tiny gems from amid the byways of the invitees' random walks through the musical jungle. A recent discovery, for instance, was the singing of the young Marianne Faithfull (a choice of Morrissey's, if I recall), of touching optimism, before the alternative chemistry of those days pulled her under.

So these selections would have to be the personal too, the small fry (mostly) among fossils that somehow lodged into the memory, or that mark some sort of step or turning point in one's own pathway through palaeontology. Nothing grand, mostly, not even the most complete or best preserved. All that matters is that they have some sort of story, to muse over (and perhaps embellish with imagined detail in each re-thinking) as one grills one's shellfish over the *al fresco* fire.

[1] Never, *ever*, ask her to examine your PhD student: no matter how well-prepared their defence of some elaborate cladogram or other – Kirsty will always, ever so gently, make them reveal the dodgier items in the character set.

[2] From Interpal, naturally.

[3] But if one had managed to smuggle an iPod past Kirsty's vigilance, maybe not so *very* unlikely.

The first piece of music is usually something from childhood – the first pop record one ever bought, that kind of thing. To follow in that grand tradition, my own first choice would likely be only a fossil in the loosest sense, taken from the days when a childish enthusiasm of things that were simply old was occasionally indulged by relatives and family friends, bringing a piece of Roman pottery here, a shell there – all of which treasures would be seized upon and then jealously guarded within a small cabinet. This was in the covetous, collecting stage of (that era of) youth, when things – that special marble with the swirly patterns, the golf ball filched from the woods behind the links, the three-year old conkers, hard as teak – were prized in their own right. At this age, the instinct for trans-disciplinarity is absolute. Amongst the properly *old* things there was a Neolithic flint scraper, acquired from goodness-now-knows-who and goodness-knows-where, which became perhaps the most talismanic item in the cabinet, the one that was carefully centrally placed, the one with the most powerful ju-ju. So that will, now, take its place by the island fireplace. Perhaps it will find a use again; it is very hard-wearing and was built for a purpose, after all.

And then? Well, to pursue that chronological line, there needs to be something that turns something from one of the many fitful enthusiasms that punctuate a child's life into something a little more lasting. So here, there is a half a trilobite's head: *Dalmanites caudatus*, from the Wenlock Shales of Burrington, Ludlow. The main thing about this is the label: beautifully written – indeed, calligraphic – with name, age, stratigraphic location, geographic location, and date. It is the handwriting of a lifetime museum curator with a deep attachment to the things that he is labelling – and lots of practice, of course. This was John Norton, of Ludlow Museum (the curious story of how he came into and redirected my life is related in an earlier column: v. 54). It was the first practical lesson in how to add a touch of direction to an energetic but chaotic enthusiasm, given by somebody who gave freely of his time to one and all. So, not only were fossils fascinating as things, but the small communities of people around them seemed *quite* singular. The word 'lifestyle' wasn't much used then. People just lived – but some much more interestingly than others.

From that time also, one selects another item: a piece – almost any piece – of the Ludlow Bone Bed. It struck me as quite amazing then, and it continues to amaze now. A bed made up almost entirely of bits of crustacean armour and the scales and spines of early armoured fish? Impossible! – yet it exists, and, indeed, can be traced for miles around Shropshire and Herefordshire. That must have been a quite remarkable sea floor, a prime target for a visit with aqualung and camera when that time machine is finally invented.

In my youth one could still, with the very longest chisel, excavate tiny bits of it out of the deep cleft in the rock (now cemented over by the council, alas) at Ludford Corner, where it had been excavated by many previous collectors. One of those previous collectors – lying in the road to better guide the chisel – must have been that grandest of old men of geology, Sir Roderick Murchison, author of the monumental *Siluria*, and architect of the Silurian itself (and the Devonian – a part share – and the Permian, too, for good measure). Murchison's achievements were staggering, but he has been regarded as a bit curmudgeonly when it comes to acknowledging previous work, so that his own star should shine the brighter. Hugh Torrens, for instance has detailed how Murchison's achievements as a historian of his own science fall short of those of his stratigraphical endeavours. Still, in the pages of *Siluria* itself, he seems generous

enough in his praise of at least some of his less distinguished colleagues and predecessors. For instance, Murchison didn't find the bone bed himself, as he notes (p. 137):

> 'This course was discovered by my friends and excellent Ludlow coadjutors, the Rev. F.T. Lewis and Dr. Lloyd, the latter, now alas! removed by death. By their assistance, and that of the late Rev. J. Evans, I traced this fish-bed in several other parts of the Ludlow promontory.'

On the same page, Murchison showed an elegant descriptive touch:

> 'Some of the fragments of fish showed a mahogany hue, but others of so brilliant a black that, when discovered, the bed conveyed the impression of being a heap of broken beetles'

and a nice line in palaeontological self-deprecation, too:

> 'The supposed fishes of this bed, as exhibited in plate 4 of my original work, must now be reduced in number. At all events, besides the remarkable *Pterygotus* … which was removed by Agassiz himself to the class of crustaceans, Professor M'Coy has diminished the list of fish remains by proving, that some of the supposed fish *defences* should be also removed to that group'.

Thus, Murchison was a little closer in his allusions to beetles than he realised. Yet more so, of course, now the bone bed has yielded washings from the nearby landscape, in the form of bits of predatory arachnid and myriapod (Dunlop 1999), while, even more dramatically, there have been ideas that an impacting meteorite may or may not somehow have had a hand (so to speak) in forming this deposit (Schmitz 1992; Smith *et al.* 1993). Next time anyone studies this deposit, they should sew up the film rights first.

Fossil number 4. Well, we must move on a little. The undergraduate experience was in Sheffield, where Geology as such is alas now extinct through some past rationalization (though the likes of Mike Romano and Martin Whyte carried on flying the flag magnificently long after the axe had fallen). While it lasted it was pretty good, right from the word go, when Leslie Moore's broad Somerset pronunciation of the word 'facies' in his splendid opening lecture became an instant catchphrase. Those were days without learning objectives, without course questionnaires, without personal development portfolios, without transferable skills, without continuous feedback, without a balanced mix of assignments and assessments. Heavens above! – however did we manage to become educated?

Well, we were pretty interested in geology, by and large. And we had time to read – even read about things that interested us that were not on the syllabus, which now seems a touch dangerous. And time, also, to go into the field, just for the hell of it. One could get to Castleton and back by bus in a day, and come back laden with brachiopods and corals and lumps of 'Blue John' fluorite (the rarest mineral in the world, the souvenir shops used to say, with scant regard for the Trade Descriptions Act[4]. There's a bit on my desk still, which combines animal and mineral. It is half a brachiopod, with valves articulated and closed so the interior was hollow: an interior that subsequently filled with that characteristic deep purple-blue fluorite.

[4] Rightly so, as the Trade Descriptions Act had only just come into force and was being treated with the disdain that it deserved

It came as a surprise that a mere fossil could control the pattern of another entirely separate phenomenon, mineralization. This was a pattern, though, that was to turn up fairly frequently afterwards. Dead things buried underground can be influential in determining the kind of chemistry that goes on within those buried rocks. That's most obviously seen where graptolites and ammonites become filled with pyrite, surprisingly early on in burial (one can dig just a few centimetres into the beach sands of Hunstanton-by-the-sea and pull out just-dead shells that are already acquiring a golden sheen). But it can get considerably more subtle than that. Those textbook white graptolites on black shale are white not because that is their natural colour, for instance, but because they acquired a shiny coating of new micas when buried a few kilometres underground. These micas, though, haven't formed on, say, brachiopods, even on the same rock surfaces, because the material they are made of didn't catalyse the same sort of reactions as did the graptolites (even when those graptolites had by then been thoroughly carbonized and might be thought to have become chemically inert). This counter-intuitive pattern is also the reason (Page *et al.* 2008) why the iconic fossils of the Burgess Shale shine so brightly. It is a story, one suspects, that will run and run.

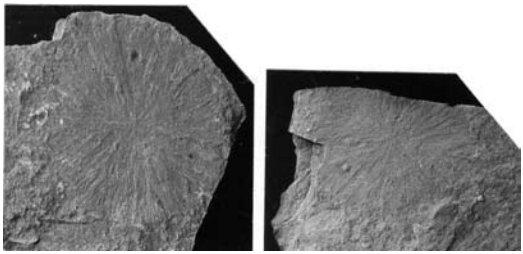
Number five. Well, this has to be a specimen of *Didymograptus* aff. *simulans* (Elles and Wood), the species which became my personal Hundred Years War (and almost my Waterloo) during my PhD, the species by which I became taxonomically sadder but wiser[5]. It's a story most every palaeontologist will recognise. Having collected, with some effort, a reasonable haul of graptolites from one locality in my mapping area, it would surely be simple to classify them using the appropriate key and therefore date the rock – a few hours work, perhaps?

It took three months of solid effort. Firstly, these particular fossils looked more or less similar to each other – but then they also differed quite a bit in detail. Did I have a dozen closely-related species in that collection, or two or three – or maybe just one species, that was a bit variable in form? The only way to find out was to make dozens of measurements on each of a few hundred specimens, and then plot those measurements against each other on graphs (no Excel then: which probably helped, to be honest). What emerged, after all that, was a more or less reasonable set of broad unimodal distributions – consistent with all of those graptolites representing one single species. But which species?

There wasn't, of course, anything as simple as a single, authoritative key to graptolite species. But there was a bewildering assortment of large monographs and papers from all over the world, in a variety of languages and a curiously varied approach to description and interpretation. When I emerged, pale and emaciated, from the brow-furrowing perusal of these, it was with the realisation that *nothing quite fitted* – there was nothing in all of that accumulated scholarship that was exactly like my graptolite species. But there were a couple of species that were quite close. Which was closest? One couldn't say, just by looking. So one had to track down and measure specimens of *those* as well, and then plot yet more graphs. The name *simulans* emerged as mathematically the closest, though with that weaselly prefix indicating affinity (how much? – one still isn't quite sure) rather than exact correspondence.

The scar tissue from that first foray into the taxonomic jungle remains, but the realisation that mystery clings to pretty much every specimen that one finds provides some sort of compensation.

[5] Wiser, perhaps not, truth be told: 'less blitheringly naive' may be a more precise way of putting it.



The mystery discs from the Tremadoc (Ceunant-y-garreg-ddu, Arenig Fawr, Wales; Conophyrys salopiensis *Biozone; Sedgwick Museum SM A102755-6). The largest one is ca 3.8 cm in diameter. Answers on a postcard, please.*

More mystery with some specimens than with others, though – at least *overt* mystery. There were some Tremadoc rocks then that provided another conundrum, still unresolved, that might nicely provide number 6. These were simple discs on shale surfaces (shales that had also yielded trilobites that could, in Richard Fortey's words, be 'as big as soup-plates' – and indeed one of them graced the Natural History Museum display for a while). They aren't very big, these discs – a couple of centimetres across, simply two-dimensional, as far as could be judged, with a sharp perimeter and fine radial lines radiating from the centre. *Voila tout* – that's all there is to them. Jellyfish, perhaps? – but even those should have more morphology. Microbial mats? – but here one might expect concentric wrinkles. Are they fossils at all? Pseudofossils from some kind of localised compaction, rather like the pattern that one can form by pressing one's finger against a spot of mud on a glass slide? – the radial lines look too regular for that. It's a bit like the Ediacaran conundrum, *Aspidella*, but that seems more 3D, and also usually has some concentric pattern (Gehling *et al*. 2000). So, there will be a fine puzzle to ponder on in the flickering firelight, while the dusk falls.

Serendipity is a good thing to think on, too. In these days of the absolute rule of the Scientific Hypothesis, it might seem absurdly quaint to rely on good old happenstance. Yet any scientific programme that I have been involved with that has been rigorously thought out, logically planned and scrupulously and systematically tested has also been, well, a bit dull and a touch clunky and with a tendency to give answers that leave the Hypothesis not quite as well tested as it should have been if the plan had gone according to, er, plan. On the other hand, if one mooches about looking at a lot of rock, then stories seem to jump out at you, and then all you have to do is follow your nose to sort them out. A tiny but perfectly-formed example can provide number 7.

Doing biostratigraphy for the British Geological Survey was, in my day, a splendid means of encouraging serendipity. One simply saw lots of fossils from many different places, and there were the peerless likes of Adrian Rushton, Dennis White and Steve Tunnicliff on hand to help ruminate on them. Lots of wonderful things did turn up. But perhaps the loveliest example came not from some newly-collected crag or quarry, but from history: a small job lot of fossils garnered in Scotland well over a century ago by that extraordinary Survey collector Arthur Macchonochie, to be re-identified.

Among them was a fine specimen of the iconic[6] species *Spirograptus turriculatus*. A thimble-sized tight spiral, it's about as common and distinctive a species as one can hope for, and this was a nice specimen – so nice that it had been figured by Gertie Elles and Ethel Wood in what is still, after a century, the one and only comprehensive monograph of British graptolites. Under a modern high-power microscope, though, this particular one showed something quite extraordinary.

[6] Assuming, of course, that any graptolite can shed its obscurity sufficiently to iconify – or perhaps iconificate – even ever so slightly

The thecae of *turriculatus* bear long spines, which, by analogy with the modern living relatives, the pterobranchs, the zooids would have crawled to the end of, so as to have a larger volume of water to filter-feed from. Spines are common in graptolites, two a penny – but these had been curiously adapted. The ends of some of them – about one in seven – were cemented to the adjacent part of the next whorl above, the join being effected by a mass of secondary cortical tissue. They now formed cross-struts, obviously a means to help stabilize the colony shape by lashing the whorls together, and the only sensible way to have formed this was by some opportunistic engineering on the part of the zooids, further establishing the case that they were animal architects and builders of the highest order. The zooid responsible must have clung to the end of the spine, like some microscopic Silurian cabin-boy sent up to the crow's nest, held it – somehow – against the side of the whorl above, and, in creatively constructional mode, stuck the two together by plastering cortical tissue over the join.

As a vignette of form and function, it was hard to beat, and the paper describing this modest palaeontological gem was ready for submission, if memory can be relied upon, three days later, to then be placed before the mercy of the editors of *Lethaia*. Christmas had come early to this little corner of the Survey.

And so it goes. A cluster of best-beloved fossils, almost all of them arriving by chance, in an utter absence of any semblance of systematic research programme – a character defect, most assuredly. All of them still work in progress – or work barely started, in the case of the Tremadoc discs – and so all suitable as companion objects-in-exile.

And the eighth? Well, there'll be plenty of time, on that island[7]. The luxury item will be a binocular microscope with camera lucida, lots of paper, inexhaustible 4H pencils and really good pencil sharpeners[8]. Washed up on the beach there will be coral and giant clam and pearl mussel, and moidores and pieces of eight too (from the local funding council). Time to get to work. Something will turn up. It always does. And the best is, naturally, yet to come.

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REFERENCES

GEHLING, J. G., NARBONNE, G. M. and ANDERSON, A. M. 2003. The first named Ediacaran body fossil, *Aspidella terranovica*. *Palaeontology*, **43**, 427–456.

JERAM, A. J., SELDEN, P. A. and EDWARDS, D. 1990. Land animals in the Silurian: arachnids and myriapods from Shropshire, England. *Science*, **250**, 658–666.

MURCHISON, R. I. 1854. *Siluria. The history of the oldest known rocks containing organic remains, with a brief sketch of the distribution of gold over the Earth.* London, John Murray. 523pp, 37pls.

PAGE, A. A., GABBOTT, S. E., WILBY, P. R. and ZALASIEWICZ, J. A. 2008. Ubiquitous Burgess-Shale-style "clay templates" in low-grade metamorphic mudrocks. *Geology*, **36**, 855–858.

SCHMITZ, B. 1992. An iridium anomaly in the Ludlow Bone Bed from the Upper Silurian, England. *Geological Magazine*, **129**, 359–362.

SMITH, R. D. A., AINSWORTH, R. B. and SCHMITZ, B. 1993. Discussion on an iridium anomaly in the Ludlow Bone Bed from the Upper Silurian, England. *Geological Magazine*, **130**, 855–856.

TORRENS, H. S. 1990. The scientific ancestry and historiography of the Silurian System. *Journal of the Geological Society*, **147**, 657–662.

[7] No e-mail, you see. That smuggled iPod will *definitely* not have wireless.

[8] It's amazing how difficult it is to find a really good pencil sharpener; a brake on the rate of palaeontological progress if ever there was one.

PalaeoMath 101
Principal and Partial Warps

While the topic of the last *PalaeoMath 101* column, the thin plate spline (TPS), is used by most morphometricians as a technique for obtaining models of shape deformations, the mathematical machinery that stands behind those abstract little grid diagrams provides much more than a simple graphical device. To understand what thin plate splines are from an analytical point-of-view we need to back off a bit and consider the mathematical problem they try to solve.

Figure 1 shows the results of a *Procrustes* (GLS) superposition of landmarks from the trilobite genera *Acaste* and *Calymene* along with the resulting TPS grid. In this case *Acaste* was selected as the reference shape.

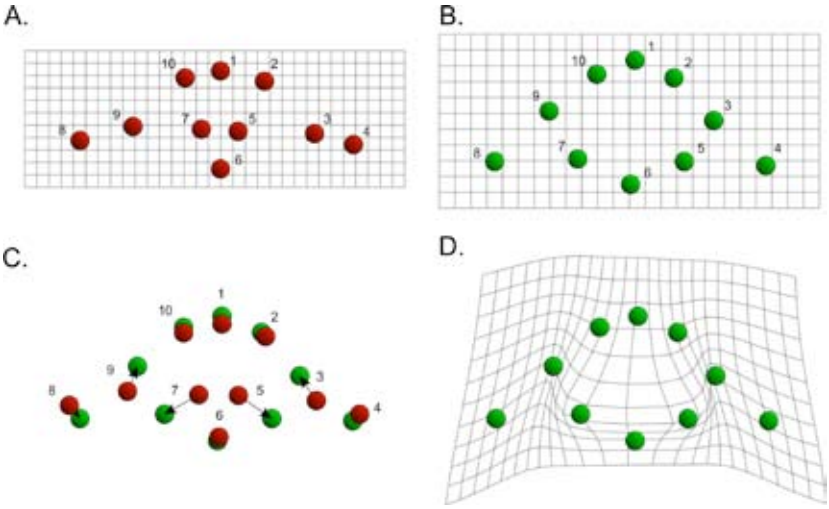

Figure 1. Graphic portrayal of the deformation implied by the transition between Acaste *(A) and* Calymene *(B) based on an analysis of topologically homologous landmarks (1–10).* Procrustes *(GLS) superposition of landmarks with shape displacement vectors (C). Thin plate spline representation of the* Acaste → Calymene *deformation (D).*

Note that the primary shape differences between these two forms reside in the locations of the eyes (landmarks 3 and 9), the position of the intersection of the glabella and posterior margin of the lateral projection (landmarks 5 and 7), and the position of the apex of the lateral projection (landmarks 4 and 8, see Fig. 1C). Accordingly, the TPS representation of this deformation shows strong displacement of the grid lines in the region of these landmarks and negligible grid deformations in the regions of the other landmarks. The important bit about the TPS representation, however, and the reason it's referred to as a spline, is that these strongly regionalized deformation patterns have been organized into a global model of non-linear displacements along the *x* and *y* axes that (1) mimics the character of a 3D surface in which the

third axis (*z*) contains the displacement vector information and (2) appears to record the character of deformations in regions of the shape that have not been sampled by landmarks.

The TPS actually represents a method of solving a very generalized problem in spatial statistics, namely the estimation of the value of a property (here length of the set of reference-target form displacement vectors) at an unsampled location based on the values of this property at neighbouring locations. In the field of spatial statistics this is a very common problem that is usually handled via a procedure called 'kriging' after its inventor, the South African mining engineer Daniel G. Krige.

Like the multivariate procedures I've discussed in previous columns, kriging is based on linear regression analysis. Unlike standard linear regression analysis, though, it does not assume the dependent variable is either completely random or distributed deterministically with respect to the spatial variables. Rather, it assumes the dependent variable is regionalized.

The idea of regionalized variables is a fundamental concept in spatial statistics.[1] These are, in a sense, variables that exhibit properties intermediate between those of a random variable whose pattern of variation obeys no rule and has no consistent structure, and a deterministic variable, whose pattern of variation is strictly rule-based and highly structured. Regionalized variables are continuous from point to point throughout the geometric space over which they are defined and can exhibit high correlations (= structure) over short distances. Nevertheless, the apparent consistency in the structure of their variation is inversely related to the distance between locations such that it's not usually possible to determine the rules by which variation is governed across the entire space. The solution to problems involving regionalized variables is to obtain a reasonable sample of variation at specific locations across the space of interest, use regression analysis-like strategies to estimate localized substructures in the dependent variable, and then to join these substructures into a single, continuous, global model.

As with all modelling procedures, the answer you obtain from a kriging analysis is, to a large extent, determined by a set of assumptions relating to the structure of covariances that exist between locations across the space of interest. In the case of the TPS, this set of assumptions is encoded by the bending energy matrix, which assumes that variations between regions of the shape are structured as though the deformation is mimicking the behaviour that would be expected from the physical deformation of an infinitely thin metal plate.

When metal plates are bent the physical energy that goes into deforming them is distributed over the entire plate in such a manner as to cause the energy required to hold the bend at any point on the plate to be minimized. In real metal plates, flaws in their structure usually cause the bending energy to be focused in the region of the flaw. If this energy exceeds the strength of the material in the region of the flaw, the plate kinks or tears. But in a hypothetical, perfect metal plate of infinite strength the distribution of energy will be smooth and solely dependent on the spatial scale of the bend. In other words, it will take relatively little energy to achieve a broad bend that involves the whole plate, a larger amount of energy to achieve a small, but localized bend in one region of the plate, and quite a lot of energy to achieve a large, localized bend in only one small part of the plate. For those readers who recall the metalworking section of their 'Shop' or 'Practical Skills' classes in secondary school, this should accord with personal experience.

[1] Actually, morphometrics is a branch of spatial data analysis and spatial statistics (see Davis 2002).

Although no one is so naïve as to pretend that organismal bodies are metal plates or that natural processes (*e.g.*, development, evolution) are constrained to minimize the magnitude of deformations in a manner inverse to their spatial scale, the metal plate metaphor has desirable properties in terms of the standard statistical models we use to describe and model variation and change in many different contexts. Chief among these is the global minimization of deviations: the least squares model. Add this to the straightforward assumption that spatial covariation across an area is structured in a manner that is uniform in all directions and conforms to a function that is the strict inverse of spatial scale, and you have the essence of the TPS solution to the standard kriging problem. Additional mathematically-convenient aspects of the TPS approach are that (1) all TPS interpolations form surfaces that are smooth at all scales, (2) the TPS model is completely determined, which is to say it needs no *ad hoc* manual tuning, and (3) all parameters needed to specify the TPS model can be estimated by solving a series of linear equations. As a general approach to fitting a continuous, global model of 3D point distributions to sparse data, the TPS is simple, elegant, visually striking, and consistent with the manner in which we're used to thinking about statistical descriptions of change in any number of parameters, including shape.

So, how can we get the TPS to produce an analytical—as opposed to a strictly graphical—model of shape change in a sample of landmarks and, once we've got that, what (if anything) can we do with it? In the last column I showed you how to calculate TPS models for individual deformations between reference and target forms. In order to explain how the TPS formalism has been used in an analytical context, there are a couple of things I need to remind you of.

The first of these is that, in all instances, the geometry of the TPS of any landmark configuration is determined entirely by the reference form. A reference form is needed to serve as the basis for the calculation of the landmark displacement vectors in the *Procrustes* space on which the spline is calculated. To take the simplest example, the TPS of a reference form compared with itself is a perfectly flat, undeformed, rectilinear grid. This obtains because the lengths of all the displacement vectors in such a comparison are 0.0. Because all the displacement vectors in such a comparison are 0.0, the overall bending energy of the deformation is also 0.0. For all other landmark configurations irrespective of whether those configurations are realized in the manner of actual specimens or not, a set of displacement vectors will be specified. The geometry of these vectors relative to the reference form will allow a non-perfectly-rectilinear, and in most cases non-flat, TPS grid to be calculated; in the case of the latter along with an associated bending energy.

As you've no doubt noticed I had to be careful with the wording of the sentence above. This is because of the hierarchy of geometric deformations that are possible in two- and three-dimensional forms. Recall these can be subdivided into two groups: uniform and non-uniform (Fig. 2, see also Fig. 5 of MacLeod, 2010). Note that the two uniform deformation modes not removed by *Procrustes* superposition can be described mathematically by applying exactly the same proportionate degree of deformation to each and every landmark location, such that the lengths of the implied landmark displacements are either exactly the same for all landmarks but oriented in different directions (compression–dilation) or are linearly proportional to the scale of the distance between non-displaced landmarks and oriented in the same direction (shear). Because of this regularity in the structure of the displacement vectors, the TPS grids resulting from uniform deformations remain strictly planar surfaces. Since these uniform deformation

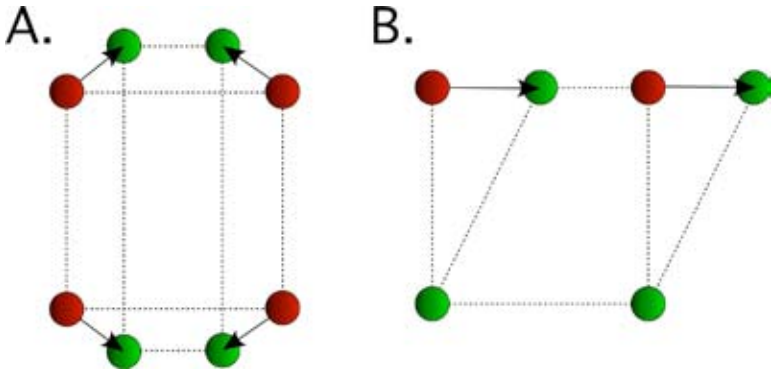

Figure 2. The two uniform shape deformation modes not corrected for by Procrustes *superposition: compression-dilation (A) and shear (B). Arrows represent deformation vectors between reference (red) and target (green) forms. These classes of deformation will produce TPS grid geometries in which only the reference grid aspect ratio has been altered. See text for further discussion.*

surfaces exhibit no global or localized displacements, their interpolated TPS surfaces are not 'bent' and so have no associated bending energy. However, outside these two special cases of geometric shape transformation, all others exhibit heterogeneous distributions of displacement vectors that give rise to variably bent or warped TPS grid geometries along with associated bending energies.

Perhaps the most unusual aspect of the TPS formulation is that it's not only the case that the spline is graphically dependent on the reference shape; all the standard bending energy calculations are referenced uniquely to the reference shape too. This makes sense because of the physical metaphor that lies at the heart of the TPS model—that bending energy is minimized across the space and that the spatial configuration of the reference form's landmarks controls the local *vs.* global deformation model. From an analytical point-of-view though, this places some subtle and easily overlooked constraints on the interpretation of TPS/bending energy analysis results.

The most critical of these constraints is an appreciation of the importance of selecting an appropriate reference shape. Recall in the column on shape theory (MacLeod 2009) I made the point that the reference shape controls the orientation of the tangent plane onto which the shapes that exist on the surface of the *Procrustes* shape hemisphere can be projected in order to obtain a linear, map-like ordination of shape variation based on their *Procrustes* distances. In principle, any shape that contains the same number of landmarks as the shapes in your sample could serve as the reference shape. But the single shape that best represents the distribution of shapes in any sample is the mean shape. This is the shape that minimizes the overall deviation of landmarks from one another. As a result, the mean shape is also the shape that has the greatest overall similarity with all other shapes across the sample.

In some instances, and for some types of analyses, it might seem logical to choose some shape other than the mean shape to serve as the reference. For example, in a taxonomic study it might seem reasonable to use the shape of the holotype as a reference. Similarly, in a study on ontogenetic shape change it might seem appropriate to select the earliest or the latest

developmental stage as the reference shape and compare all other shapes in the sample to that. Unfortunately, these will, in almost all cases, lead to a needlessly distorted ordination of shapes within the space of the plane tangent to the *Procrustes* shape hemisphere at the coordinate location of those potential reference shapes.

To illustrate the importance of this issue, let's take a simple example that involves use of the TPS to make a comparison of the structure of the bending energy matrix for alternative reference forms. You will recall that the TPS calculations are based on the bending energy matrix (L_p^{-1}) where L_p is as follows.

$$L_p = \begin{bmatrix} 0 & U_{1,2} & U_{1,3} & \cdots & U_{1,p} \\ U_{2,1} & 0 & U_{2,3} & \cdots & U_{2,p} \\ U_{3,1} & U_{3,2} & 0 & \cdots & U_{3,p} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ U_{p,1} & U_{p,2} & U_{p,3} & \cdots & 0 \end{bmatrix} \quad (20.1)$$

In this equation, which is identical to equation 19.3 of the previous newsletter column (MacLeod 2010), recall that U is a measure of the distances between landmarks in the reference shape (see Equation 19.1). The inverse of this matrix establishes the metaphor of pure, homogeneous bending energy in the sense that it is the simple inverse function of inter-landmark proximity.

The bending energy matrix can't be visualized in its entirety using a TPS grid because that technique requires a contrast in landmark configurations between reference and target forms in order to supply the landmark displacement vectors. However, since the bending energy matrix is a symmetric, square matrix, it is susceptible to linear decomposition via eigenanalysis in precisely the same manner as we've decomposed covariance, correlation, distance, and other sorts of similarity matrices throughout this essay series. There is an important difference between the eigenanalysis of the bending energy matrix and the eigenanalysis of those other matrices though, and it's this difference that really gets to the heart of the reference shape issue.

In all previous applications of eigenanalysis we've discussed, we were decomposing a matrix that represented *r*-mode and/or Q-mode similarity/dissimilarity matrices between all pairs of objects in a sample. Eigenanalysis of such matrices results in the production of a set of orthogonal vectors that are aligned with directions of maximum variation or distance or similarity across the sample. If we've chosen our sample correctly, those directions also estimate the directions of maximum variation or distance or similarity in the parent population from which our sample was drawn.

The difference in the case of the bending energy matrix is that it's a matrix composed of distances between landmark positions drawn *from a single object or specimen*. Eigenanalysis of this matrix, when combined with the coordinate locations of the reference shape landmarks themselves, produces a set of orthogonal fields or modes of variation aligned with the directions of minimum landmark dispersion (= maximum bending energy) in the set of landmarks that describe this single object or specimen. Since the dispersion of landmarks is related directly

to spatial scale, this means that, in addition to being aligned with the directions of minimum landmark dispersion, these modes of form or shape variation will also be ordered in terms of spatial scale. Eigenvectors of the bending energy matrix that account for the highest bending energies will represent modes of deformation characterized by large deviations over small spatial scales. Those accounting for the lowest bending energies will represent modes of deformation characterized by small deviations over large spatial scales.

Bookstein (1989, 1991; see also Rohlf 1993) have termed the eigenvectors of the bending energy matrix ($\boldsymbol{L}_p^{-1}$) 'principal warps', drawing on the clear and compelling analogy with principal components analysis. These authors also referred to the eigenvalues associated with those vectors as 'principal values'. In contrast, Slice *et al*. (1996) termed these same eigenvectors 'partial warps', in the sense that they describe parts of the deformation pattern inherent in the bending energy matrix. This dual terminology has led to much confusion, especially insofar as Bookstein (1989, 1991) had already used the term 'partial warps' for the result of a decidedly different procedure (see below). Despite claims that the Slice *et al*. (1996) terminology has become 'standard' (*e.g.*, Zelditch *et al*. 2004)[2], for the purposes of this discussion I will employ the original terminology.

Because aspects of shape variation are removed from each landmark set during its conversion to shape coordinates, there are only k-3 positive principal values, where k is the total number of landmarks used to sample the form. For the ten landmarks used to quantify cranidial variation in our trilobite genera then, eigenanalysis yielded seven vectors with positive eigenvalues or seven principal warps. Four of these are shown for each of three reference configurations in Figure 3. Since any landmark configuration can be used as the basis for a principal warp calculation, Figure 3 includes principal warps calculated for two real specimens (*Acaste*, *Calymene*) and one hypothetical configuration; the mean of consensus shape for the 18 trilobite specimens on which these ten landmarks can be located.

The principal values (λ) for each principal warp are shown below the TPS grids in Figure 3, expressed as a percent contribution to the overall bending energy for each alternative reference shape. Although the principal warps have no intrinsic deformation—after all, they are calculated for a single specimen—an external scaling factor is usually applied to supply the deformation magnitudes required by the TPS calculations. Setting this scaling factor to a constant allows the spatial heterogeneities implicit in the set of reference shape-specific principal warps to be displayed graphically. The arbitrary scaling factor selected for the calculation of all TPS grids in Figure 3 was 0.206.

As you can see from these grids, the principal warp decomposition for each alternative reference shape yields a set of increasingly more localized deformational geometries. In each case principal warp 1 specifies a broad deformation that encompasses the entire landmark set. These high-level deformation patterns contrast strongly with the deformations expressed by principal warp 7, each of which predominantly involves relative adjustments in the positions of a pair of adjacent landmarks near the mid-line and at either the anterior (*Acaste*, *Calymene*) or posterior (mean shape) ends of the cranidia. The deformation patterns expressed by principal warps 3 and 5 are, in all cases, intermediate between these extremes.

[2] Jim Rohlf's morphometrics program packages for computing principal and partial warps (tpsSplin and tpsRelw) — which are the industry standards in this field — use the original terms for these procedures.

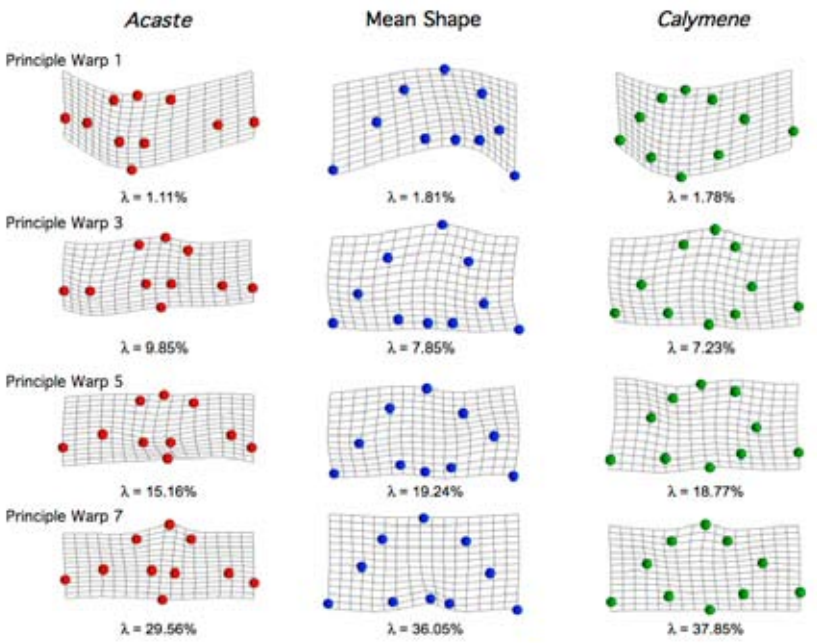

Figure 3. Selected TPS deformation grids for principal warps calculated from the Acaste *(left),* Calymene *(right) and trilobite sample mean or consensus shape (centre). Note the wide range of variation inherent in the geometry of these TPS decompositions. See text for additional discussion.*

By the same token, though, it should be noted that, while the deformation sequences for *Acaste*, *Calymene*, and the mean shape are all consistent and make reasonable sense by themselves, there seems little geometric similarity between these deformation sequences. Principal warps 1 and 7 for *Acaste* and *Calymene* are somewhat similar geometrically, but both of these differ markedly from the mean shape's principal warps 1 and 7. In contrast, principal warps 3 and 5 of *Acaste* and *Calymene* exhibit marked differences whereas they are broadly similar for *Calymene* and the mean shape.

The point is that each potential reference shape—including the mean shape and especially for mean shapes calculated from samples containing high shape variation and low sample size—is going to incorporate atypical or idiosyncratic landmark placements to a greater or lesser extent. Because of the nature of the principal warps, these idiosyncratic differences will lead to broad and chaotic incompatibilities between the principal warp shape spaces calculated on the basis of individual specimens. Selection of the mean shape as the reference configuration will minimize this tendency to some extent, depending on how well constrained and representative the mean is with respect to the shapes included in the overall sample. But even use of the mean shape as a basis for these calculations will not stabilize the principal warps space entirely. We will return to a discussion of the implications of the inherent instability and idiosyncratic nature of the principal warps sequence below.

Once specified, the principal warps of the reference configuration can be used as the mathematical basis for the creation of a linearized space within which any shape described by sets of corresponding landmarks may be projected. To make connection with the previous essay on shape theory (MacLeod 2009), the bending energy matrix represents the plane tangent to the *Procrustes* shape hemisphere at the point of the reference shape. The principal warps represent a set of orthogonal variables that re-describe the bending energy matrix as a series of spatially ordered modes of shape variation. Bookstein (1989, 1991), Rohlf (1993), and many others have referred to the projection of forms defined by comparable sets of landmarks and transformed into the principal warps space as 'partial warps'. The representation of these projections can take two forms.

The first, and possibly most analytically useful of these, is to represent the projection in the form of a scatterplot of scores of projected shapes along the space defined by the *x* and *y* principal warp vectors[3] (Fig. 4). These scatterplots represent ordinations of between-specimen shape

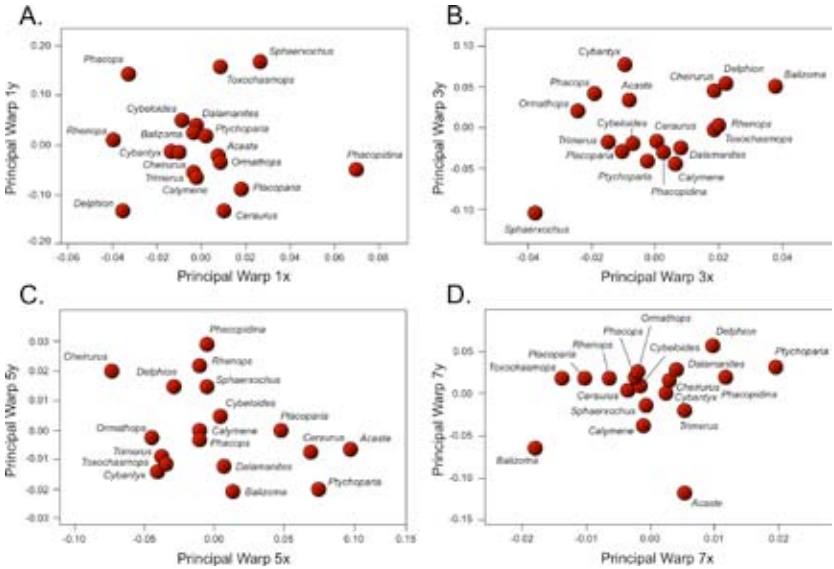

Figure 4. Scatterplots of trilobite partial warp scores on principal warps 1 (A), 3 (B), 5 (C) , and 7 (D) calculate using the trilobite sample mean shape as the reference shape.

similarity and/or difference with respect to those aspects of shape deformation being represented by the principal warp. The advantage of this sort of analysis is that, because the principal warp is referenced to a single specimen, the nature of the space so defined will not change with the acquisition of new specimens, removal of non-reference specimens due to taxonomic revision, *etc*. Recall this is not the case with the vast majority of standard multivariate data analysis methods (*e.g.*, PCA, FA, PCoord, CVA, MDS) because they require a representation of similarity across a sample of objects. This, in turn, requires that the sample remain intact for the results of these analyses to remain meaningful. Change the sample in any way (*e.g.*, drop some specimens out of the sample because of taxonomic revision, add some specimens to the sample because

[3] Or x, y, and z axes in the case of 3D landmark data.

of new discovery) and you must re-compute all the results of these analyses for the patterns expressed to remain optimal and valid. This sample dependence is avoided in a principal warps analysis. So long as the reference shape remains valid, it defines the principal warps space. Any shape described by a comparable set of landmarks may be projected into and/or removed from this principal warps space without altering the nature of that space in any way.

The principal disadvantage of a principal warps analysis is exactly the same. Because the ordination space created is referenced to a single specimen, the influence of that specimen is absolute. Since the spaces so created are not optimized over a sample of specimens, they represent nothing more (or less) than the shape characteristics of that single specimen, albeit one than might be a hypothetical best single representation of a sample or population such as the mean shape. But even in this case, all that is being used in the analysis is the raw spatial configuration of hypothetical landmark points without any associated indication of presence, much less the extent or character, of within-sample shape variation.

The other manner in which partial warps have been used is to gain a visual sense of the deformational geometries being expressed by the distribution of partial warps scores in the principal warps ordination space via TPS modelling. Figure 5 provides examples of such models for selected specimens whose ordination locations are shown in Figure 4. These models are heuristic devices that can be very useful in making qualitative interpretations of the shape ordination results and/or explaining the implications of those results to non-quantitative colleagues in a manner they can appreciate and understand.

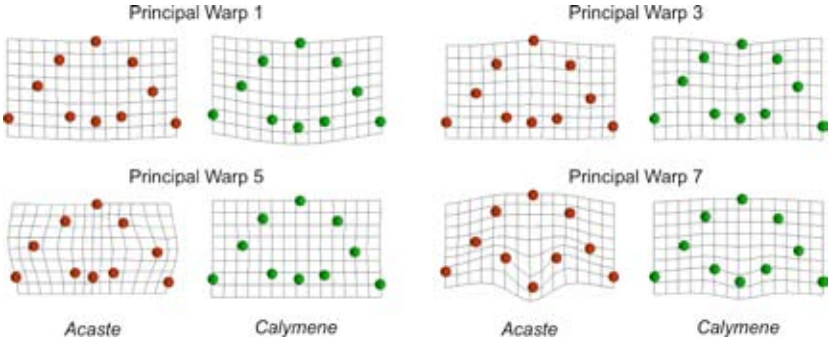

Figure 5. Partial warp TPS grids for the Acaste *and* Calymene *landmark configurations on the principal warps shown in Fig. 4. This grid represents the TPS interpolations from the reference shape in four of the eigenvector decompositions of the mean shape's bending energy matrix.*

Whereas the calculation of principal warps is quite easy computationally, and the manner in which they manage to support the creation of shape variables in which the deformational modes are ordered in terms of their spatial generality is quite elegant mathematically, their utility as analytical tools is, unfortunately, compromised by their inherent instability and absolute dependence on the configuration of a single set of landmarks. In the early days of geometric morphometrics it was more-or-less informally thought that the high-energy principal warps might be sufficiently localized spatially to represent taxonomic characters, developmental modules, and/or any of a number of other biological concepts based on the subdivision of a complex morphology into component parts, an assessment of whose shape would be useful.

An example of this was an attempt by Zelditch *et al*. (1995) to use principal warps analysis to define character states that could then be coded for use in a phylogenetic analysis. In a comment on this suggestion Rohlf (1998) noted that the inherent instability of principal warps spaces made ordinations of partial warp scores in those spaces ill-suited for use in the context of the shape-based characterization of sets of morphometric data. Moreover, the *ad hoc* mathematical decomposition of bending energy matrices defined on the basis of the arbitrary selection of a single specimen conforms to no recognizable theory of biological homology; the theory stands at the heart of the character concept. Rohlf went on to suggest that an analysis of geometric shape variation that was referenced to a sample of shapes under consideration would be a more appropriate approach to this general problem. Later, I followed Rohlf's suggestion, albeit in a slightly different shape-analytical context, in an explicit test of the ability of morphometric data to provide insight into phylogenetic character state definition (MacLeod 2002). Still later, Zelditch and colleagues acknowledged the limitations of their previous use of principal warps analysis in this context (Zelditch *et al*. 2004).

Presently principal warps analysis represents something of a blind alley in morphometrics. From time-to-time you run across this strategy being used to ordinate shapes and test shape-related hypotheses (Naylor 1996, Rohlf *et al*. 1996). But these are usually example analyses whose real purpose is to illustrate the principal-partial warps technique rather than to use it as a tool to test biological hypotheses. Principal and partial warps concepts and calculations are also covered in most textbooks on morphometrics, both older and new (Bookstein 1991, Reyment 1991, Dryden and Mardia 1998, Costa and Cesar 2000, Zelditch *et al*. 2004) despite their lack of a track record of clear and unambiguous utility and in the face of reasonably trenchant criticisms that have been levelled at the (comparatively few) investigations in which they have been employed. I suspect one of the main reasons interest in principal/partial warps survives is because their calculation is included in a number of standard morphometrics software packages. Prominent among these is Jim Rohlf's tpsRelw package in which the ordering of the calculation steps implies to many that determination of principal warps is a necessary precursor to the calculation of relative warps, which have always been considered far more useful than principal-partial warps. I'll use the next essay to explore this issue in the context of a description of the relative warps technique. In any event, the foregoing discussion is presented to inform the reader as to what principal and partial warps are, how they relate to TPS, to set the stage for our discussion of how they relate to relative warps, and to emphasize that, if this approach to shape analysis is used at all, it should be with caution.

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REFERENCES

BOOKSTEIN, F. L. 1989. Principal warps: thin-plate splines and the decomposition of deformations. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, **11**, 567–585.

BOOKSTEIN, F. L. 1991. *Morphometric tools for landmark data: geometry and biology*. Cambridge University Press, Cambridge, 435 pp.

COSTA, L. da F. and CESAR, R. M., Jr. 2000. *Shape analysis and classification: Theory and Practice*. CRC Press, New York. 680 pp.

DAVIS, J. C. 2002. *Statistics and data analysis in geology (third edition)*. John Wiley and Sons, New York. 638 pp.

DRYDEN, I. L. and MARDIA, K. V. 1998. *Statistical shape analysis*. J. W. Wiley, New York. 376 pp.

MacLEOD, N. 2002. Phylogenetic signals in morphometric data. *In* N. MacLEOD, and P. L. FOREY, eds. *Morphology, shape and phylogeny*. Taylor & Francis, London. 100–138 pp.

MacLEOD, N. 2009. Shape theory. *Palaeontological Association Newsletter*, **71**, 34–47.

MacLEOD, N. 2010. Shape models II: the thin plate spline. *Palaeontological Association Newsletter*, **73**, 24–39.

NAYLOR, G. J. P. 1996. Can partial warps scores be used as cladistic characters? In L. F. MARCUS, E. BELLO, and A. GARCÍA-VALDECASAS, *eds. Contributions to Morphometrics*. Museo Nacional de Ciencias Naturales 8, Madrid. 519–530.

ROHLF, F. J. 1993. *Relative warp analysis and an example of its application to mosquito wings*. In L. F. MARCUS, E. BELLO, and A. GARCÍA-VALDECASAS, *eds. Contributions to Morphometrics*. Museo Nacional de Ciencias Naturales 8, Madrid. 131–160 pp.

ROHLF, F. J. 1998. On applications of geometric morphometrics to studies of ontogeny and phylogeny. *Systematic Biology*, **47**, 147–158.

ROHLF, F. J., LOY, A. and CORTI, M. 1996. Morphometric analysis of old world Talpidae (Mammalia, Insectivora) using partial warp scores. *Systematic Biology*, **45**, 344–362.

SLICE, D. E., BOOKSTEIN, F. L., MARCUS, L. F. and ROHLF, F. J. 1996. *Appendix I: a glossary for geometric morphometrics*. In L. F. MARCUS, M. CORTI, A. LOY, G. J. P. NAYLOR and D. E. SLICE, eds. *Advances in morphometrics*. Plenum Press, New York and London. 531–551 pp.

ZELDITCH, M. L., FINK, W. L. and SWIDERSKI, D. L. 1995. Morphometrics, homology, and phylogenetics: quantified characters as synapomorphies. *Systematic Biology*, **44**, 179–189.

ZELDITCH, M. L., SWIDERSKI, D. L., SHEETS, H. D. and FINK, W. L. 2004. *Geometric morphometrics for biologists: a primer*. Elsevier/Academic Press, Amsterdam, 443 pp.

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Meeting REPORTS

The Wellnhofer Pterosaur Meeting
Munich, Germany *10 – 14 September 2007*

On 10–14 September 2007 the Bayerische Staatssammlung für Paläontologie und Geologie (Bavarian State Palaeontological Collection – BSPG) hosted the Wellnhofer Flugsaurier conference, an international conference dedicated to research on pterosaurs, held in celebration of the work of Dr Peter Wellnhofer. Organized by **David Hone** (Beijing), the meeting was attended by more than 55 pterosaur workers from around the world, included 26 talks and over 20 posters, and also included a day of open discussions, a field trip, *and* a day devoted to the examination of pterosaur specimens that had been specially brought in from various collections.

Talks were broken down into the following sections: systematics and taxonomy, diversity and ecology, anatomy and physiology, skulls, wings, flight and locomotion, and 'other areas of research'. Discussion sessions covered functional morphology, and taxonomy and systematics. The meeting opened with a talk by **Eric Buffetaut** on Peter Wellnhofer's career: Wellnhofer's contribution to pterosaur research has been huge, but he has also published on ichthyosaurs, crocodilians and dinosaurs, has contributed much to the literature on *Archaeopteryx*, and began his palaeontological career working on bivalves.

Beginning with the systematics and taxonomy section, **Brian Andres** provided an overview of how competing schemes on pterosaur phylogeny compare. **David Peters** provided an overview of his unique view of pterosaur diversity and phylogeny. Peters employs a 'photo-interpretation' technique to discover various details of anatomy, both in pterosaurs and in diverse other reptiles, and there is, to put it mildly, a feeling of scepticism that what he reports accurately reflects morphology. **Taissa Rodrigues** discussed the systematics of *Coloborhynchus* and *Anhanguera*: both are similar keel-crested ornithocheiroid pterosaurs and, while some authors (*e.g.* Fastnacht 2001) have opined that at least some (perhaps all) *Anhanguera* species should be sunk into *Coloborhynchus*, Rodrigues argued that the type species of the two genera are different enough for the two genera to be kept apart. Systematic arguments were also the topic of **Alex Kellner**'s talk: concentrating on splitting *vs* lumping in Cretaceous pterodactyloids, he cautioned against the idea that taxa based on fragmentary remains (such as those from the English Cambridge Greensand) should be used as 'gold standards' for the far superior material that comes from, for example, the Brazilian Santana and Crato formations.

In the diversity and ecology section of the meeting, **Junchang Lü** reviewed all of the Chinese pterosaurs: that's about 28 genera and 32 species. Several taxa have now been suggested to be allied to, or part of, Istiodactylidae, including *Haopterus* and *Longchengopterus*, while tapejarids, represented by several species of *Sinopterus* and *Huaxiapterus*, are proving increasingly abundant. **Darren Naish** gave a brief review of Lower Cretaceous pterosaur diversity in Europe. Istiodactylids are now known to have had a more extensive range in the Barremian than thought previously, and *Coloborhynchus* has a ridiculously long stratigraphic range *if* all species referred to this genus really belong there.

Despite being afflicted with a terrible illness that reduced his voice to a harsh croaky whisper, **Dave Hone** spoke about mutual sexual selection in pterosaurs – an area that Dave, I and Ines Cuthill are currently working on. Because both sexes in some pterosaur species are ornamented, it has sometimes been doubted that the crests might have had a role in sexual display. But it is well established that, particularly in birds, *both* sexes can be ornamented (for a recent review see Amundsen 2000). Dave and I also had a poster at the meeting titled 'Perceptions of pterosaurs through time – a brief history'. This was essentially an excuse to put up pictures of Tarzan fighting a giant rhamphorhynchid, Raquel Welch being carried off by a bat-winged pteranodontid, a Gary Larson cartoon, and much else besides.

Moving to the anatomy and physiology section of the meeting, **Dave Unwin** (and an absent D. Charles Deeming) reviewed what we know of pterosaur eggs and embryos. Variability in pterosaur eggshell structure isn't problematical given the morphological variability seen in the eggshells of some living clades, and pterosaur eggshell porosity indicates that the eggs were buried. Pterosaur babies seem to have been hyperprecocial, and to have developed in thermal environments that were close to ambient.

Two talks – by **Leon Claessens** and **Pat O'Connor** – looked at physiology and pneumaticity. Claessens showed that, while pterosaurs exhibited a reduction of those skeletal components that permit costal ventilation of the lungs, the sternum and its associated structures must have been capable of a significant amount of dorsoventral excursion, and the prepubes probably helped with this too. The bottom line is that pterosaurs evolved an efficient avian-style flow-through pulmonary system long prior to the appearance of birds. The evidence for avian-style skeletal pneumatisation in pterosaurs is very robust and based on excellent evidence; for a review see Bonde & Christiansen (2001, 2003). Basal pterosaurs appear not to have been pneumatic, but rhamphorhynchids and pterodactyloids clearly were.

Pat O'Connor showed that skeletal pneumaticity in pterosaurs strongly parallels that present in birds, and that large taxa in both clades exhibit similar styles of skeletal pneumaticity not seen in their small relatives. Pterosaurs were probably able to pneumatise distal skeletal elements (such as wing finger phalanges) via the opportunistic invasion of diverticula from a subcutaneous air-sac that may have extended across part of the forelimb skeleton. As **Dave Martill** pointed out after this talk, there may be direct evidence for the presence of this air-sac from some preserved pieces of pterosaur wing membrane: in addition to layers containing aktinofibrils and blood vessels, pterosaur wing membranes have been reported to contain a 'spongy' layer that has been inferred to have been mostly air-filled (Frey *et al*. 2003). Might this 'air-filled' layer correspond to a subcutaneous air-sac?

One area of palaeobiological speculation that surprised me slightly was the inference from a few pterosaur workers that *Tapejara* was herbivorous. This idea was initially proposed by Wellnhofer & Kellner (1991) in their description of *T. wellnhoferi*, and later discussed by biologists interested in the role that Mesozoic vertebrates must have played in ancient endozoochory (Fleming & Lipps 1991). In an effort to determine the diet of *Tapejara*, **Hanneke Meijer** and colleagues used morphometric analyses to compare the inferred bite strength and other details of *Tapejara* with those of extant birds. Their work indicated that these pterosaurs lacked the sort of skull anatomy we would expect if they were cracking seeds, but the data appear consistent with herbivory involving soft plants, or with a diet of insects.

Pterosaur skull evolution was also looked at by **Michael Fastnacht** and **Jesús Marugan-Lobón**. Fastnacht's talk employed the principles of construction morphology, and among other things he argued that certain phylogenetic pathways were not available once a certain construction had evolved. The immense, sometimes bizarre sail-like cranial crests of some pterosaurs have led to suggestions from the start that these organs might – or even must – have had an aerodynamic effect. Ross Elgin and colleagues have actually tested this, using scale models and wind tunnels. A paper on this is due to appear soon, and the bottom line is that crests have no significant aerodynamic effect, either positive or negative. **Dave Unwin** provided a review of what we know about pterosaur wing membranes based on the fossil evidence. Fossils show that pterosaur patagia, preserved across a wide and representative diversity of taxa, were mostly extensive, incorporating the hindlimb down to the shin or ankle.

The extent of the patagia has been the subject of much controversy within pterosaur science, and equally controversial has been the exact location and orientation of the pteroid. The pteroid is a unique rod-like bone that projected from the pterosaur wrist and helped support the propatagium, a part of the wing that extended from the shoulder to the wrist and probably helped control air-flow over the rest of the wing. While it has generally been assumed (based on articulated, but often flattened, specimens from Solnhofen and elsewhere) that the pteroid projected medially toward the shoulder, a novel orientation was proposed by Frey & Riess (1981). They argued that the pteroid projected forwards, parallel to the animal's sagittal axis, creating a broader, much bigger propatagium than that traditionally imagined. While this hypothetical configuration was initially criticized quite heavily (*e.g.* Padian 1984), it has more recently received support both from articulated Chinese specimens (*e.g.* of the anurognathid *Jeholopterus*), and from new studies of pterosaur aerodynamics (Wilkinson 2007; Wilkinson *et al*. 2006).

In order for this configuration to work, however, the pteroid has to articulate with the lateral carpal bone (aka preaxial carpal or medial carpal) in a manner that allows it to point forwards. Those who favour this orientation have therefore shown the pteroid articulating with the 'tip' of the lateral carpal, and fitting into a socket in this area (*e.g.* Unwin *et al*. 1996, Wilkinson *et al*. 2006). In a discussion section held toward the end of the meeting, **Chris Bennett** presented data showing that the pteroid did not or could not articulate with the lateral carpal in this manner: the socket favoured as the area for the pteroid's proximal end was occupied instead by a sesamoid, and the pteroid instead articulated on the medial side of the carpal on a small eminence. Chris will give two boxes of Canadian beer to anyone who can demonstrate that the pteroid really did articulate with the carpal in the manner favoured by Wilkinson and colleagues. Incidentally, Chris only offers one box of beer for the discovery of nessie or sasquatch, so you know he's serious. One recently described, articulated pterosaur wrist – that of the nyctosaurid *Muzquizopteryx* (ironically, described by Dino Frey and colleagues) – provides strong support for Chris's contention that the pteroid points medially, not forwards (a paper resulting from this research has since been published: Bennett 2007a).

Chris also gave a talk, mostly on how the pterosaur hand might have become reoriented during evolution. Because the three clawed fingers of pterosaurs flex anteriorly while the wing finger (digit IV) flexes posteriorly, it has often been thought that metacarpal IV must have rotated about its long axis in order to reorient the plane of flexion of digit IV. If that were true, however, we should expect the extensors and flexors of digit IV to loop around metacarpal IV, and instead these muscles seem to have run parallel to the metacarpal in standard fashion. Digit IV was probably not 'twisted' after all: instead, it was the orientation of digits I-III that changed as the limb became adapted for flight.

Mike Habib spoke about *Bennettazhia*: CT-scanning of the holotype (a complete humerus) revealed internal trabecular bracing consistent with the idea that azhdarchoids launched quadrupedally into flight. Pterosaur wing mechanics and flight were also looked at by **Laurence Browning** and colleagues: a finite element structural analysis of the wing bones of *Anhanguera piscator* gave some idea of how the wing would have deflected under load, and a scale model was constructed to test the same ideas. A unique view of pterosaur wing morphology and evolution was presented by **Dietrich Schaller**: Schaller contends that pterosaurs had a remarkably narrow brachiopatagium, divided into several distinct segments, and his views on how the wings must have evolved led him to propose a new classification with new taxonomic names (including such gems as Brachiokaiskelopterida and Rhamphorhynchomorpha). His views on wing anatomy are based on the apparent compartmentalisation of the Zittel wing – one of the best preserved wing membrane specimens – as deduced from a blown-up photo (Schaller 1985, 2007).

Mark Witton discussed pterosaur mass estimates: the entrenched dogma in pterosaurology is – to quote Greg Paul – that pterosaurs were ultralight airbeings (Paul 1991, p. 88). By employing various methods, Mark found that pterosaurs were not sky-beasts composed of 90% air as most people seem to have been saying; instead they were animals about comparable in mass to what you might guess from similar-sized birds and other tetrapods. A giant pterosaur like *Quetzalcoatlus* couldn't really have weighed 50 or 60 kg or so, but was actually more like 250 kg (that's still very, very light for its size of course).

One of the most jaw-dropping of presentations at the meeting was **Rico Stecher**'s on a new and totally unique Triassic pterosaur from Switzerland. While clearly a true pterosaur, this animal looks like no other pterosaur yet described, particularly in its superficially theropod-like skull. It is heterodont, with campylognathoidid-like multicusped posterior teeth, interlocking anterior teeth (a diastema separates these two regions of the dentition), a rostral dentary crest, and a nasal horn. Its fully in-turned femoral head indicates parasagittal hindlimbs. Its humerus is notably long and slender. As Dave Hone pointed out, the fact that multicusped teeth of this sort occur in this taxon might mean that we will have to re-evaluate all the other multicusped pterosaur teeth that have been referred to *Eudimorphodon*. Since the meeting, this animal has been published as *Raeticodactylus filisurensis* (Stecher 2008).

One outstanding event which made this meeting truly exceptional was that special efforts were made to bring along multiple significant pterosaur fossils from different collections. These included the *Pterodactylus* holotype and famous Vienna specimen, the Crato Formation taxa *Ludodactylus* and '*Tapejara*' *navigans*, the *Rhamphorhynchus* 'dark wing' specimen, and various other holotypes and new, as-yet-unpublished specimens. I was particularly taken with the new, tiny anurognathid specimen (since published by Chris Bennett: Bennett 2007b), and by the fantastic 'Painten pelican', a new pterodactyloid taxon from the Solnhofen limestone, not to mention the Munich *Archaeopteryx* and *Compsognathus*. The market value of all the specimens combined – if there is such a thing – was estimated at €8,000,000.

We also got out of the BSPG and visited the Bürgermeister-Müller-Museum and Jura Museum, both the repositories of more outstanding specimens.

The conference ended with **Peter Wellnhofer** giving a talk on the history of pterosaur research: earlier in the meeting he had been given a new painting by **Luis Rey**, produced specially for the meeting. It depicts both *Archaeopteryx* and a fleet of pterosaurs.

Peter Wellnhofer accepts a new painting [photo and painting by Luis Rey]

All in all, the meeting was an awesome success, and Dave Hone and colleagues put together a splendid, highly successful event. A special volume of *Zitteliana* devoted to papers given at the meeting is currently in preparation and is due out later this year, and it is planned that regular 'Flugsaurier'meetings devoted to pterosaur science will take place in the future: the next is scheduled for 2010 and will be held in the Chinese Academy of Geological Science in Beijing. If it is anywhere near as good as the Munich meeting, it will most certainly be worth attending.

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REFERENCES

AMUNDSEN, T. 2000. Why are female birds ornamented? *Trends in Ecology & Evolution*, **15**, 149–155.

BENNETT, S. C. 2007a. Articulation and function of the pteroid bone of pterosaurs. *Journal of Vertebrate Paleontology*, **27**, 881–891.

BENNETT, S. C. 2007b. A second specimen of the pterosaur *Anurognathus ammoni*. *Paläontologische Zeitschrift*, **81**, 376–398.

BONDE, N. and CHRISTIANSEN, P. 2001. Aspects of the detailed anatomy of *Rhamphorhynchus*. *In*: *Two Hundred Years of Pterosaurs, A Symposium on the Anatomy, Evolution, Palaeobiology and Environments of Mesozoic Flying Reptiles. Strata Série* **1 11**, 29–31.

BONDE, N. and CHRISTIANSEN, P. 2003. The detailed anatomy of *Rhamphorhynchus*: axial pneumaticity and its implications. *In*: BUFFETAUT, E. and MAZIN, J.-M., eds. *Evolution and Palaeobiology of Pterosaurs*. Geological Society Special Publication 217. The Geological Society of London, pp. 217–232.

FASTNACHT, M. 2001. First record of *Coloborhynchus* (Pterosauria) from the Santana Formation (Lower Cretaceous) of the Chapada do Araripe, Brazil. *Paläontologische Zeitschrift*, **75**, 23–36.

FLEMING, T. H. and LIPPS, K. R. 1991. Angiosperm endozoochory: were pterosaurs Cretaceous seed dispersers? *The American Naturalist*, **138**, 1058–1065.

FREY, E. and RIESS, J. 1981. A new reconstruction of the pterosaur wing. *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen*, **161**, 1–27.

FREY, E., TISCHLINGER, H., BUCHY, M.-C. and MARTILL, D. M. 2003. New specimens of Pterosauria (Reptilia) with soft parts with implications for pterosaurian anatomy and locomotion. *In*: BUFFETAUT, E. and MAZIN, J.-M., eds. *Evolution and Palaeobiology of Pterosaurs. Geological Society Special Publication* 217. The Geological Society of London, pp. 233–266.

PADIAN, K. 1984. A large pterodactyloid pterosaur from the Two Medicine Formation (Campanian) of Montana. *Journal of Vertebrate Paleontology*, **4**, 516–524.

PAUL. G. S. 1991. The many myths, some old, some new, of dinosaurology. *Modern Geology*, **16**, 69–99.

SCHALLER, D. 1985. Wing evolution. *In*: HECHT, M. K., OSTROM, J. H., VIOHL, G. and WELLNHOFER, P. (eds) *The Beginnings of Birds – Proceedings of the International Archaeopteryx Conference*, Eichstätt 1984, pp. 333–348.

SCHALLER, D. 2007. *The superordinate pterosaur evolution as deduced from the evolution of their wings*. Verlag Dr. Friedrich Pfeil, München.

STECHER, R. 2008. A new Triassic pterosaur from Switzerland (Central Austroalpine, Grisons), *Raeticodactylus filisurensis* gen. et sp. nov. *Swiss Journal of Geology,* **101**, *185–201*.

UNWIN, D. M., FREY, E., MARTILL, D. M., CLARKE, J. B. and RIESS, J. 1996. On the nature of the pteroid in pterosaurs. *Proceedings of the Royal Society of London* B, **263**, 45–52.

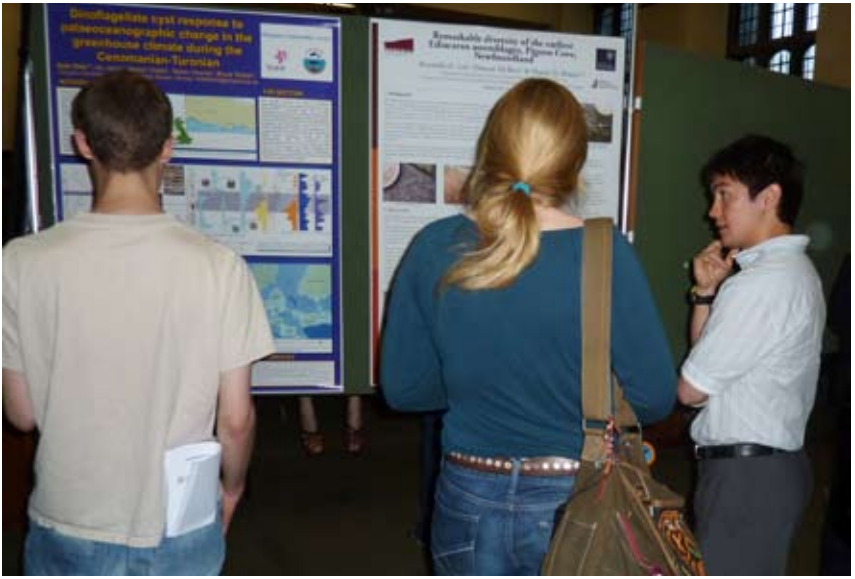
WELLNHOFER, P. and KELLNER, A. W. A. 1991. The skull of *Tapejara wellnhoferi* Kellner (Reptilia, Pterosauria) from the Lower Cretaceous Santana Formation of the Araripe Basin, northeastern Brazil. *Mitteilungen der Bayerischen Staatssammlung für Paläontologie und Historische Geologie*, **31**, 89–106.

WILKINSON, M. T. 2007. Sailing the skies: the improbable aeronautical success of the pterosaurs. *Journal of Experimental Biology*, **210**, 1663–1671.

WILKINSON, M. T., UNWIN, D. M. and ELLINGTON, C. P. 2006. High lift function of the pteroid bone and forewing of pterosaurs. *Biological Society Proceedings*, **273**, 119–26.

Progressive Palaeontology 2010
University of Bristol, Bristol, UK *26 – 28 May 2010*

The much-anticipated return of *Progressive Palaeontology* to Bristol kicked off on a bright Spring evening at the Eldon House, Clifton, with an icebreaker reception, sponsored by the Taylor Francis group. Most of the delegates were safely inside enjoying wine and mini poppadoms by the time the heavens opened for a proper Bristolian welcome, although there were a few soggy latecomers. However, not even a *gurt big* West Country downpour could dampen the atmosphere as old friends and colleagues were introduced to new ones amid an air of excitement over the 24 talks and ten posters that would follow the next day. Once the free plonk and mango chutney had been exhausted at the Eldon, many of the delegates continued their lively scientific discussions (lubricated with beverages, of course) further down the road at the Woods, some of which continued into the wee hours (or so I'm told…).



Discussing posters over coffee

The following morning (most of) the 55 delegates arrived at the Wills Memorial Building bright-eyed and bushy-tailed ready for a full programme of enthralling talks. Dr **Emily Rayfield** made the welcoming remarks and passed the baton to **Duncan Murdock** to chair the first session, which opened with **Emily Mitchell** (Cambridge) describing her models of feeding strategies in Ediacaran communities, complete with brightly-coloured cartoons, making sure everyone was awake. This was followed by a thorough investigation of the palaeobotany of a local coalfield by **Janine Pendleton** (Sheffield), then a delve into much more recent palaeoenvironments through analysis of the isotopic composition of Egyptian pectinid bivalves by **Soheir H. El-Shazly** (Beni Suef University, Egypt). **Russell Garwood** (Imperial) presented the next talk, which remarkably brought binary to life with a description of an intriguing computer program modelling evolution over palaeontological timescales. Once the discussion had settled down, **Alex Dunhill** (Bristol) brought us the next talk, dealing a blow to palaeodiversity studies with his use of remote sensing and GIS to quantify rock exposure area. The final talk of the first session was an examination of the phylogeny of early eurypterids by **James Lamsdell**.

The first coffee break of the day was not only an opportunity to attempt to reduce the mountain of biscuits on offer, but also the first chance to take a look at the posters, many dealing with the biomechanics of a range of animals; the avian furcula (**Roger Close**, Bristol); spinosaurs *versus* gaviolids (**Andrew Cuff**, Bristol); and the crocodile *Isisfordia duncani* (**Steven Osborne**, Bristol). **Nick Crumpton** (Cambridge) presented the delightfully titled poster *The holes in moles*, complete with cute pictures of the velvet gentlemen. Other posters covered trace fossil classification (**Keith Nicholls**, Plymouth), Dinoflagellate cyst response to climate change (**Kate Olde**, Kingston), the excavation of the second Westbury pliosaur (**Judyth Sassoon**, Bristol) and dinosaur osteology (**Jon Tennant**, Manchester). Two posters just squeaked ahead of the others and were each awarded

a prize, courtesy of Cambridge University Press; a fascinating description of the diversity of the earliest Ediacaran assemblages by **Alex Liu** (Oxford) and **Emily Woodruff**'s (Bristol) innovative approach to examining disparity and evolution in Palaeogene primates.

It was then back into the lecture theatre for the second session, chaired by **Roger Close**. This began with a thoroughly entertaining talk by **Colin Palmer** (Bristol) who, despite the technically challenging topic, brought to life the flight of pterosaurs. His bottom-up approach using engineering techniques and crystal clear explanations, ripe with analogy, earned him a unanimous vote for best talk of the day, and a prize, courtesy of Cambridge University Press. Not daunted by this, **Javier Ortega-Hernández** (Cambridge) presented the second prize-winning talk of the day, this time for best scientific concept for his insightful study using evidence from Cambrian microfossils to reconstruct the mechanisms behind the evolution of priapulid worms. The impressively high quality of talks continued with the significance of fossils in reconstructing the tree of life by **Anne O'Connor** (Bath) followed by a microtextural investigation of the diet of fish by **Laurent Darras** (Leicester). **Dave Marshall** finished off the morning with the phylogeny of chasmataspid arthropods, the clarity of his slides and elegant simplicity of his diagrams earned him the last prize on offer, for best presentation.

After being let loose on Bristol for lunch, the delegates reconvened for the third session, chaired by **Rachel Warnock**. **Stephen Mitchell** (Bristol) got the afternoon started with a talk on the macroevolutionary patterns through cynodont evolution followed by the taphonomy of ichthyosaur stomach contents by **Benjamin Hyde** (Manchester), leading some to regret the squid they'd just enjoyed at Beijing Bistro. The next talk, by **Peter Heintzman** (Royal Holloway), used ancient DNA to reveal the phylogeography of Ice Age beetles from Beringia. This was followed by a talk at the opposite end of the timescale by **Leila Battison** (Oxford) looking at Britain's oldest fossils from billion-year-old Scottish lake basins, which Leila (and the rest of us) concluded were "funky". **Joe Bonsor** (Bristol) gave the next talk, describing the 'Big Trig', an enigmatic arachnid from the Devonian of Arctic Canada, as well as the difficulties of trigonotarbid phylogeny: "Some of them are just a leg…". To finish the session **Martin Hughes** (Bath) spoke on the latest techniques to examine morphological disparity through time.

After the final coffee break, the last session of the day (chaired by **Alex Dunhill**) was started by **Andrew Smith** (Bristol) and his talk on the taxonomic diversity of a stem-mammal from Welsh fissure fill deposits, a taster of similar deposits to those we would be crawling over

Delegates outside the Wills Memorial Building

Enjoying a drink in Bristol's historic harbourside before the annual dinner

the next day on the field trip. This was followed by patterns of vegetation in the Cretaceous from **Emiliano Peralta-Medina** (Royal Holloway) and the importance of treading carefully when establishing fossil calibrations for molecular clock studies by **Rachel Warnock** (Bristol). **Michael Pittman** (UCL) then treated us to a look at the evolution of tails in sauropod dinosaurs through modelling their function. To round off the day **Marco Brandalise de Andrade** enthusiastically told us all we needed to know about Cretaceous crocodylomorphs.

With the talks over and prizes given out it was then to the business of the annual dinner. Held at the Severnshed Restaurant in Bristol's historic harbourside, credit must go to **Aude Caromel** for organising it as everyone enjoyed three tasty courses. No visit to Bristol would be complete without a taste of West Country cider, so after dinner many delegates retired to the Apple Cider Barge before continuing the frivolities and sampling Bristol's nightlife.

Perhaps a little bleary-eyed, 27 delegates assembled the next morning for the post-conference fieldtrip to two South Gloucestershire quarries. In the glorious sunshine, led by Dr **Pamela Gill**, we headed first to Tytherington quarry, site of the famous Bristol Dinosaur, *Thecondontosaurus.* The morning was spent hammering away at the Triassic fissure fill deposits in search of vertebrate material, which (once we could tell the difference between it and the Carboniferous limestone!) yielded a few bits and pieces of bone and lots of brachiopods (some people still a little confused…). Undeterred, we headed for lunch at the Royal Oak pub, Cromhall, for much-needed refreshments. After lunch, at the second locality (Cromhall quarry) the haul was significantly improved with pretty much everyone coming away with bits of *Clevosaurus,* and the like, bulging out of their pockets. Thanks must go to Pam, the staff at Tytherington quarry and Cromhall Dive Centre, and Dr **Graham Pugh** for stepping in to drive the minibus. It was a very enjoyable day and a fitting end to the conference.

The abstract book is still available for download on the PalAss website for anyone wishing to recap. They were an extremely enjoyable three days, demonstrating the depth of study and the range of

cutting-edge techniques being employed in palaeontological research today, a very promising sign for the future of our subject. We would like to express thanks to all the delegates, especially those who presented, the organisers and sponsors of the conference and everyone who helped to make it possible. Finally, we would like to wish good luck to Leicester, who will be hosting the conference next year; we hope to see many of you there!

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Hunting for vertebrate fossils in Cromhall quarry

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

Flugsaurier 2010: Third International Symposium on Pterosaurs
Beijing, China *5 – 10 August 2010*

Pterosaurs are among the most fascinating and enigmatic of all extinct creatures. Thanks to some spectacular fossil finds in recent years our understanding of the palaeobiology and evolutionary history of these 'flying reptiles' has seen several dramatic advances. Some of the most important discoveries, including the first eggs with embryos, have been made in China, where the Late Jurassic/Early Cretaceous is currently producing new species of pterosaurs at a faster rate than anywhere else in the world. In recognition of this the Third International Symposium on Pterosaurs, 'Flugsaurier 2010', will be held in China in August 2010. This will be the third international pterosaur symposium and follows successful meetings in France in 2001 and Germany in 2007.

The meeting will be organised by the Geological Survey of China, sponsored by the Institute of Geology, Chinese Academy of Geological Sciences, and co-sponsored by the Bureau of Fossil Protection, Liaoning Provincial Department of National Land Resources, and the People's Government of Yixian.

The meeting is planned for 5–10 August 2010. Talks, posters, at least one open discussion session and (subject to availability) examination of specimens, are planned for the first three days of the meeting. This will be followed by an optional three-day field excursion to view exposures of the Jehol Group and exhibitions/collections of fossils from this sequence which has yielded more than 100 specimens of pterosaurs in the last ten years. All those interested in pterosaurs and the communities and environments in which they lived are encouraged to attend.

1. Meeting aims:
As in previous symposia this meeting is intended to cover all aspects of pterosaur palaeobiology and the world in which they lived:

(a) The origin and evolution of pterosaurs
(b) Taxonomy, systematics and phylogeny
(c) Palaeobiology including anatomy, functional morphology and ontogeny
(d) Taphonomy, sedimentology and environments of preservation
(e) Ecosystems and contemporaneous fauna and flora

2. Meeting Programme:

- (a) Academic sessions (three days): Oral presentations: These will consist of key-note lectures (45 minutes) and talks (30 minutes). These times include at least five minutes for discussion. Posters: There will be at least one poster session (further details will be given in the second circular). Language: English.
- (b) Field excursion (three days): North-east China. This will include visits to field sites, exhibitions and collections primarily in Liaoning Province.

3. Abstracts and Symposium Volumes:
An abstract volume will be prepared for distribution at the meeting. The abstract submission deadline is 31st March 2010. No abstracts will be accepted after this date. Abstracts of up to two printed pages (A4) are preferred, but longer abstracts will be considered. Preferred formats are

'Word' for text files and 'JPG' for figures. A symposium volume is planned for publication in 2011 and will be available to both attendees and non-attendees. The manuscript deadline will be 31st December 2010 (further details will be given in the second circular).

4. Expressions of interest/information:
If you are interested in attending this meeting please send us an expression of interest indicating your plans to attend the academic session and the field trip, possible talk/poster title(s) and likelihood that you will be accompanied.

All correspondence (e-mail preferred) should be sent to Lü Junchang and Dave Unwin:

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The 5th International Conference on Fossil Insects, Arthropods and Amber
Beijing, China *20 – 25 August 2010*

The 5th International Conference on Fossil Insects, Arthropods and Amber will be held at Capital Normal University in Beijing, China from 20th to 25th August, 2010. A series of scientific sessions including plenary and special sessions, and special group meetings, in addition to mid-conference and post-conference field excursions will be organized, along with social events and programmes.

PRELIMINARY SCHEDULE

20 August: Registration and welcome reception
21 August: Opening Ceremony and group photo, Conference symposia and general sessions
22 August: Conference symposia and general sessions; Congress Banquet
23 August: Mid-social programme and conference excursion
24 August: Conference symposia and general sessions
25 August: Conference symposia and general sessions, workshops, Closing Ceremony, Post-Congress Excursion preparations
26–28 August: Post-conference field excursions

CALL FOR ABSTRACTS

All abstracts should be submitted by e-mail before 1st May 2010, and must include:

Author's name
Author's affiliation
Title of the presentation
Abstract (500 words or less)
E-mail address
Postal address
Presentation preference (oral or poster)

PROPOSED FIELD EXCURSIONS

1. Mid-Conference social programme (23rd August):
Great Wall and Ming Tombs: One day, about 80 km from CNU campus. including hotel pick-up and drop-off, air-conditioned coach, English-speaking guide, lunch, all admission tickets.

2. Post-conference Excursion (26–28 August):
The Jurassic–Cretaceous Biota of Northern China: Insects, Feathered Dinosaurs, Basal Birds, Mammals and Angiosperms

Contents: In recent years, the study of the Jurassic–Cretaceous Biota has been progressing rapidly in Western Liaoning of China. A lot of very significant fossils have been found in this area. Up to now, about 23 kinds of fossils in the Jehol and Yanliao Biota have been reported from Western Liaoning, including insects, dinosaurs, lizards, choristoderes, pterosaurs, birds, mammals, turtles, amphibians (anurans and salamanders), fishes, conchostracans, ostracods, bivalves, gastropods, shrimps, limuloids, spiders, ferns, gymnosperm, angiosperm, algae, pores and pollens.

Western Liaoning of China is really a rare treasury of Mesozoic fossils and a magnificent place to study the origin and evolution of insects, birds, eutherian mammals and angiosperms. This trip begins and ends in Beijing, including two localities in Beipiao City, one locality in Chaoyang City and one locality in Lingyuan City of Western Liaoning.

REGISTRATION

Professional participant: 350US$
Student: 200US$
Accompanying person: 200US$

The registration fees cover the cost of the meeting's resources and support, congress publication (congress special issues, abstract volume and programme, not provided for accompanying members), conference bag, T-shirt, tea and coffee breaks, and all lunches and dinners from 20th to 25th August, and the Mid-Conference social programme to the Great Wall and Ming Tombs on 23rd August. The Congress Banquet in the evening of 22nd August will be available for regular registrants without additional charge.

Note:

1. Registration fees are subject to modification depending on the exchange rate between the Chinese Yuan RMB and US$. The exchange rate on 23rd January was 100US$ = 680.37RMB Yuan.)
2. Payment: A down-payment for the meeting and field trips is requested in this Second Circular. The balance will be due at the time of the meeting, payable in US$.
3. Outstanding students and distinguished retired palaeoentomologists may apply for limited financial support (free of charge for Registration Fees and Accommodation from 20th to 26th August). All applicants should give an oral presentation and contribute an original manuscript to the Proceedings for evaluation by the Organizing Committee.

Methods of Payment:

The registration fees and field excursion costs may be paid in either of the following ways:

1) Bank Transfer to the bank account designated for FossilX3 CNU 2010:
Name of Account: GAO TAI PING
Bank Account Number: 4022000-0188-009752-2

Name of Bank: Bank of China, Beijing Xisanhuanbeilu Sub-Branch
Address of Bank: B1-Floor, No.72 xisanhuan North Road, Haidian District, Beijing China
Swift address code: BKCHCNBJ110

Note: Please inform us by e-mail (<**rendong@mail.cnu.edu.cn**>) the detailed information (such as name, how much registration fees and how much field excursion fees) when you complete your payment by bank transfer. The invoice will be given to you upon check-in at the conference.

2) On-site Payment in Cash:
If you can't pay by bank transfer, you can pay all fees in cash when you check-in at the Registration Desk at the Conference.

Cancellation and Refunds:

Cancellations for registration and field excursion fees must be in writing and addressed to the Secretary Office of FossilX3 CNU 2010.

Cancellations received in writing before 1st August 2010 will be accepted and fees will be refunded in full except for RMB 200 Yuan banking service charge. The requested refund will be sent to the registrant after the Congress. Cancellations received after 1st August 2010 will not be refunded.

All persons interested in receiving the Second Circular with programme outline, registration and abstract forms and the application for accommodations, should contact the Conference Organizing Committee at the following address.

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8th International Symposium, Cephalopods – Present and Past (8ISCPP)
Dijon, France *31 August – 3 September 2010*

The 'International Symposium, Cephalopods Present and Past' – ISCPP – brings together all scientists working on extant or extinct cephalopods. The diversity of this group of molluscs, together with its broad temporal and spatial distribution, makes it a successful model for addressing key scientific issues. We are proud to host the 8th ISCPP at the University of Burgundy, Dijon, France from 31st August to 3rd September 2010. It will be a unique opportunity for sharing research ideas and recent findings on all aspects of cephalopod biology and evolution. We strongly encourage young scientists to attend this symposium. Studies using cutting-edge techniques and original approaches

are particularly welcome. Dijon is located 310 km (186 miles) from Paris and it takes only about 90 minutes to get there by train. Two fieldtrips will follow the symposium: a one-day fieldtrip in Burgundy, and a four-day fieldtrip beginning near Lyons and continuing in the "Réserve Géologique de Haute-Provence" (South of France).

For further details e-mail <**Pascal.Neige@u-bourgogne.fr**>.

Second International Conference on Palaeontology of Southeast Asia (ICPSEA 2010)
Mahasarakham, Thailand 1-5 November 2010

Much has happened in the palaeontological world of Southeast Asia since the 1st International Conference on Palaeontology of Southeast Asia (ICPSEA) in 2003. Now is a good time to discuss new dinosaur discoveries, new palaeogeographical views and even new important sections. We particularly welcome participants from overseas to share their views of the past of Southeast Asia.

The Second International Conference on Palaeontology of Southeast Asia is open to all individuals who are interested in the fields of palaeontology and geology including sedimentology, stratigraphy, tectonics, *etc*. The committee of ICPSEA 2010 welcomes the submission of abstracts or full papers for oral and poster sessions.

For more information, please visit the meeting website: <**http://www.prc.msu.ac.th/icpsea2010/**>.

Alternatively please e-mail the meeting organizers at <**icpsea@msu.ac.th**>.

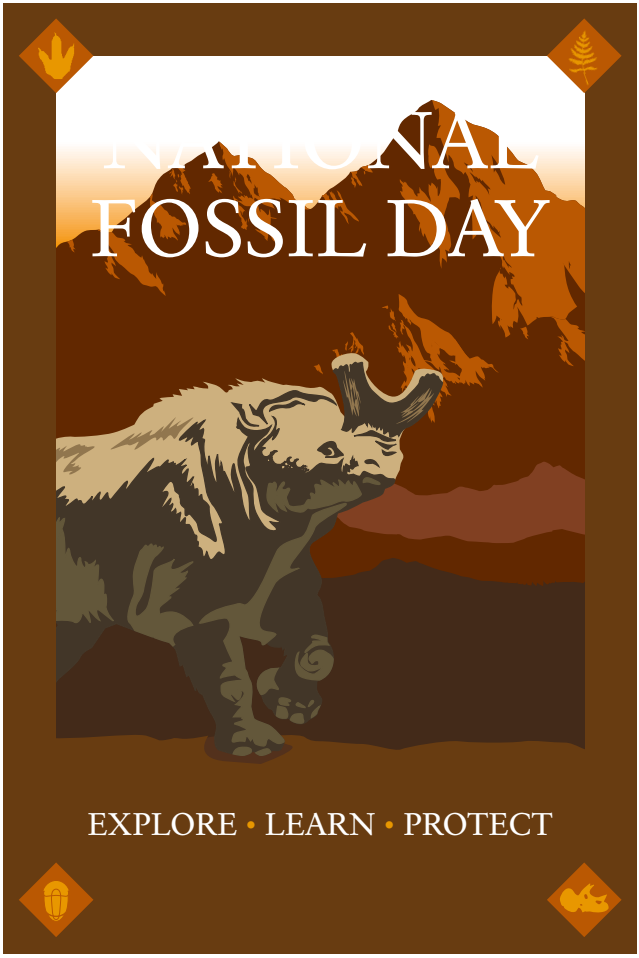
XVII International Congress on the Carboniferous and Permian
Perth, Western Australia *3 – 8 July 2011*

International congresses on the Carboniferous and Permian run every four years – the previous one was in Nanjing in 2007. The venue for the 2011 congress will be the University of Western Australia. The hosts are UWA and the Geological Survey of Western Australia.

Perth lies in the central Perth Basin which is one of a series of basins extending from Timor in the north that formed part of the East Gondwana rift system. We will be running excursions to the Canning, Carnarvon and Perth basins in Western Australia and to Timor Leste. As well as highlighting Permian and Carboniferous exposures, we will be visiting the World Heritage Shark Bay (with the famous stromatolites), Ningaloo Reef – an exceptional modern coral reef that has been nominated for World Heritage listing – and the Devonian reefs of the Canning Basin.

We invite you to participate in the Congress and to join us on one or more of the associated field excursions. Full information on the Congress is provided at <**http://www.iccp2011.org/**>.

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



National Fossil Day: 13 October 2010

Attention, palaeontologists! Would you like to promote the work you do and explain why it is important? Would you like to teach students about fossils? If yes, then get ready to celebrate National Fossil Day, arriving this October.

The National Park Service and the American Geological Institute are partnering to host the first National Fossil Day during Earth Science Week (<**www.earthsciweek.org**>). National Fossil Day is a celebration to promote public awareness and stewardship of fossils, and to foster a greater appreciation of their scientific and educational value.

More than 228 parks managed by the National Park Service contain fossil resources. Fossils discovered on the nation's public lands preserve ancient life from all major eras of Earth's history, and from every major group of animal or plant. In the national parks, for example, fossils range from primitive algae found high in the mountains of Glacier National Park, Montana, to the remains of ice-age animals found in caves at Grand Canyon National Park, Arizona. Visitors can stand where a fossil tree was rooted or where a fossil animal walked millions of years ago.

Learn more about outreach activities or becoming a National Fossil Day partner at <**http://nature.nps.gov/geology/nationalfossilday/**>. Join in the celebration today!

MYSTERY FOSSIL 19

This issue's mystery fossil was sent in by Jesper Milàn (Østsjællands Museum, Denmark). According to Jesper, the sum total of his knowledge about this specimen is as follows: "it was found by Claus Heinberg at Stevns Cliff, in the Maastrichtian limestone, and measures 5 cm at its widest point. The small 'channels' perpendicular to the U-shape are fine structures that go through the material. The fossil itself is structureless but very hard."

As usual, if you know what it may be please e-mail me at the usual address: <**newsletter@palass.org**>.

Richard Twitchett

Update on Mystery 'Fossil' 18

Last issue's Mystery Fossil – sent in by **Jan Ove Ebbestad** of the Museum of Evolution, Uppsala University – generated an enormous amount of interest. Unfortunately, most responses arrived while the Editor was incommunicado in the field, and some of your email replies may have been caught by the overzealous university spam filters or bounced due to an overflowing inbox, so apologies if you sent in a reply but your name doesn't appear beneath.



In total, 22 replies were received with the unanimous verdict being that Mystery Fossil 18 is, in fact, not a fossil at all. As **Joseph Boscheinen** succinctly put it: "the pebble may be Jurassic and the matchbox is nice, but the 'fossil' is not fossil!". So, if not a fossil, then what is it?

The first response received was from **Rodrigo Soler-Gijón**, who suggested that it "is a nice egg case of a mantid, probably *Mantis religiosa*". The following also identified the object as an egg case (or ootheca) of a mantid, with most naming the European (or Praying) Mantis, *M. religiosa*, as the most likely species responsible: **Björn Berning**, **Dave Bond**, **Joseph Boscheinen**, **Gérard Breton**, **Arnaud Brignon**, **Lionel Cavin**, **Murray Eiland**, **Jaume Gallemí**, **Sam Gon III**, **Ben Hyde**, **Christian Klug**, **Scott McKenzie**, **Tae-Yoon Park**, **Vincent Perrier**, **Markus Poschmann**, **Brian Pratt**, **Steve Tolan**, **Paul Varotsis** and **Monique Vianey-Liaud**. There were a few alternative suggestions: **Dave Bond**, who "couldn't resist writing in" also hedged his bets by suggesting that it may be an 'egg case' of a wasp; **Paul Selden** suggested a hymenopteran nest; and **Andy Gale** identified it as "a modern rock wasp nest encrusting a piece of rock as they do".

The balance of opinion, however, is clearly in favour of a mantis ootheca ["Gottesanbeterin" in German, apparently – thanks Joseph!], and many replies were accompanied by various images in support of this identification, most of which were lifted from the web and can easily be found through your favourite search engine.
A special award goes to **Bruno Garnier**, however, who was so inspired by MF18 that he went out into the field in SE France to try and locate his own specimen. Having found one he covered it with paper towel to protect it. One month later, back in the lab, Bruno was apparently unpacking the specimen when he found that a number of small hymenopterans had emerged. Rather than being the nest-builders, these little animals are probably parasites belonging to the genus *Podagrion*.


Bruno Garnier's specimen with hymenopterans emerging (top)

Several respondents also accompanied their identifications with lurid descriptions of mantid habits. **Vincent Perrier** noted how the "females eat their male during/after copulation", and that this is "quite common in France" (presumably amongst mantids). **Gérard Breton** explained this habit by noting that the female "needs a lot of proteins for making her eggs and the ootheca, and the male provides her the best quality and amount … of protein. Some zoologists add that inhibitor centres of the copulation reflexes lay near the nervous centres in the head of the male, so that beginning the nuptial dinner with the male's head makes him more vigorous…". Perhaps, therefore, one could argue that Mystery Fossil 18 is really just a re-cycled male praying mantis.

Thanks to all who responded to the mystery fossil-that-wasn't. I was somewhat surprised at the number of replies, compared to the usual one or two responses that trickle in for the 'real' fossils, but on reflection perhaps this is merely an indication that we're all comfortable with discriminating between fossils and non-fossils. Or, perhaps, it simply reflects our desire to deal swiftly with ignorant Newsletter Editors and suchlike who can't tell the difference! As noted by **Björn Berning** and **Jaume Gallemí**, given that praying mantises are absent from the Uppsala region, and given that they only had a photograph of the specimen, it is perhaps not too surprising that the true identity of MF18 was not immediately apparent. In case you are still smugly congratulating yourself for your knowledge of the egg-laying habits of the praying mantis, it's worth remembering that such misidentifications do (rarely) manage to make it into print (*e.g.* Stanley and Senowbari-Daryan, 1999) – something we should all be on our guard against. Hopefully we're all slightly the wiser thanks to MF18!

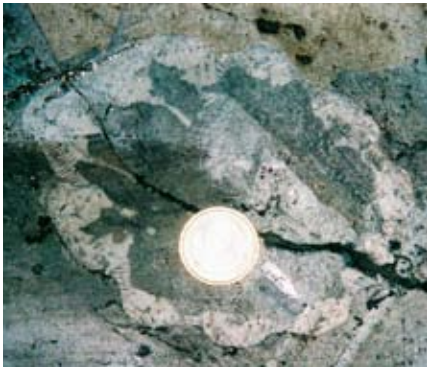
Finally, for those of you interested in such things: according to a recent phylogenetic study the Mantodea probably originated around the Triassic/Jurassic boundary (Svenson and Whiting, 2009), with the oldest known fossil examples of mantises being from the Cretaceous.

REFERENCES

STANLEY, G. D. and SENOWBARI-DARYAN, B. 1999. The Triassic sponge *Neoguadalupia oregonensis* Senowbari-Daryan and Stanley, 1998, is actually the trace of a living bee's nest. *Journal of Paleontology*, **73**, S. 721.

SVENSON, G. J. and WHITING, M. F. 2009. Reconstructing the Origins of Praying Mantises (Dictyoptera, Mantodea): the roles of Gondwanan vicariance and morphological convergence. *Cladistics*, **25**, 468–514.

Update on Mystery Fossil 13



There have also been some suggestions for identification of MF13, which appeared in Newsletter 68:

Following his success at identifying the mantis ootheca, **Christian Klug** thinks, 'but is not sure', that Mystery Fossil 13 may be the cross-section of an echinoid, perhaps a clypeasteroid. Passing the buck somewhat, and throwing down a challenge at the same time, he goes on to suggest that "Andrew Smith might know"…

Regardless of whether Andrew really does know what it is, **Jaume Gallemí** is certainly convinced that MF13 "corresponds to a section of a Miocene clypeasteroid echinoid (why not *Clypeaster*?), because you can see (mainly in the left part of the section) some distal parts of the petals [showing] the elongated sections of their pore-pairs. The 'internal walls' or elongated elements connected to the periphery are just parts of the walls and pillars (architectural elements)…. The undulating perimeter also corresponds to the bowed ambulacra essentially developed in the middle and higher part of this skeleton. Such 'high' forms of clypeasteroids are mainly developed in Miocene times, and formations from this period are well represented across Sicily". So, unless Andrew (or anyone else) has anything to say to the contrary, I think we can safely say: mystery solved.

Stumped for ideas

> *"I visited the Royal Tyrrell Museum of Palaeontology in Drumheller, Alberta (Canada) last week and it occurred to me that civilization as we know it is built on two pillars. One is great museums, the other is online cricket commentary for wayward souls who live in places where the sport is not well-known."*
>
> Leigh Harris, Canada, Test Match Special inbox, 8th August 2008

I'll be open and up-front with you. Since the last newsletter was published, I have been at a loss as to what palaeontological topic to report on next. It's not a lack of material exactly – I was on a fieldtrip recently that turned up a (Carboniferous) bone of a new-found land animal, this province's first, for example – but nothing satisfactory sprang to mind.

Part of the problem is the time of year. Summer has made its entrance, and, freed from the burdens of teaching and admin, most university palaeontologists have turned their attention to getting on properly with research, or venturing out into the field. This is true even for palaeontologists in Newfoundland, where Summer doesn't so much make an entrance as sidle truculently over from a dark corner of the room after having had its name called out repeatedly. And then scuttle off again when you briefly turn your back.

Being a wayward soul, however, I fail to obey this seasoned rule. As my former Ph.D. supervisors might recall, Summer for me brings along something far more distracting: the opportunity of throwing small, hard, red leather objects at stick-wielding opponents. Yes, it's cricket time.

This might seem a futile pastime for someone now living in a country where ice hockey is king and cricket isn't even the bastard son of the Prince of Wales, but you underestimate my addiction. With a group of like-minded individuals, a fair number of them geological, I have decided that 2010 is the year to resurrect the sport in Newfoundland. If Jamaica can produce its own Winter Olympic bobsleigh team, surely an Atlantic Canadian province can rustle up a cricket eleven?

This version of *Cool Runnings* – 'Cool Innings' – is going to be serialized on the web-pages of Cricinfo, so I won't bore you any further with it here. I will, however, stick with the broad idea. Cricket, fossils and museums are variations on a theme, one which I will attempt to render coherent over the next few paragraphs. If this prospect leaves you disinclined to read on, I won't bear any grudges.

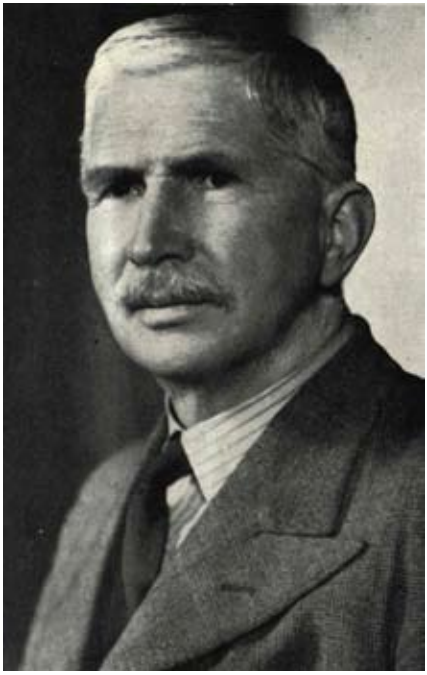
++++++++++

It only opened last year, so has barely had time to acquire greatness, but the Museum of Interesting Things certainly has potential. Based in The Coaching Station Inn at Nymboida, New South Wales, this new MIT is the brainchild of Russell Crowe, movie star, cricket fanatic and now museum curator (Apps, 2010). It seems to have an unarguable name. Where else could you find a baggy green cap belonging to Crowe's cousin Martin, former captain of the New Zealand cricket team, vying for space with a dinosaur skull donated by Leonardo Di Caprio? You're not likely to see the NHM curators put a David Gower sun-hat on their *Diplodocus*.

The MIT is growing with every Antipodean visit Crowe makes. A chariot used in *Gladiator* is imminent, apparently, and some castle moulds from the new *Robin Hood* movie, but Di Caprio

was recently outbid by Nicolas Cage for a *T. Rex* specimen, so the Earth Science section may be in stasis for a while. To remedy this, Crowe might like to contemplate an exhibition devoted to his fellow Kiwi, Patrick Marshall.

Born in Suffolk in 1869, Marshall moved to New Zealand with his family at the age of seven, and went on to study geology at Canterbury University College and the University of Otago. He specialized in igneous petrography, but took a position as a lecturer at an agricultural college and, demonstrating his diverse scientific talents, produced some extremely high-quality taxonomic studies of fungus gnats and gall midges. Having named 61 species, all but six still valid, Marshall may have had his fill of tiny dipterans, and returned to earth sciences. As lecturer, and later professor, at the University of Otago, his interests focused primarily on hard rocks, recognizing the 'Andesite Line' separating different Pacific igneous provinces and coining the term 'ignimbrite'.



Patrick Marshall – first class cricketer, petrologist, taxonomist and palaeontologist

Marshall was still happy to branch out though, and wrote on various aspects of Mesozoic and Cainozoic palaeontology, including a monograph of the Upper Cretaceous ammonites of New Zealand, compiled after a stint in London at the Natural History Museum. Gastropods and molluscs caught his critical eye too, and he even authored a paper on fossilized moa bones.

Best of all, though – at least to my mind and current predicament – is that having reached his early thirties, Marshall decided that Summers need not be entirely geological. He became a first-class cricketer! The Auckland Aces were his team, and he played three first team matches for them, all in the 1900-01 season. Cricinfo reveals that his batting average was pretty poor, but as with journal impact factors, sporting statistics don't always provide clarity. And, anyway, I don't care. I need self-justifying case studies. If a monograph-writing geological polymath could also be a top-level sportsman in New Zealand, a polygraph-cheating palaeontological monomath can surely be a mediocre cricketer in Newfoundland.

Combining 'cricket' and 'palaeontology' on Internet searches was proving most entertaining, so I continued. A couple of clicks later, and I'd brought up an intriguing-sounding paper entitled 'The evolution of cricket songs' (Otte 1992). Unlike football, where tuneless tribal chanting is strongly encouraged, cricket is a sport whose supporters don't provide much vocal accompaniment (except towards the end of the afternoon, after copious pints of bitter). I was therefore curious to find out more about the phenomenon, and downloaded the multi-megabyte pdf.

Liam Herringshaw batting at the Fortune Head Precambrian–Cambrian boundary GSSP to the delight of the gathered photographers

It was, of course, a piece of scientific orthopteran research, a study which argued that, prior to the late Permian, terrestrial environments would have been eerily quiet. The fossil record shows that, by at least the 250 million year mark, the two main cricket lineages had diverged, and their sound-making organs are 'too much alike and too complex in structure to have appeared more than once' (Otte 1992, p. 25). Earth's earliest musicians had evolved.

Though founded on the diversity of cricket singing behaviour in extant taxa, Otte's paper did note that the changing forewing structures of fossil species allow ancient acoustics to be deduced. Crickets began with trilling, changing subsequently to chirping in some species, either by dropping pulses from their songs, or by pulse-pairing, with some lineages reverting back to trilling again later in time. Some species – burrowers and cave-dwellers in particular – gave up sound emission altogether. They're not singing any more! They're not singing any more! *etc*.

But what of the fossil record of cricket? Some time ago, my boss stuck a cartoon on my office door, depicting the discovery of a hominid whose affinities were uncertain, but who undoubtedly bowled left-arm spin. Being dozy, I hadn't realized this was a reference to the hoax of Piltdown Man. The palaeontology-cricket search results put this oversight to rights.

As Chris Stringer explained in his article marking the 50th anniversary of the hoax's uncovering (Stringer 2003), the discovery of Piltdown Man and its initial interpretation was not met with universal approval. Some anthropologists doubted that the disarticulated skull and jaw came from the same organism, but then a host of new specimens and artefacts were found. And these included a cricket bat, carved from elephant bone. Whether, as 'the first Englishman', Piltdown Man simply *had* to have been a cricketer, I'm not sure, but I can't for the life of me see how this failed to raise serious doubts in more people's minds. As remarkable and exciting as it was to find a million year-old man in a Sussex gravel pit, was an accompanying sporting implement not a bit too much? I suppose, to steal from Simon & Garfunkel, the man sees what he wants to see and disregards the rest.

I can hardly claim never to have done such a thing. In a sport where batsmen hog the limelight, bowlers like me tend to develop highly selective memory skills. When performing well, you can find yourself stopping any runs being scored, but not actually taking any wickets. At the other

end, the batsmen decide to try and score runs off your partner, who is having a more erratic day, and in their eagerness to do this they get out. You work well in combination, but his average ends up better than yours, so he appears to be more successful. One ought to be magnanimous about it, but it's tricky, especially when the end-of-season stats are published. Even after taking on the job of club statistician, I couldn't make my numbers say what I thought they should.

Having been both, I find many parallels between the roles of cricket club statistician and systematic palaeontologist. To be worthwhile, both require plenty of attention to detail, and a certain type of mind, so they don't suit some people, whilst others aren't keen to take on the responsibility, especially when the feedback is minimal and their immediate impact low. If no-one does it, however, the absence is soon noticed, and without such foundations the whole enterprise becomes rather shaky.

Rather shaky also describes the career trajectory of a systematic palaeontologist. Unable to unleash many high-impact deliveries, we trundle away at a medium pace, hopeful that something miraculous will happen. Instead, the thorough, slowly written, on-a-decent-length paper is respectfully dead-batted, and collects a citation or two every so often. Papers whanged down by the quickies, however, will hit the target on certain occasions and be smashed out of the stadium on others. Is one method better than the other? Or is it just a matter of working in tandem? I'm inclined towards the latter, but only if the system recognizes the need.

Just as cricket is devalued by too many fast-format games, so palaeontology loses worth by the piecemeal iteration of scientific hypotheses, by excessive self-citation, and the 'short' papers that now come with reams of Supplementary Online Material because the Internet permits it, but have poor taxonomy because the published journal size prohibits it. It is the sound-bite culture of the modern world. We need monographs but we get tachographs. I am advised to 'play the game', but might as well be ordered to go out and bat like Kevin Pietersen. I don't have the talent, so, like this article, the outcome will only be messy.

My contract here at MUN expires shortly. 'Show us the money!' demand the job applications, disguised as Jerry Maguire, and I don't have any. I'm not sure if the IPL is the Indian Premier League or the Instant Publishing Legacy, but it doesn't matter. You have to be a big hitter to make a name for yourself, so it's probably time to look elsewhere. My predecessor's article discussing the potential value of multidisciplinary field centres (McGowan 2009) set me thinking. Perhaps I should try and establish the world's first fossiliferous cricket field museum centre. It would keep me out of mischief, at least.

Liam prepares to receive his first delivery

Regardless of that, systematic palaeontology, Test cricket and great museums are part of the old world, a world we should cling on to with all our might. They represent contemplation, a less manic pace of life, a pleasure derived from something worked for over a considerable slice of time, not the sugar rush of instant gratification. By all means utilize the big-hitting excitement – Di Caprio's dinosaurs and the Twenty20s – to draw people in, but then lead them on to the stuff that yields its secrets more slowly, be it Test matches or turrilepadids. Let the pitch be two-paced.

The ball is clearly 'grounded beyond the boundary' (Law 19.3) (in this case, at Grand Bank, just up the coast from Fortune Head)

And having stretched the cricket-palaeo connections well beyond their breaking point, I shall stop. I need to prepare myself to return to Blighty for a couple of weeks. Visiting my recently relocated other half takes priority, and then the International Palaeontological Congress in London, but I hope to be able to find an opportunity to head home and re-visit one of my favourite places in the world. Popping in to admire the holotype of *Charnia masoni* in Leicester's New Walk Museum is an act of pilgrimage, and if I time it right I'll be able to do it whilst listening to *Test Match Special* and the inimitable strains of Aggers and Boycott describing England *versus* Australia at Lord's. Anything else just wouldn't be cricket.

Liam Herringshaw
Memorial University of Newfoundland
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REFERENCES AND WEBSITES

APPS, L. 2010. Museum has plenty to Crowe about. *Daily Examiner*, 20th March 2010. <**http://www.dailyexaminer.com.au/story/2010/03/20/museum-gets-more-interesting-by-the-day-thanks-to-/**>

BENSON, W. N. 1951. Patrick Marshall obituary. *Transactions and Proceedings of the Royal Society of New Zealand* **79**: 152–155. <**http://rsnz.natlib.govt.nz/volume/rsnz_79/rsnz_79_01_002570.html#n274**>

McGOWAN, A. 2009. Palaeontology courses: a hard sell for hard times? *Palaeontological Association Newsletter*, **71**, 74–77.

OTTE, D. 1992. The evolution of cricket songs. *Journal of Orthoptera Research*, **1**, 25–49.

STRINGER, C. 2003. Piltdown 2003. <**http://www.talkorigins.org/faqs/homs/piltdown2003.html**>

Cricinfo, 2010. Patrick Marshall's career statistics. <**http://www.cricinfo.com/ci/content/player/37818.html**>

The Laws of Cricket. <**http://www.lords.org/laws-and-spirit/laws-of-cricket/**>

Cool Innings: <**http://www.cricinfo.com/magazine/content/story/463204.html**> (Ed.)

Graduate Opportunities in Palaeontology!

Students: Do you want to study for a postgraduate qualification (MSc, MRes, PhD etc.) in palaeontology or a related discipline in the UK or abroad?

If the answer is YES then please check out the home page of the Palaeontological Association (<**http://www.palass.org/**>) and follow the link to "Careers & Postgrad Research".

These pages will be updated regularly over the coming months, so don't forget to check back at regular intervals!

Researchers: Do you want to advertise your palaeo-related MSc course or PhD to as many students as possible?

If the answer is YES then please send details of your courses/projects to the Newsletter Editor. These details will then be posted on the Association website and will be published in a forthcoming edition of the *Newsletter*.

For available PhD titles please include the title, the names of all academic advisors and a contact email address. For MSc and other graduate courses please include a brief descriptive paragraph, a link giving details of admission procedures and a contact email address or telephone number.

MSc Courses

MSc in Palaeobiology: University of Bristol, Department of Earth Sciences

The Bristol M.Sc. in Palaeobiology is the longest-established and most successful Masters programme of its kind in the world, with over 200 graduates since it was founded in 1996, many in excellent jobs around the world. Students are mainly British, but there are four or five overseas students each year, from countries as diverse as the United States, Iceland, Venezuela, Belgium, France and Mexico. The programme is unique in the success of students in research and the number of projects so far published.

The MSc offers a broad-based overview of modern approaches in palaeobiology. Students study core courses and a broad range of options, with topics ranging from taphonomy & palaeoecology to vertebrae palaeontology, to trace fossils and arthropod palaeobiology, biomechanics, and systematic methods. Then there is a six-month independent project, and students are offered a wide range of topics. The programme is designed for students with a BSc in either a biological or an earth sciences subject, and conversion courses in evolutionary biology and sedimentology are offered. Students also receive training in writing scientific papers, creating websites, and applying for PhDs and jobs (both in Britain and overseas). So far, 160 students have graduated, and many have gone on to rewarding careers in palaeontology and related scientific areas.

The project is a major component of the degree, and we encourage students to carry out cutting-edge work and to present it in publishable form. So far, some sixty MSc projects have been published, all in leading international journals, and we aim to help and encourage students to publish as many as possible.

Full details of the programme, of former students, and of how to apply are available on the course website. Application forms may be downloaded from <**http://palaeo.gly.bris.ac.uk/MSc/**>, or they can be provided by <**earth-msc@bris.ac.uk**>.

MSc in Advanced methods in taxonomy and biodiversity: Imperial College London

Imperial College London College of Science, Technology and Medicine and The Natural History Museum are jointly offering a Masters degree course in Advanced Methods in Taxonomy and Biodiversity.

The one-year full-time MSc course provides essential skills for all concerned with taxonomy and biodiversity. The course is composed of ten taught modules followed by a four-month research project. The series of modules seeks to provide as wide as possible an overview of the theory and practice of modern taxonomy and systematics, with associated biodiversity studies. During their four-month research project, students can specialise in their chosen area.

The course is based at The Natural History Museum, London, one of the world's premier institutions for research on the diversity of the natural world. The collections include over 68 million

specimens, 800,000 of which are type specimens, and the Museum houses a world class library covering all areas of taxonomy and systematics. The Museum is situated next to the main South Kensington campus of Imperial College, and there are close research and teaching links between the two establishments. Students will therefore be situated in the heart of London, and are able to make full use of the facilities at both institutions.

Students are trained to a high level of competence in systematics and a detailed understanding of the various uses and problems involved. The course provides methodological background, including quantitative skills, computer applications and practical skills in morphological and molecular techniques of taxonomy and systematics. The most up-to-date ideas and research in taxonomy and biodiversity are taught, to a large extent from primary literature. Hands-on training in conducting research in this area will be provided by project supervisors, with specialisation in the student's field of choice.

After completing the course, students will be able to:

- apply a wide range of techniques to the study of systematics, including collections management, identification, key construction, taxonomic revision, phylogeny reconstruction and comparative methodologies;
- understand the diversity of living organisms in space and time, and be familiar with methods for measuring this diversity and monitoring changes due to both anthropogenic and natural factors, and in Earth history;
- select appropriate methods to solve taxonomic and biodiversity problems, and be able to acquire and analyze taxonomic data, including both traditional and molecular data;
- understand fully the conceptual basis of taxonomy and phylogenetics and in particular, cladistics, and to understand "biodiversity" within this framework;
- apply these concepts to issues of biodiversity and conservation management and research, to set priorities for sustainable development, environmental assessment and inventories;
- apply these concepts to other areas of biology such as parasitology and epidemiology.

Who is this course aimed at?

The course is aimed at anyone concerned with taxonomy and biodiversity. It is relevant to those involved with biodiversity assessments, conservation and sustainable development, from biomedical sciences to agriculture and fisheries, as well as to those intending to pursue academic careers in systematics and related fields.

Entry requirements:

Applicants should normally either have or expect to gain at least a lower second class honours degree (or equivalent) in a biological or environmental subject (*e.g.* zoology, botany, microbiology, agriculture and veterinary science). Exceptionally students with different backgrounds or with related work experience will be considered.

Further details are available from:
<**http://www3.imperial.ac.uk/pgprospectus/facultiesanddepartments/lifesciences/postgraduatecourses/advancedmethods**>

MSc/MRes in Marine Geosciences: University of Plymouth, School of Geography, Earth and Environmental Sciences

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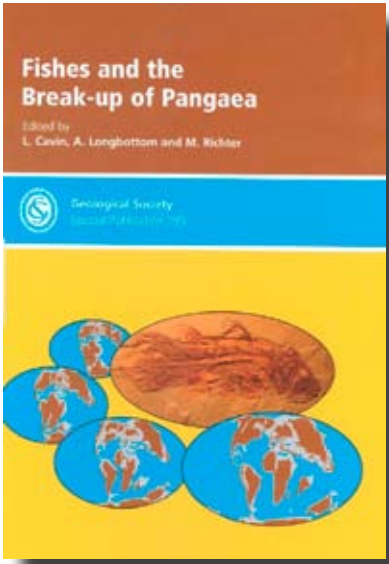
Book Reviews

Fishes and the Break-up of Pangaea. Geological Society Special Publication 295

Lionel Cavin, Alison Longbottom and Martha Richter (eds). Geological Society of London. 2008. 372 pp. ISBN 978-1-86239-248-9. £95.



The volume came out of a meeting organized in honour of the long and productive career of Dr Peter Forey, who remains an active researcher into the systematic evolution of fishes and the application of cladistics to a range of problems in palaeobiology. The *Newsletter* owes Peter a debt of gratitude for his excellent series of columns on cladistics in palaeontology, which are archived on the Association website.

The volume opens with a summary of Peter's contributions to the field, as befits any *Festschrift*, and is followed by a brief summary by the editors of the 15 papers in the volume. The introduction makes a strong case for the inclusion of fossil data in biogeographic work, reminding us that both the evolution of the earth and biological evolution are historical processes that can be elucidated by historical data.

The remainder of the volume is subdivided into three, rather uneven, major divisions: *Setting up Pangaea: Triassic* (two papers); *The Break-up of Pangaea: Jurassic and Cretaceous* (seven papers); *Birth of the modern world: the Tertiary* (six papers). The lack of papers about Carboniferous and Permian taxa is both surprising and a little limiting. Many would regard Pangaea as having been established by the Permian and beginning the long process of fragmentation during the Triassic. Obviously a volume of contributed papers relies on the interests of the contributors, but the lack of papers relating to the biogeography of fishes during the interval when provinciality and associated endemicity might be dropping does, to some extent, focus any biogeographic findings on vicariance-based processes at a time when many biogeographers are starting to re-explore Erwin's Taxon Pulse Hypotheses after a long period when the maximum vicariance models held sway (see Brooks, 2005, for a summary).

Rather than give a summary of each chapter, it seems more fruitful to focus on the potential wider impact of the papers. Many of the researchers are well-known established researchers with excellent reputations for work on the particular fish groups that their chapters focus on. The quality of the photographic illustrations of specimens is uniformly high, and there are many excellent stipple drawings to interpret the specimens. Illustrations of this quality remind us that the process of carefully drawing a specimen leads to new insights into the morphology and the development and scoring of cladistic characters. I would highlight the drawings featured in the chapters by Arratia and by Hilton and Grande. However, the maps and other diagrams do not always match

up to this standard. Several maps are small and only plot localities on present-day geographies. However many of the chapters do feature palaeogeographic maps that give the reader a sense of the spatial relationship among localities, which is an important aspect of palaeobiogeographic thinking. A couple of chapters also feature figures or tables that have been printed at low resolution or have been resized in such a way as to slightly distort text.

Most of the chapters focus on the systematics and anatomy of a particular taxonomic group within a broad interval of time. Papers such as these are vital for advancing research into the evolution of groups and for reporting new discoveries, and are the basis for much of the work on biodiversity in the fossil record. Given the difficulty of producing monographs, series such as the *Geological Society Special Publications* and the *Systematics Association Special Volumes* do offer an opportunity to publish high-quality taxonomic papers with good illustrations. However, the bulk of the papers in the volume are likely only to be of interest to specialists in the field, and as the volume is £95 it is unlikely to be a casual purchase.

Four of the papers feature detailed new cladistic analyses and such new cladograms are a vital source of data for cladistic palaeobiogeographic research. The chapters by Cavin and by Kriwet and Klug stand out as works that are more synthetic and make attempts to tackle the break-up of Pangaea quantitatively, as an influence on the evolution of fishes. Cavin's panel figures combining palaeogeographic maps and cladograms showing area relationship are excellent at communicating the putative vicariance events, and he does give serious consideration to the role of dispersal. Kriwet and Klug, through their consideration of broader issues such as the quality of the fossil record and changes in taxonomic richness of neoselachians in a regional context, also produce a paper that will appeal to a broader audience. Many of the other papers in the volume confine their biogeographic content to a short, narrative discussion at the end with no quantitative analysis. Given the availability of free palaeobiogeographic reconstructions and software to tackle quantitative biogeographic analyses, this does seem to be a missed opportunity to have produced a volume where the rigour of the palaeobiogeographic work matched the excellent systematic and taxonomic work. One other issue that passed without much comment was the potential for biogeographic analyses to test palaeogeographic reconstructions and even propose events that geologists should be seeking evidence for (*e.g.* Riddle *et al.* 2008).

Fish and chips is a quintessentially British dish. In Scotland, we have the sit-down Fish Tea, an all-inclusive deal that comprises fish, chips, bread and butter and a cup of tea. Many establishments are judged on the generosity of the accompanying elements of the meal. For me, the Fish Tea offered by '*Fishes and the Break-up of Pangaea*' has the finest fresh fish research, but skimps on the side dishes of palaeobiogeographic research.

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REFERENCES

BROOKS, D. 2005. Historical biogeography in an age of complexity: expansion and integration. *Revista Mexicana de Biodiversidad,* **76**, 79–94.

RIDDLE, B. R., D. J. HAFNER, L. F. ALEXANDER and J. R. JAEGER. 2000. Cryptic vicariance in the historical assembly of a Baja California Peninsular Desert biota. *Proceedings of the National Academy of Sciences,* **97**, 14438–14444.

The Age of Dinosaurs in South America

Fernando Novas (2009). Indiana University Press, Bloomington, IN. 480 pp. ISBN 978-0253352897 (Hardback) $49.95/£33.00.

Fernando Novas' new encyclopedia of South American dinosaurs is brimming with facts, but one tidbit really caught my attention. Although the first South American dinosaur fossil was discovered in 1883, it was not until the late 1950s that detailed, systematic studies of the continent's Mesozoic reptile faunas were launched. By this point, the dinosaur record of Britain had largely been tapped out, and the famous tyrannosaurs, ceratopsians and sauropods of North America had already been monographed. Yet today, barely 50 years later, South America proudly boasts some of the most important and best-studied Mesozoic terrestrial fossil assemblages.

These fossils are expertly chronicled in Novas' book *The Age of Dinosaurs in South America*, a valuable tome that has quickly carved out a prominent space on my bookshelf. More encyclopaedia than narrative, Novas' book covers the entire spread of South American dinosaurs, across the Mesozoic and from every corner of the continent. This volume is clearly the most important reference work on South American dinosaurs available and a useful tool for any palaeontologist whose research even remotely verges towards the realm of Mesozoic reptile evolution. Novas, a noted Argentinian palaeontologist, has been involved in many of South America's most provocative dinosaur discoveries of the past two decades. His deep expertise and personal involvement in the field enliven his prose, giving a subtly personal touch to what is mostly a 480-page powerhouse of anatomical descriptions and discussions of faunal change.

The Age of Dinosaurs in South America is somewhat of a misnomer. The focus is on dinosaurs only, and other fossils from the Mesozoic are only mentioned in passing. However, this minor quibble can easily be forgiven. The dinosaur record of South America, which has become central to many of the most stimulating debates in dinosaur palaeontology, is more than deserving of its own encyclopaedia. Argentina and Brazil claim what is arguably the best record of Triassic dinosaurs in the world, and both the oldest dinosaurs and their closest outgroups have been discovered here. Although the Jurassic record is spottier, newer discoveries include critical basal members of major clades. But the Cretaceous is where South America really shines. Dinosaur bones and footprints from this period have been found across the continent, among which are fossils of some of the largest and strangest creatures ever to inhabit the earth, as well as endemic forms indicative of a unique South American radiation that occurred in concert with the fragmentation of Pangaea.

Novas does a wonderful job of summarizing this long and valuable record. He begins with a primer on dinosaur anatomy and phylogeny, with a focus on skeletal characteristics that differentiate dinosaurs from other vertebrates. This richly illustrated chapter is among the best popular

summaries of dinosaur morphology and diagnostic characters that I have seen. The meat of the book is comprised of summaries of the dinosaur fossils, as well as their entombing rocks and palaeoenvironmental settings, from the Triassic, Jurassic and Cretaceous. The first two time periods are reviewed in single chapters, but the rich Cretaceous record necessitates separate chapters for sauropods, theropods and ornithischians, as well as two chapters that summarize the dinosaur-bearing formations and the major patterns of faunal change during this final stanza of dinosaur history. Each of these chapters is vividly illustrated with numerous photos of important fossils, as well as life-like reconstructions, cladograms, field maps, and sentimental photographs of field expeditions. The book is capped off with an impressive bibliography, which includes citations of nearly every reference to South American dinosaurs published up until 2008.

On the whole, I consider *The Age of Dinosaurs in South America* as one of the best recent titles in Indiana University Press' *Life of the Past* series. What I particularly like about this book is that it is authoritative and comprehensive, but avoids degenerating into a simple compendium of names, dates and places. Novas bridges his various chapters by focusing on large-scale patterns of evolution and faunal change, and places South American fossils in context with the global Mesozoic record. All throughout, the text is well-pitched to a specialist audience and is an informative gateway into the primary literature. Unlike many other titles in the *Life of the Past* series, *The Age of Dinosaurs in South America* does not suffer from poor image quality and resolution. On the contrary, the photographs and drawings alone will guarantee that this book remains a relevant resource for many years to come.

True, there are some errors, but these are mostly minor. The Triassic time scale has been updated considerably since this book went to press; many cladograms show mutually exclusive patterns of relationships and are based on outdated research. The book remains current up until about 2007 or early 2008, and much new information about the Triassic evolutionary radiation of dinosaurs and the uniqueness (or lack thereof) of South American faunas during the Early Cretaceous has come to light since then. Sometimes Novas seems guilty of reading the fossil record too literally without considering possible sampling biases, especially when discussing biogeographic relationships and patterns of faunal change. But again, these are only marginal quibbles that do not detract in the slightest from the usefulness of this book.

Taking stock of the bounty of information in Novas' book, from the earliest Triassic dinosaurs to enormous Late Cretaceous behemoths such as *Argentinosaurus* and *Giganotosaurus*, it is striking to reflect on how much the South American palaeontological community has accomplished during the past half century. A 480-page inventory of South American dinosaurs would have been scoffed at by pioneering researchers like José Bonaparte, Osvaldo Reig and Rodolfo Casamiquela. But – largely as a result of their many decades of committed work – the South American dinosaur record stands today as one of the most informative in the world. *The Age of Dinosaurs in South America* is, more than anything, a testament to the careers of these trailblazers, and it is fitting that Novas dedicates the book to them. With the fast pace of current South American discoveries, I can only imagine what excitements lie in store when Novas' cavalcade of students – an impressive list that comprises several lines in the acknowledgements – dedicate a book to him down the road.

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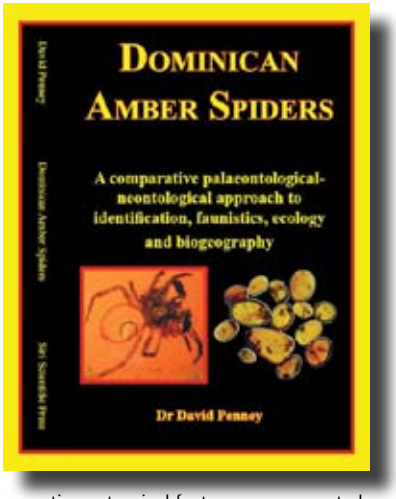
Dominican Amber Spiders: A comparative palaeontological-neontological approach to identification, faunistics, ecology and biogeography

David Penney. 2008. Siri Scientific Press. 176pp. Over 330 illustrations, mostly in colour. ISBN 978-0-9558636-0-8. £42.50.



There are many books about creatures in fossil amber. Some focus solely on insects in amber, presenting the field in context for general readers. These books can be long in text and short on pictures, and occupy another niche. The present book is in another category entirely. The title might suggest that this is a precisely focused work directed only at those with an interest in fossil spiders. This would be incorrect. The terms of reference established by the book are, as the long title suggests, broad. The copious bibliography indicates the level of synthesis the author has achieved. This volume is an excellent introduction to what can be learned from fossil amber, in this case Dominican amber. Introductory material covers the history of Dominican amber, as well as aspects of palaeoecology and historical biogeography. The bulk of the book is, of course, devoted to fossil spiders. Detailed drawings of diagnostic anatomical features are presented, along with full-colour photographs of ancient and modern spiders. For anyone with an interest in these spiders the book could be essential reading. It can also be usefully consulted by anyone with a general interest in fossils as well as issues of tropical biogeography.

The book makes extensive use of charts and lists to present detailed information. The keys are devoted to Dominican spiders, and focus upon identification to family level. They should be easy to use for those from any field, and in some cases allow determination of genus and species as well. The biological focus of the book is in keeping with the background of the author. As he notes in the foreword, many palaeontologists are accidental zoologists, while he is approaching the field from the other way around. Not surprisingly, much attention has been devoted to identifying various species on the basis of their external copulatory organs. Quite clearly spiders preserved in rocks would be far more challenging to identify. As a rule amber preserves a particular subset of the species and individuals that would have been present in life. For example, male spiders tend to be over-represented when compared to female spiders. The latter – particularly Araneidae and Tetragnathidae – waiting in webs, were unlikely to become trapped in resin. In contrast large aerial web spinners are usually recorded in abundance in the field. Jumping spiders (Salticidae), the largest extant spider family, are frequently found in resin, as their active lifestyle might predict. However, they are not found in Cretaceous amber, suggesting they evolved relatively recently. It appears that spiders, as well as other organisms, were trapped by wandering onto sticky patches of resin rather than being more passively engulfed by low viscosity resin. Consequently, body size is a factor in their preservation, as larger species may be able to pull away and are not often encountered in amber. On the other hand, as the author notes, small species, such as tiny araneoid spiders, may be small enough to move over sticky surfaces without difficulty. Compared with some

other amber assemblages, with numbers of organisms from the leaf litter, Dominican amber tends to preserve organisms associated with tree trunks.

Some interesting conclusions can be drawn from considering the assemblage of fossil spiders as a whole, and it is here where Dr Penney's synthesis emerges at its most satisfying. The Caribbean fauna did not originate from North America, but some of the shared spider genera probably originated from the Caribbean. Perhaps not surprisingly, the greatest similarities are found with South America. The next question to address is their method of dispersal. Did species move across a land bridge, or was there some form of over-water dispersal? While some spiders are known to disperse via ballooning, others are burrowers with poor chances of dispersal. When taken with evidence for other species, over-water dispersal alone is an unlikely mechanism. The model favoured by the author is the GAARlandia landbridge followed by island–island variance.

Species in Dominican amber have several other salient features. They are relatively young (<40 million years old) and the fossil fauna is broadly similar to extant species. This raises the interesting possibility of DNA extraction. Specimens are preserved in amber very rapidly via fixation and dehydration. While everything from feature films to detailed scientific studies have been devoted to this subject, the author suggests that this is still a contentious area. Replication of many studies has been problematical, not least because of contaminants. There is also a real question of how much organic material is preserved in fossil amber. While even structures at the level of cell membranes and organelles are preserved, the geochemical basis of fixation and preservation is not well understood. This is clearly a target for future research. That much remains to be done regarding classification via observed features is clearly illustrated by this book. Considering it is published in a small print run with excellent images, the relatively high cost is expected. It will no doubt serve as a standard reference for some time to come. It ably surveys a wide field, and paints, in a broad brush, the biogeographic origins of Dominican spiders.

It is available from the publishers (<**http://siriscientificpress.co.uk/Books.aspx**>).

Murray Lee Eiland
London

Books available to review

These titles are available for review. If you would like to review any of them, please contact our Book Review Editor, Dr Charlotte Jeffery-Abt, via e-mail to <**chj@liverpool.ac.uk**> or at the Department of Earth and Ocean Sciences, University of Liverpool, 4 Brownlow Street, Liverpool L69 3GP.

- *Patagonian Mesozoic Reptiles* (Life of the Past), by Zulma Gasparini, Rodolfo A. Coria and Leonardo Salgado
- *Modelling Evolution*, by Derek Roff
- *Protogaea*, by G. W. Leibniz, translated by Claudine Cohen & Andre Wakefield
- *Introduction to Plant Fossils*, by Christopher Cleal & Barry Thomas
- *Cambro–Ordovician Studies 3*, edited by Laurie, Brock & Patterson

Special Paper 83: Silurian conodonts from the Yangtze Platform, south China

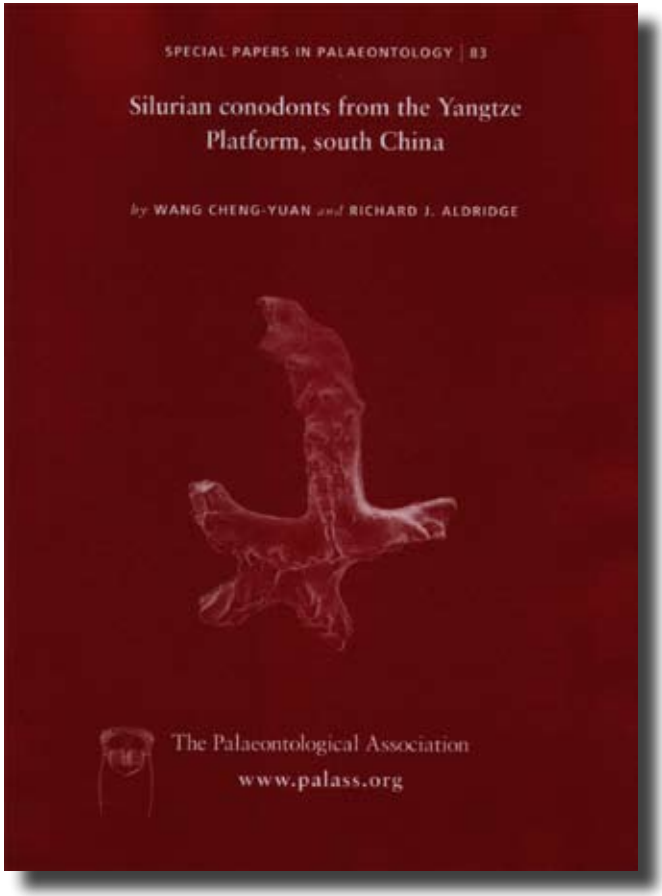
Abstract:

Silurian conodonts from several sections in the area of the Yangtze Platform, south China, are described and their taxonomy revised.

Two new families, Pseudooneotodidae and Gamachignathidae, are erected, one new genus, *Chenodontos*, and ten new species and subspecies: *Apsidognathus ruginosus scutatus*, *Chenodontos makros*, *Distomodus cathayensis*, *Oulodus tripus*, *Ozarkodina wangzhunia*, *Panderodus amplicostatus*, *Pterospathodus sinensis*, *Wurmiella amplidentata*, *Wurmiella curta* and *Wurmiella recava*. Some additional new taxa are introduced in open nomenclature.

The status of Silurian conodont biozonation in China is reviewed, and the following successive appearance biozones provisionally recognised to span the Llandovery succession in ascending order: *Ozarkodina* aff. *hassi* Biozone; *Ozarkodina obesa* Biozone; *Ozarkodina parahassi* Biozone; *Ozarkodina guizhouensis* Biozone; *Pterospathodus eopennatus* Biozone; *Pterospathodus celloni* Biozone; *Pterospathodus amorphognathoides* Biozone.

The re-assessment of conodont data indicates that unequivocal Wenlock taxa have not been recorded on the Yangtze Platform and that Wenlock marine deposits, if present, are much less extensive than previously suggested. Current conodont evidence also indicates that red beds are probably developed at three levels in the Silurian of the region: upper Aeronian to lower Telychian; upper Telychian, perhaps extending into the Wenlock; Ludlow, pre-*O. crispa* Biozone.



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CONTENTS

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